Science, Strategy and War: The Strategic Theory of John Boyd

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Science, Strategy and War

The Strategic Theory of John Boyd

Frans Osinga

The cover illustration depicts the comprehensive rendering of the OODA loop which features in John Boyd's final presentation titled *The Essence of Winning and Losing*.

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Science, Strategy and War

The Strategic Theory of John Boyd

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We are survival machines.
Richard Dawkins

Strategy is the mode of survival of a society.
Henry Kissinger

First Lt. John Boyd in the cockpit of an F-86 during the Korean War
(USAF photograph)

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1. INTRODUCTION

> *To flourish and grow in a many-sided uncertain and ever changing world that surrounds us, suggests that we have to make intuitive within ourselves those many practices we need to meet the exigencies of that world. The contents that comprise this 'Discourse' unfold observations and ideas that contribute towards achieving or thwarting such an aim or purpose*
>
> *John Boyd, A Discourse*, p.1

Who is John Boyd and what is *A Discourse* ?

The general objective of this study is to provide a better understanding of the ideas concerning conflict and military strategy John Boyd developed and laid down in *A Discourse.* It aims to correct and complement the common interpretation of his work, while in addition showing the impact of this body of strategic thought on U.S. military doctrine and defence policy of the past two and a halve decades. An answer to the question who John Boyd was and what *A Discourse* comprises may start with some sections of a tribute written two days after Boyd's death on 9 March 1997 which describes him as

> a towering intellect who made unsurpassed contributions to the American art of war. Indeed, he was one of the central architects in the reform of military thought which swept the services, and in particular the Marine corps, in the 1980's. From John Boyd we learned about the competitive decision making on the battlefield-compressing time, using time as an ally. Thousands of officers in all or services knew John Boyd by his work on what was to be known as the Boyd Cycle or OODA loop. His writings and his lectures had a fundamental impact on the curriculum of virtually every professional military education program in the United States-and many abroad [..]he was the quintessential soldier-scholar - a man whose jovial outgoing exterior belied the vastness of his knowledge and the power of his intellect[1].

Boyd was a strategist, a person who, according to Colin Gray, sees, even though he or she cannot possibly be expert in, all dimensions of the 'big picture' of the evolving conditions of war[2]. John Boyd was an officer in the United States Air Force who lived from 1927-1997. He saw combat action as a fighter pilot, flying the F-86 Sabre during the Korean War. In the fifties and sixties he developed air combat tactics and trained pilots at the Fighter Weapons School at Nellis Air Force Base near Las Vegas. During the sixties, posted at the Pentagon, he was closely involved in the design of the F-16 and the F-15 fighter aircraft. He retired as a colonel in 1975. He continued his involvement with military affairs as a (virtually non-paid) consultant. In this capacity he was involved in attempts to reform the US defense establishment and the acquisition process at the Pentagon that he considered a stifling bureaucracy. The period from retirement to 1995 marks the gestation period of *A Discourse.* One of his biographers states that most of his real education occurred after he retired from

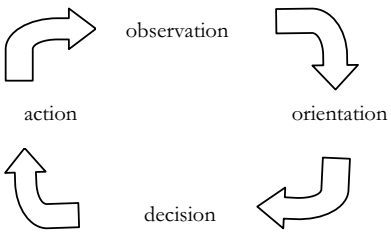
---

[1] General C.C. Krulak, Commandant of the Marine Corps, *Inside the Pentagon,* 13 March 1997, p.5.
[2] Colin Gray, *Modern Strategy* (Oxford, 1999), p. 52.

the Air Force. His expertise developed slowly over a long period of time and was the result of a huge synthesis of nearly everything he learned, formally and informally[3].

John Boyd left the military community a stack of hard copies of his presentation titled *A Discourse on Winning and Losing*. Started because of his involvement with the development of the A-10 Close Air Support aircraft, which led him to study the nature and history of close air support, his investigations in military history evolved over the years into a comprehensive theory of strategy. *A Discourse on Winning and Losing* consists of four briefings and an essay. The set has also been labeled as *The Green Book*. It was completed in 1987, although subsequently frequently specific wording on slides was revised. The essay *Destruction and Creation* was written in 1976. This forms the philosophical foundation for his proposition that uncertainty pervades everything. It is a window to Boyd's mind, according to Robert Coram, one of the two biographers[4]. In it Boyd states that uncertainty is a fundamental and irresolvable characteristic of our lives, no matter how good our observations and theories for explanation are. The way to go about this, is to make sure one has (a) the ability to recognize the extent to which one's mental model is correct and the ability to use different models simultaneously.

Patterns of Conflict forms the historical heart of his work and is the longest of his presentations. First draft completed in 1977, it has turned into the opus of Boyd's research on conflict and warfare. This briefing contains 193 slides. It is a historical analysis of warfare and theories for victory. This analysis is the vehicle that Boyd used to construct his argument. It also provided him a tool to guide the audience through the several stages and propositions of his argument. Each slide elaborates upon the previous one, differing often only through a short addition of a term or suggestion or by a slightly different interpretation of a term he used before. In the end he derives from his survey of military history patterns for success. This presentation represents, in Boyd's own words, 'a compendium of ideas and actions for winning and losing in a highly competitive world'[5]. It also contains an introduction to the conceptual heart, the condensed essence of Boyd's thought: the OODA loop model or the Boyd Cycle. In simplified form, it looks like the following figure.



OODA stands for observation, orientation, decision, action. Explained in brief, observation is sensing yourself and the world around you. The second element, orientation, is the complex set of filters of genetic heritage, cultural predispositions, personal experience, and knowledge. The third is decision, a review of alternative courses of action and the selection of the preferred course as a hypothesis to be tested. The final element is action, the

[3] Grant Hammond, *The Mind of War, John Boyd and American Security* (Smithsonian Insitution Press, Washington, D.C., 2001), p.56.
[4] Robert Coram, *Boyd, The Fighter Pilot Who Changed the Art of War* (Little Brown and Company, Boston, 2002), p.451.
[5] John Boyd, 'Abstract', in *A Discourse,* p.1.

testing of the decision selected by implementation. The notion of the loop, the constant repetition of the OODA cycle, is the essential connection that is repeated again and again. Put simply, Boyd advances the idea that success in war, conflict, competition even survival hinges upon the quality and tempo of the cognitive processes of leaders and their organizations. War can be construed of as a collision of organizations going their respective OODA loops.

In the presentations *Organic Design for Command and Control* (first draft in 1982) and the one intriguingly titled *The Strategic Game Of ? and ?* (first draft in 1986) he uses insights and conclusions from *Patterns of Conflict* but now in abstract form. He employs these abstractions to develop arguments about leadership and about the essence of strategy, or in Boyd's own description: *Organic Design for Command and Control* 'surfaces the implicit arrangements that permit cooperation in complex, competitive, fast moving situations', while *The Strategic Game of ? and ?* emphasizes 'the mental twists and turns we undertake to surface appropriate schemes or designs for realizing our aims or purposes'[6]. The last presentation, *Revelation* 'makes visible the metaphorical message that flows from this *Discourse*'.

He also developed two other short briefings that have not been an integral part of *The Green Book* but are fully in line with, and an elaboration on previous arguments. *The Conceptual Spiral* was completed in 1992. It is a kind of summation of *A Discourse* and in another sense it is another angle on the insights he had provided in *Destruction and Creation*. In this briefing he uses these insights to explain how and why innovation occurs in science, engineering and technology. Simultaneously this briefing provides additional support for his proposition that the capability to adapt to unfolding circumstances is of utmost relevancy for organizations. The final briefing is titled *The Essence of Winning and Losing*, which is a very condensed rendering of Boyd's core ideas and contains an elaborated model of the OODA loop. It was completed in 1995. This too will be discussed.

Why study Boyd?

There are four very sound reasons for a close examination of *A Discourse*. First, as will be demonstrated, Boyd's ideas are important. Second, they have been - and still are - influential. Indeed, it has proven a powerful theory in the sense that it has directly inspired many studies and shaped military doctrine. Third, they are, however, not really all that well and properly understood. A final reason is that, although important, influential and not always properly understood, as yet there have not been many papers, studies or books published that focus solely on Boyd's work or go beyond the familiar OODA loop idea. I will elaborate on these four points.

Influential and important. In his recently published study of modern strategic theory, Colin Gray ranked Boyd among the outstanding general theorists of strategy of the 20th century, along with the likes of Bernard Brodie, Edward Luttwak, Basil Liddell Hart and John Wylie. Gray states that

> John Boyd deserves at least an honorable mention for his discovery of the 'OODA loop'…allegedly comprising a universal logic of conflict….Boyd's loop can apply to the operational, strategic, and political levels of war…The OODA loop may appear too humble to merit categorization as grand theory, but that is what it is. It has an elegant simplicity, an extensive domain of applicability, and contains a high quality of insight about strategic essentials…[7].

[6] Ibid.

[7] Colin Gray, *Modern Strategy*, pp.90-91.

A theory with such an accolade invites and requires further study.

His wide influence manifests itself in the fact that John Boyd's idea captured in the picture of the OODA loop has become a instantly recognized symbol for military people throughout the western world marking both a decision cycle and a maneuvrist style of warfare. His ideas permeate current (Western) military doctrines and war fighting concepts. Boyd's influence first became appeared in the development of, what later turned out to be, the AirLand Battle concept[8]. Boyd's influence since then has widened. What are now familiar concepts, such as Information Warfare, Command and Control Warfare, fluidity in battle, shaping the battlefield, harmony, decision making cycles, promoting uncertainty and disorder, were all either invented, re-discovered or inspired by Boyd.

The heart and spirit of the US Marines prime war fighting manual, MCDP-1, which was published in the midway of the 1990's is pure "Boydian". In Chapter 1, the US Marines' vision on the nature of war is defined. To describe war the doctrine employs core Boydian concepts such as the pervasiveness of non-linearity, uncertainty, risk, fluidity and disorder, the view that war is a meeting of complex systems, and that war is the emergence of collective behavior of these complex systems in conflict with each other. Chapter 4, 'The Conduct of War', contains the Marines interpretation of maneuver warfare which bears in particular Boyd's influence. It states that

> the essence of maneuver is taking action to generate and exploit some kind of advantage over the enemy […] That advantage may be psychological, technological, or temporal as well as spatial. Especially important is maneuver in time - we generate a faster operating tempo than the enemy to gain a temporal advantage. Maneuver warfare is a war fighting philosophy that seeks to shatter the enemy's cohesion through a variety of rapid, focused and unexpected actions which create a turbulent and rapidly deteriorating situation with which the enemy cannot cope[9].

Further on it describes the Marines command philosophy, and again Boyd's advice permeates directly into the doctrine: 'in order to generate the tempo of operations we desire and to best cope with the uncertainty, disorder, and fluidity of combat, command and control must be decentralized'[10]. The US Joint Chiefs of Staff Publication, JP 3-13.1, Joint doctrine for Command and Control Warfare (C2W) the OODA loop is included in Appendix A (without however mentioning Boyd's name anywhere). The UK military doctrine description of the doctrinally preferred method of war fighting, "the maneuvrist approach" is also pure Boydian (and fully in line with the US Marines doctrine):

> The maneuvrist approach to operations is one in which shattering the enemy's overall cohesion and will to fight, rather than his materiel is paramount […] significant features are

---

[8] See for a recent thorough historical analysis of the development of maneuvre warfare and AirLand Battle Shimon Naveh, *In Pursuit of Excellence, The Evolution of Operational Theory* (Frank Cass, London, 1997), Chapter 7. This chapter provides an in depth survey of all sources that contributed to the development of Airland Battle. For a shorter but very useful overview of these developments, which focusses in particular on the cooperation of the US Army and US Air Force, see Richard P. Hallion, *Storm over Iraq, Air Power and the Gulf War* (Smithsonian Institution Press, Washington DC, 1992), chapters 2 and 3. In Chapter 3 Boyd's involvement with the development of AirLandBattle will be elaborated upon.

[9] *Marine Corps Doctrinal Publication 1, Warfighting* (Department of Defence, Washington D.C., 1997), p.74

[10] Ibid. p.77

> momentum and tempo, which in combination lead to shock and surprise. Emphasis is on the defeat and disruption of the enemy - by taking the initiative, and applying constant and unacceptable pressure at the times and places the enemy least expects - rather than attempting to seize and hold ground for its own sake. It calls for an attitude of mind in which doing the unexpected and seeking originality is combined with ruthless determination to succeed. A key characteristic of the maneuvrist approach is to attack the enemy commander's decision process by attempting to get inside his decision making cycle. This involves presenting him with the need to make decisions at a faster rate than he can cope with, so that he takes increasingly inappropriate action or none at all, thereby paralyzing his capability to react. Clearly any degradation of the overall command system which can be achieved by physical or other means will hasten the onset of paralysis[11].

Following the same doctrinal footsteps, the doctrine of the Netherlands Army actually includes a, somewhat altered, picture of the OODA loop whereby orientation is interpreted to equate with evaluation and decision equals both planning and deciding[12].

Although not the focus of this paper it is noteworthy to point out that the 1991 Gulf War air campaign employed F-16, F-18 and F-15 aircraft, fighters that Boyd helped create. The war itself is by some considered a validation of the innovation in operational theory and praxis that matured in AirLand Battle, the doctrine Boyd helped to develop[13]. In fact, Boyd has been credited with directly influencing the design of the military ground campaign through his association with Dick Cheney, then US Secretary of Defense, a former member of the so called Military Reform Group, who was well versed in Boyd's military thinking. The ground portion of the Desert Storm campaign involved a threat of an amphibious assault on Kuwait, which pinned down forces in that area, and an enveloping move deep into Iraqi territory behind Iraqi front lines. This design avoided a head to head battle by US forces on Iraqi strong points. Instead, Iraqi units were surrounded and surprised by the speedy advance of US forces combined with the multiple thrusts, which created the demoralizing impression US units were everywhere. The continuous air attacks compounded the sense of helplessness and hopelessness, and thousands of Iraqi soldiers surrendered. Deception, ambiguity, tempo, there Boydian elements were clearly present. In the May 6 1991 issue of *US News & World Report* Boyd was mentioned, together with two officers who were directly influenced by Boyd, as the persons who determined the tactics employed during the Gulf War. As Robert Coram asserts, everything successful about the Gulf War is a direct reflection of Boyd's *Patterns of Conflict*[14].

In the aftermath of the terrorist attacks of 11 September 2001, US Secretary of State and former chairman of the US Joint Chiefs of Staff Colin Powell implicitly honored Boyd by talking of a response involving multiple thrusts and getting inside the adversary's decision cycle[15]. Looking back on the stunning victory of Operation Iraqi Freedom (2003) against substantial Iraqi armed forces, the commander of the coalition troops, General Tommy Franks also referred explicitly to Boyd's idea of getting inside the enemy's decision cycle[16].

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[11] *British Defence Doctrine, Joint Warfare Publication 0-01* (Her Brittanic Majesty's Stationary Office, London, 1997), pp.4.8-4.9.

[12] *Militaire Doctrine,* (Sdu Uitgevers, Den Haag, 1996), p.121.

[13] See for Boyd's role for instance Hallion, pp.38-42, and pp.278-281.

[14] Coram, p.425, 444. The other two were Mike Wyly and Huba Wass de Czege, who were closely involved in the doctrinal shifts of the US Marines and US Army respectively. Chapter 31 of Coram's book describes Boyd's role in Desert Storm.

[15] Coram, pp.446-447.

[16] See the interview with general Tommy Franks in Peter J. Boyer, 'The New War Machine', *The New Yorker*, June 30, 2003, p.70. In the article the author also introduces the military reform movement and

This indicates that Boyd's concepts and terminology have become mainstream in the Western militaries, and will also be employed for the security challenges of the 21st Century.

Indeed, some regard Boyd as the most important strategist of the 20th Century, or even since Sun Tzu[17]. James Burton claims that 'A Discourse on Winning and Losing will go down in history as the the twenthieth century's most original thinking in the military arts. No one, not even Karl von Clausewitz, Henri de Jomini, Sun Tzu, or any of the past masters of military theory, shed as much light on the mental and moral aspects of conflict as Boyd[18].

And his fame has not been confined to military strategy. Tom Peters, author of *Thriving on Chaos*, a book that revolutionized management theories in America, talks of creating and exploiting chaos - the essence of maneuver conflict - of shaping the marketplace and of mutual trust. Peters admitted that his book had been shaped by Boyd's ideas. Since then Boyd's ideas have been applied by consultants and have been taught at business schools, with the active endorsement of Boyd, who considered this an affirmation of the fact that his intellectual legacy encompassed more than war fighting; his ideas were universal, timeless, and could be applied to any form of conflict[19]. If a man's ideas are alleged to be so influential, a closer look at his work is a useful exercise for anyone trying to understand current military thought.

Multiple, contradictory and limited interpretations. Like Clausewitz and Sun Tzu however, he is more heard of than read or understood, and this needs to be remedied. Few people have actually worked their way through the presentations, or even know about their existence. As illustrated above, the one thing most people know about Boyd is the OODA loop, the graphic schematic depiction that can to a certain extent be seen as an abstract summary of his theory of conflict. In fact, the OODA Loop has been discussed not only in military circles, but also in *Forbes* and *Harvard Business Review*[20]. In the popularized interpretation, the OODA loop suggests that success in war depends on the ability to out-pace and out-think the opponent, or put differently, on the ability to go through the OODA cycle more rapidly than the opponent. Boyd's name will probably always remain associated with the OODA loop and this popular interpretation. By some the OODA loop is perceived as *the* concise representation of his ideas. Thus the neat graphical depiction of the OODA loop has become the symbol of Boyd's entire work. Explaining Boyd, Meilinger for instance states that, according to Boyd,

> the key to victory was to act more quickly, both mentally and physically, than your opponent. He expressed this concept in a cyclical process he called the OODA Loop. As soon as one side acted, it observed the consequences, and the loop began anew. […] The significance of Boyd's tactical air theories is that he later hypothesized that this continuously operating cycle was at play not only in a tactical aerial dogfight, but at the higher levels of war as well. In

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Boyd's role in it, asserting that current US Secretary of Defence Rumsfeld had been influenced in the seventies and eighties and had become a supporter for military reform and innovation in strategy. However, for a balancing view see William Lind's reaction to various commentators 'The Three Levels of War, Don't Take John Boyd's Name in Vain', *Counterpunch*, May 3, 2003, electronic version, *www.counterpunch.org/lind05032003.html,* date accessed 16-12-2003.

[17] Coram, p.445.

[18] James Burton, *The Pentagon Wars: Reformers Challenge the Old Guard* (Annapolis, Md., Naval Institute Press, 1993), p.10.

[19] Coram, p.429.

[20] Hammond (2001), p.11.

> tracing the history of war Boyd saw victory consistently going to the side that could think the most creatively, and than acting quickly on that insight[21].

He also states that

> John Boyd's entire theory of the OODA Loop is based on the premise that telescoping time - arriving at decisions or locations rapidly - is the decisive element in war because of the enormous psychological strain it places on an enemy[22].

The narrow focus on, and interpretation of the meaning of the OODA loop also surfaces in an article co-authored by the (then) Chief of the Army Staff Gordon Sullivan in which he lays out a vision of war in the information age. Incorporating the same pictogram of the OODA loop as used above, Sullivan argues that the concept of time has changed. Tomorrow we will observe in real time, orient continuously, decide immediately and act within an hour or less[23]. And in 1996 this same interpretation of the OODA loop was incorporated in, and elevated to, long term US defense policy when the Joint Chiefs of Staff 1996 document Joint Vision 2010 stated that US Forces will gain "OODA-loop dominance", being able to 'observe, orient, decide, and act much more quickly than our opponents'[24].

In an article that critiques the US dogmatic belief in the value of speed, one author blames Boyd's influential OODA loop based idea that 'quicker decisions often led to victory'. He argues that this idea has permeated US military thinking, in particular the US Marines who hold that 'warfare is necessarily a function of decision making and, whoever can make and implement decisions consistently faster gains a tremendous, often decisive advantage. Decision making in execution thus becomes a time-competitive process, and timeliness of decisions becomes essential to generating tempo'[25]. Unfortunately, and unintentionally, one of his biographers reinforces the impression by stating that 'Boyd's equivalent of E=MC2 is OODA Loops. That to Boyd is the sum total of life'[26].

As a consequence, discussions concerning the merits of Boyd's work focus on the merits of the OODA cycle idea, with one school suggesting that cycling through the OODA loop faster than the opponent will result in a decisive advantage. Explaining how the OODA Loop is a valuable analytic tool for examining how a system can generate superior tempo, one author admits that although 'the OODA Loop is not a totally accurate description of how many types of systems operate in practice, the loop provides a very useful way of

---

[21] Phillip S. Meilinger, 'Air Targetting Strategies: An Overview', in Richard Hallion, *Air Power Confronts An Unstable World*, (London, 1997), pp.60-61. This is not a critique of Meilinger who merely includes Boyd as one of a several theorists on air power. But his rendering of Boyd's work is however somewhat typical of most interpretations of Boyd.

[22] Phillip S. Meilinger, *Ten Propositions Regarding Air Power* (Washingon D.C. Air Force History and Museums Program, 1995), pp.31-32. For similar brief and consequently limited discussions of the OODA loop see Gary Vincent's two articles 'In the Loop, Superiority in Command and Control', *Airpower Journal*, Summer 1992; and 'A New Approach to Command and Control, the Cybernetic Design', *Airpower Journal,* Summer 1993.

[23] Gordon R. Sullivan and James M. Dublik, ' War in the Information Age', *Military Review*, April 1994, p. 47. Remarkable is the fact that Boyd is not listed as the intellectual father of the OODA loop, suggesting that the OODA construct has already become very commonplace.

[24] US Department of Defense, Chairman of Joint Chiefs of Staff, *Joint Vision 2010* (Washington DC, 1996). Cited in Lonnie D. Henley, 'The RMA After Next', *Parameters,* Winter 1999-2000, p.46.

[25] Thomas Hughes, 'The Cult of the Quick', *Air Power Journal,* Vol. XV, No.4, Winter 2001. Only in the endnotes does Hughes ackowledge that Boyd's ideas are more complex that this interpretation.

[26] Hammond (2001), p.15.

describing how a system operates. The OODA Loop ties cognition to action, providing a general description of how a system designed to perform some function operates'. He then goes on to develop suggestions to actually get inside the opponent's decision cycle exploiting the elements of the OODA Loop[27]. Colin Gray asserts that 'Boyd's theory claims that the key advantage to success in conflict is to operate inside the opponent's decision cycle. Advantages in observation and orientation enable a tempo in decision-making and execution that outpaces the ability of the foe to react effectively in time'[28]. According to David Fadok, who wrote one the earliest studies on Boyd, for Boyd the crux of winning becomes the relational movement of opponents through their respective OODA Loops[29].

But whereas Colin Gray considers Boyd to be at the same level as for instance the French strategist André Beaufre, and regards the ideas of Boyd to constitute a general theory of conflict, others discuss his ideas in particular within the framework of operational level doctrine of warfare, regarding his work as the conceptual foundation of maneuver warfare[30]. In contrast to both of these views, some dismiss Boyd's ideas as rather underdeveloped and too theoretical due to the fact that Boyd, unlike Baron de Jomini or more recently air power theorist John Warden, did not offer specific guidelines for designing military campaigns. Alternatively, they doubt the relevance of the rapid OODA loop idea for the strategic and political level decision-making. In addition some point out that the enemy may not be interested in rapid OODA looping, on the contrary, as in the case of guerrilla warfare, prolonging a conflict and stretching out time may be quite rational. One author even denied anything like an OODA loop exists. In an award-winning essay Jim Storr, a British officer, asserts that:

> amongst conceptual writings, the landmark development in Western military thought in the 1990s was probably Lind's OODA Loop. The OODA Loop suggests that the process of observation, orientation, decision and action is a circular, iterative process. Military advantage accrues from being able to go around the loop faster than one's opponent. However, the OODA process is not circular. It apparently takes 24 hours to execute a divisional operation. Planning takes a minimum of 12 hours. Thus a divisional OODA loop would have to be at least 36 hours long. Yet the Gulf War an other recent operations show divisions reacting far faster. Military forces do no in practice wait to observe until they have acted. Observation, orientation and action are continuous processes, and decisions are made occasionally in consequences of them. *There is no OODA loop. The idea of getting inside the enemy decision cycle is deeply flawed*'[31].

Storr points the finger at the methodological error William Lind (a close associate of Boyd's and deeply influenced by Boyd), made in extrapolating from what hold true for fighter operations, where Boyd derived his insight from, to hold also true for command and control

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[27] Paolo Bartolomasi, 'The Realities and Challenges for Concepts and Capabilities in Joint Manoeuvre', *RUSI Journal*, August 2000, pp.8, 9.

[28] See Gray (1999), p.91.

[29] David S. Fadok*: John Boyd and John Warden: Air Power's Quest for Strategic Paralysis*, in Col. Phillip Meilinger (ed), *The Paths to Heaven* (Maxwell AFB, Air University press 1997), p.366. Fadok distills the gist from Boyd's slides and presents them clearly in a chapter in which he combines and compares Boyd and Warden. As such it is an excellent primer on Boyd's ideas.

[30] Such as Naveh and Bartolomasi.

[31] Jim Storr, 'Neither Art Nor Science- Towards a Discipline of Warfare', *RUSI Journal*, April 2001, p.39. Emphasis is mine. Michael Lind was the second intellectual responsible for the development of Airland Battle. His prime rol in the process was acknowledging the soundness of Boyd's ideas and translating them into digestible format for the wider military public. See for his role Naveh, Chapter 7.

in general. Referring to Karl Popper, Storr states that 'induction is unsafe' and 'to generalize about formation-level C2 from aircraft design is tenuous'[32].

Very few studies available. And that leads to the final reason for reading about Boyd. His ideas have been conveyed through, and contained in, presentations he gave. He amended these briefings time and again after such sessions, if and when the discussions with the audience or some new books he had read, had provided him with new or improved insights. Despite the fact that he gave some parts of his briefings about 1500 times not many people outside the American military community have had the opportunity to attend his lectures, which sometimes lasted 14-18 hours[33]. And John Boyd died on 9 March 1997 at the age of seventy. There will be no more Boyd briefings.

The problem is that, unlike Sun Tzu and in particular Clausewitz, Boyd did not record his ideas in a coherent manuscript (if one can consider Sun Tzu's *The Art of war* as such). Boyd's ideas reside in a short essay and slide set of 327 pages. So if one wants to read Boyd's mind and study his work, this loose collection is all that is left to read. Moreover, his slides exist in different versions, for as recently as the Summer of 1995, Boyd made his last update on his presentations. The stack of slides is not really widely or easily available to the wider public, they have not been officially published, nor are they in themselves self-explanatory throughout. Indeed, his briefs are virtually impenetrable without explanation, Coram asserts[34]. There is thus a need for a detailed account of his work that stays close to the original and offers a readable version of his work.

There are a number of short papers[35]. Most if not all deal almost exclusively with the OODA loop concept. Recently, two biographies have appeared. Robert Coram's work focuses in particular on Boyd's life and less on Boyd's strategic theory, although he does provide a good synopsis of it. Boyd's biographer Grant Hammond surpasses Coram in his rendering of Boyd's strategic theory but the book nevertheless falls short of offering a comprehensive account of Boyd's work. Instead it must be considered an authoritive and very accessible description of Boyd's ideas. Moreover, as it does not contain an integral rendering of Boyd's work, the educational experience contained within Boyd's slides, his unique use of words and the way he structures his arguments, does not receive the emphasis it deserves. Finally, although touching upon Boyd's wide array of sources underlying his work, space restrictions prevented a proper discussion of the intellectual background of Boyd's work.

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[32] Naveh, p.44.

[33] Hammond, p.13.

[34] Coram, p.329. This point caused one author to exclaim in a review essay that Boyd's 'notions remain too vague to amount to anything other than a moving target of little use in structuring a debate or attempting to educate one's mind on the nature of war before arriving at the battlefield'. See David R. Metz, 'Boydmania', *Air & Spacepower Journal*, September 2005.

[35] Fadok's study has been mentioned already. In addition Rinaldi offers a concise analysis in: '*Complexity Theory and Air Power; a new paradigm for air power in the 21th century'*, in *Complexity, Global Politics and National Security*, NDU press, also on *www.ndu.edu/ndu/inss/books/complexity/ch10a.html.* Another recent and informative study of Boyd's ideas is Micheal T. Plehn's paper '*Control Warfare: Inside The OODA Loop*', Maxwell AFB, June, 2000, in which he argues that the OODA loop model is an accurate depiction of both behavior and command and control processes. While offering a good and valuable comparison of Boyd's model with insights from cognitive sciences that validate Boyd's model, this paper does not offer a comprehensive study of Boyd's work but confines itself to the OODA loop model as offered by Fadok and the notion of "Rapid OODA looping", focussing on the role of information and time in the command and control process.

Objective and thesis

In light of the incomplete and contradicting interpretations, and the absence of an accepted authoritive and comprehensive account of Boyd's work, *this study aims to develop a comprehensive interpretation of John Boyd's strategic theory*. It will address questions that the previous section raised. Does Boyd's importance lie exclusively in the OODA loop? What other arguments did he develop? What merits his alleged status as the prime strategist of the past 50 years? What is his unique contribution to strategic theory? The *thesis* of this study too follows from the confusion concerning his theory:

> *Boyd's OODA loop concept as well as his entire work are more comprehensive, deeper and richer than the popular notion of "rapid OODA looping" his work is generally equated with.*

I argue that the features that merit Boyd's work the status of a general theory of strategy, do not lie solely in the rapid OODA loop idea but in several additional overarching insights concerning individual and organizational survival. I also argue that the value of Boyd's work lies in great measure in the way he constructs his argument, in the sources that he uses and in the argument he develops concerning the nature of strategic thinking. The value of Boyd's work lies as much within his slides as within the approach he followed in developing it.

The general perception of what Boyd argues laid out above is not so much wrong as it is incomplete, for two reasons. First, the illustration included in this chapter of the OODA-loop included at the beginning of this chapter which features in a host of publications is actually a very simplified rendering of a much more complex and informative graphic Boyd developed and included in his work. This simplified version tends towards an exclusive focus on speed of decision making, while obscuring various other themes, theories and arguments that lie behind and are incorporated in it. Simply put, the OODA loop idea as advanced by Boyd says much more than "just" going through the decision cycle more rapidly than one's opponent and subsequent critique on Boyd's work should be based not on the simplified model but on the comprehensive picture painted by Boyd himself, as well as through the discussions that preceded the birth of this complex picture.

Second, and following from this, while acknowledging the relevance and originality of the OODA loop idea, it would be a loss if that were all that was remembered of his ideas, for Boyd's work shows a richness in ideas and a freshness in approach, as this study will prove. *A Discourse* is not only about tactical and operational level war fighting. There are other themes that deserve equal attention. Not only does Boyd address a vision on the proper organizational culture for armed forces, I will argue that *A Discourse* is about the creation of organizations in general, from tactical units, army corpses, armed forces, guerrilla bands, businesses, nation-states and societies, that are adaptive, that can survive and prosper. Organizational agility is the theme here.

And ultimately his aim was not to convince people about the validity of this or that doctrine, but instead to create among his audience a way of thinking, a thought process[36]. Mental agility is the key here. Boyd would agree with the statement that the message, the relevant part of his ideas, is not only and exclusively in the final product, the OODA loop, but equally resides in his approach to military thought, in the way that he came to those insights that finally led to the OODA loop. Boyd's work thus contains a *strategic theory* but equally the work, its structure, its sources and the thought process that led to the content,

[36] See also Hammond, p.15.

constitute an argument about *strategic thinking*. In fact, he states as much on page 2 of *A Discourse*:

> the theme that weaves its way through this 'Discourse on Winning and Losing' is not so much contained within each of the five sections, per se, that make up the 'Discourse'; rather, it is the kind of thinking that both lies behind and makes-up its very essence. For the interested, a careful examination will reveal that the increasingly abstract discussion surfaces a process of reaching across many perspectives; pulling each and everyone apart (analysis), all the while intuitively looking for those parts of the disassembled perspectives which naturally interconnect with one another to form a higher order, more general elaboration (synthesis) of what is taking place. As a result, the process not only creates the 'Discourse' but it also represents the key to evolve the tactics, strategies, goals, unifying themes, etc. that permit us to actively shape and adapt to the unfolding world we are a part of, live-in, and feed-upon.

As interesting and valuable as his OODA construct is, the really interesting question, and the one often neglected in existing writings about Boyd, is thus how he developed this insight. If we are not aware of the background of the theory, the conceptual soil from which his concepts and the abstract theory sprang, it will remain just that, a theory, if it deserves that label, and a set of hypothesis and propositions, a persuasive idea but an abstract and possibly a highly debatable one. And subsequent claims concerning his status as a strategist remain uninformative.

A closer look at the material may reveal the logic and the strength of his argument, as well as the extent of consistency and validity of it. A closer examination of the conceptual roots will show the originality of his contribution as well as Boyd's normative view concerning strategic thinking and strategic theory formulation. We therefore need to study the evolutionary process of Boyd's theory. How did it come into being? How did it grow, evolve? For a proper understanding one needs to go beyond the OODA loop and go through the same learning process that Boyd wanted his audience to go through when they attended his presentations. We need to follow Boyd through his slides step by step. This will improve our understanding of the actual meaning of the OODA loop and lead us to the various other themes he addresses. An added benefit of this study is that it will offer not only insight in the process of developing strategic theory, it will also improve our insight into the nature of strategic theory.

Organization

A discussion on the nature of strategy and strategic theory precedes the investigation of Boyd's strategic theory. This short introduction will lay out the meaning of strategy and strategic theory, their relevance as well as the challenges of formulating good strategy and sound strategic theory. It also introduces the various formative factors that have traditionally shaped and colored the development of strategic theory in a particular period. This introduction lays the foundation for the approach to examine Boyd's work.

The approach adopted to show what Boyd said and meant, to improve our understanding of Boyd's strategic theory, is in one sense an indirect one, informed by the fact that *A Discourse* is not self-explanatory. Instead of starting with presenting *A Discourse* right away, a proper understanding requires an awareness of the background, context and various concepts Boyd incorporated in his work, directly or indirectly. Chapters 3 to 5 discuss at length the formative factors of Boyd's work. In the case of Boyd these formative factors consist first of all of his personal experiences which include his tour as a fighter pilot during the Korean War and his experimentation in air combat afterwards; a second factor

shaping his work lies in his views on the Vietnam experience and the challenges facing the US military in the aftermath of that war, the time during which Boyd developed his work; and his audience to which he lectured.

As is the case with many strategists, Boyd studied military history and strategic theories and the influence of specific theories and insights permeate and color his work too. Chapter 3 therefore includes a discussion of a number of strategic theorists who have exerted an obvious influence on Boyd through his study of strategic theory, such as Sun Tzu, Julian Corbet, T.H Lawrence, J.F.C. Fuller and Basil Liddell Hart. This will introduce ideas which found their place in Boyd's work, thus easing the path for understanding the slides in *A Discourse*. It will also facilitate positioning Boyd in the history of strategic theory as well as provide insights concerning the extent of his contribution to strategic theory.

A less obvious but very interesting and equally influential formative factor is formed by his avid study of a variety of scientific fields, which offered him conceptual lenses through which he interpreted, explained and substantiated his ideas. It suggested a number of essential insights concerning the way science progresses, the way humans learn and the nature of knowing. Azar Gat has convincingly demonstrated that strategic thinkers of the recent centuries fit into the intellectual framework of their time period and how, in turn, strategic thought has developed as the intellectual environment has evolved[37]. This also applies to Boyd. Chapters 4 and 5 focus on this aspect of Boyd's work. They show the scientific *Zeitgeist* (here used as shorthand for the intellectual environment in a particular period) during which Boyd formulated his theory, as well as the way and the extent to which it influenced his work. I argue that Boyd's work is rooted in this scientific *Zeitgeist* and cannot be properly understood without a level of familiarity with the debates and developments that took place in the period Boyd developed his theory.

Against this background, equipped with certain "conceptual lenses", chapters 6 and 7 offer a comprehensive view on the entire set of presentations Boyd left behind. It comprises of a very close rendering of the slides of Boyd's presentations and his essay. This description allows the reader to follow Boyd through his own essay and the four presentations of *A Discourse* as well as through the two additional presentations. This somewhat elaborate examination of the essay and each individual briefing will give an impression of Boyd's way of reasoning and of his ideas on how one should contemplate about military strategy. It will show how Boyd built up his argument and what is behind the popular OODA loop notion. It furthermore substantiate the conclusion laid out in Chapter 8 that Boyd's work contains many more arguments and insights concerning successful strategic behavior. Based in particular upon the themes, debates and insights from the scientific *Zeitgeist* that color Boyd's work, and upon the pervasive presence of his ideas in military studies and doctrinal debates in what many analysts have described as the post modern period of the 1980s and 1990s, I conclude also that Boyd may be considered the first post-modern strategist, in particular considering the conceptual similarities between Boyd and several post modern social theorists, an argument which furthermore underlines the importance of an awareness of the *Zeitgeist* for understanding strategic theory.

But first a brief introduction to strategic theory. Developing a comprehensive strategic theory is a very difficult and daunting endeavour, and any study attempting to describe, interpret and appreciate a theory should do so based on an appreciation of the peculiarities of strategic theory.

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[37] See C. Dale Walton, 'The Strategist in Context: Culture, the Development of Strategic Thought, and the Pursuit of Timeless Truth', *Comparative Strategy*, 23, 2004, for a short assessment of Azar Gat's work.

2. ON STRATEGY AND STRATEGIC THEORY

So long as war is a possibility the discipline concerning its use is indispensable to sovereign groups that are to survive.

Quincy Wright[1]

What is strategy? A mental tapestry of changing intentions for harmonizing and focusing our efforts as a basis for realizing some aim or purpose in an unfolding and often unforeseen world of many bewildering events and many contending interests.

John Boyd

Strategy

Introduction

The core subject of his study concerns a comprehensive theory about success and failure in conflict. *A Discourse on Winning and Losing* examines how organizations can be effective in conflict, how they can win, or loose, or in the words of John Boyd, how they can 'survive and prosper', and 'improve our ability to shape and adapt to unfolding circumstances, so that we (as individuals or as groups or as a culture or as a nation-state) can survive on our own terms'[2]. In military terms this conflict is called war. But *A Discourse* also looks beyond war and into organizational behavior under adversarial conditions in general, as the epitaph by Boyd already suggests. This means that military theory, operational art, military strategy, strategic theory and thinking strategically in general are key terms defining the content of this study. These terms are not self explanatory nor is it generally appreciated what the specific character is of strategic theory *as* theory, and which peculiar inherent difficulties are attached to developing strategic theory, nor indeed, what sources of inspiration – formative factors – generally influence the development of a strategic theory. For understanding the nature of John Boyd's endavour an introduction on the nature of the subject of this study is necessary. It will illuminate the subject matter Boyd was concerned with; it will show the specific character of strategic theory and it will lead toward an appreciation concerning the criteria that may be applied in judging innovations in strategic theory. Moreover, it will introduce the concept of formative factors of strategic theory which underlies the subsequent chapters that describe the various sources of inspiration and motivation behind Boyd's work.

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[1] Quincy Wright, *The Study of International Relations* (New York, 1955), p.155.
[2] John Boyd, *The Strategic Game of ? and ?*, p.58.

Definitions

Military theory describes the best way to wage war, and can encompass the strategic, operational and tactical levels, and the various dimensions of warfare and environments in which war is fought. This term is broad and not in common use, contrary to the term *operational art*, which has found its place in modern doctrine manuals of armed forces across the western world. Operational art is the body of knowledge dealing with the use and behavior of military forces in a military campaign aimed to achieve strategic or operational level military objectives. Campaigns are normally confined in time and geographical scope.

Another term that might have been employed is "The Art of War", which is actually the title of a few books on strategy. The central idea in the literature [on the Art of War] has been practical advice on how to win wars, Quincy Wright noted[3]. These terms are here implicitly subsumed in the terms *strategy* and *strategic theory*. In this study strategy and strategic theory are the preferred terms because those terms are more common, although not always properly defined in their use, and because using the term strategy allows one a broader scope of activities as well as types and levels of organizations to be studied than war and armed forces. But above all, this choice is inspired by the nature of Boyd's work where strategic behavior is distinctly not confined to the military realm. But what is strategy?

Strategy has several meanings, some narrowly defined, some broadly. Several apply to the nature of strategy and strategic theory here under investigation. The first set of interpretations of strategy and strategic theory that pertain to this study concerns the use of military force and war between political communities. The word strategy has its origin in the Greek word *strategos,* which is normally translated as "general" , or the "art of the general"[4]. In the modern post-Clausewitzian instrumentalist interpretation of strategy, strategy is the bridge that relates military power to political purpose. It tells one how to conduct a war, or how to achieve political objectives, using the military instrument. In the Clausewitzian sense strategy is the use that is made of force and the threat of force for the ends of policy[5]. Literally Clausewitz stated strategy is the use of engagements for the object of the war[6]. Freely translated he tells us that strategy is the use of tacit and explicit threats, as well as of actual battles and campaigns, to advance political purposes. However, the strategy may not be (purely) military strategy, instead it may be grand strategy that uses "engagements", meaning all of the relevant instruments of power as threats or in action, for the objectives of statecraft[7].

Strategy thus provides the conceptual link between action and effect and between instrument and objective. It is an idea. Strategy is a plan of action designed in order to achieve some end; a purpose together with a system of measures for its accomplishment[8]. Liddell Hart suggests that strategy is the art of distributing and applying military means to fulfill the ends of policy[9]. André Beaufre captured the interactive nature, the dueling character of strategic behavior when he states that strategy is the art of the dialectic of two

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[3] Wright, p.148.

[4] J. Mohan Malik, 'The Evolution of Strategic Thought', in Graig Snyder (ed), *Contemporary Security and Strategy,* MacMillan (London, 1999), p.13.

[5] Gray *Modern Strategy,* p.17.

[6] Carl von Clausewitz, *On War,* trans. Michael Howard and Peter Paret (Princeton, NJ, 1976), p.128.

[7] Gray *Modern Strategy*, p.17.

[8] J.C.Wylie, *Military Strategy: A General Theory of Power Control* (Rutgers University Press, New Brunswick, NJ), p.13.

[9] Basil Liddell Hart, *Strategy: The Indirect Approach* (London, 1967), p.335.

opposing wills using force to resolve their dispute[10]. A recently posited definition emphasizes the dynamic nature of this process, and of strategy, stating that strategy is a process, a constant adaptation to shifting conditions and circumstances in a world where chance, uncertainty and ambiguity dominate, a view in particular that is very much in line with Boyd's idea[11].

Strategy has also a more general application beyond the military sphere, and the last mentioned definition of strategy already provides such a more general meaning of strategy, which is reflected in a definition of strategy taken from management theory:

> strategy is an adaptive process where piecemeal strategic decisions are taken based on continuous feedback between formulation and implementation in an emergent pattern over time[12].

This definition incidentally includes the feedback notion that features prominently in the work of John Boyd. Since the Second World War civil institutions - businesses, corporations, non-military government departments, universities - have come to develop strategies, by which they usually mean policy planning of any kind. Thus the term strategy is no longer the sole province of the military[13]. But here too there are various opinion of what strategy is and does. In a comment that seems applicable to military strategy one author recently observed that 'in the evolution of strategy research a diversity of partly competitive and partly supplementary paradigms have emerged'[14]. The following viewpoints enjoy agreement among experts[15]:

- Strategy concerns both organization and environment: the organization uses strategy to deal with changing environments;
- The substance of strategy is complex: because change brings novel combinations of circumstances to the organization, the substance of strategy remains unstructured, unprogrammed, nonroutine, and non-repetitive;
- Strategy affects overall welfare of the organization: strategic decisions are considered important enough to affect the overall welfare of the organization;
- Strategy involves issues of both content and process: the study of strategy includes both the actions takes, or the content of strategy, and the processes by which actions are decided and implemented;
- Strategies are not purely deliberate: intended, emergent, and realized strategies may differ from one another;
- Strategies exist on different levels: firms have corporate strategy (what business shall we be in?) and business strategy (how shall we compete in each business?);
- Strategy involves various thought processes: strategy involves conceptual as well as analytical exercises.

Generally speaking then, in organization and management theory strategy refers to the various ways an organization tries to maintain a strategic fit between an organization's goals,

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[10] André Beaufre, *An Introduction to Strategy* (London, 1963), p.22.
[11] Williamson Murray and Mark Grimsley, 'Introduction: On Strategy', in Murray, MacGregor Knox, and Alvin Bernstein (eds.), *The Making of Strategy: Rulers, States, and War* (Cambridge, 1994), p.1.
[12] Patrick Regner, 'Complexity and Multiple Rationalities in Strategy Processes', in Henk W. Volberda and Tom Elfring, *Rethinking Strategy* (Sage Publications, London, 2001), p.44.
[13] Malik, p.14.
[14] Volberda and Elfring, p.1.
[15] Adopted from Henry Minzberg et al, *Strategy Safari* (Free Press, New York, 1998), p.16.

its internal make up and the dynamic environment. War, in this definition, provides a very dynamic environment. Such a broad view on strategy matches well with a broad view of war, or conflict, John Boyd maintained that comprises acts of physical, biological, psychological, social, cultural and other destruction at all levels, e.g. intrapsychic, interpersonal, intergroup, interorganizational, and international[16].

Not incidentally, quite a number of books on general management, leadership in business and strategic management refer to military strategic thought. The classical strategic theorists Clausewitz and Sun Tzu have both been applied to the business environment[17]. Henry Mintzberg, an acknowledged expert on strategic management, has made up a frequently cited list of ten distinct points of view concerning strategy and strategic management, not unlike the various schools of military strategic thought[18]. A short overview of this list gives an additional insight into the nature of the subject of this study for although the work under investigation is primarily focused on the military environment, it explicitly incorporates this wide interpretation of the term strategy[19].

The Design School	strategy formation as a process of conception
The Planning School	strategy formation as a formal process
The Positioning School	strategy formation as an analytical process
The Entrepreneurial School	strategy formation as a visionary process
The Cognitive School	strategy formation as a mental process
The Power School	strategy formation as a process of negotiation
The Cultural School	strategy formation as a collective process
The Environmental School	strategy formation as a reactive process
The Configuration School	strategy formation as a process of transformation

Strategy matters, hence the epitaph of Quincy Wright. To neglect strategy in defense planning or the conduct of war would be like trying to play chess without kings on the board[20]. Strategy is the essential ingredient for making war either politically effective or morally tenable. Without strategy there is no rationale for how force will achieve purposes worth the price in blood and treasure. Without strategy, power is a loose cannon and war is mindless. Mindless killing can only be criminal. Politicians and soldiers may debate which strategic choice is best, but only pacifists can doubt that strategy is necessary[21]. Flawed strategy will bring the most expert and battle-hardened forces down[22], while the absence of a strategy does not means no strategic effects will result from tactical actions. Strategy abhors a

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[16] This definition is from Dennis J.D. Sandole, *Capturing the Complexity of Conflict* (New York, 1999), p.1.

[17] The most recent addition is a discussion of Clausewitz by a noted expert in an attempt to show his relevance for the senior management levels of commercial organizations. Interestingly, the book was produced under the auspices of the Boston Consulting Group, a recognized leader in strategic consulting. See Tiha von Ghyczy, Bolko von Oetinger and Christopher Bassford, *Clausewitz on Strategy* (John Wiley & Sons, New York, 2001).

[18] Malik for instance discerns the Continental, Maritime, Aerospace, Revolutionary and Nuclear schools. These are not as neatly categorized as the list of schools in strategic management, which all refer to the process of strategy formation. Malik's list contains a combination of classification: environment, type of operation and type of weapon.

[19] Minzberg, 1998, p.5. It is for instance included in Volberda and Elfring, p.7.

[20] Gray *Modern Strategy*, p.44.

[21] Richard K. Betts, 'Is Strategy an Illusion?', *International Security*, Vol. 25, No.2 (Fall 2000), p.5.

[22] Williamson Murray and MacGregor Knox, 'Conclusion, the future behind us', in MacGregor Knox and Williamson Murray, *The Dynamics of Military Revolution, 1300-2050* (Cambridge University Press, 2001), p.180.

vacuum: if the strategic function is lacking, strategic effect will be generated by the casual, if perhaps unguided and unwanted accumulation of tactical and operational outcomes[23].

Strategy has both extrinsic and intrinsic value. The extrinsic merit in strategy lies in its utility for keeping the military assets of a particular security community roughly in balance with the demands and opportunities that flow as stimuli from the outside world, or in organization theoretical terms, in its utility to maintain organizational fitness. The intrinsic merit in strategy resides in its role as conductor of the orchestra of military and other assets so that they can be applied economically to serve political objectives. Strategy transforms tactical performance into strategic effect for strategic performance in the service of policy[24].

Making good strategy is difficult

Strategy is also very difficult, and may remain even an illusion the following reasons:

- strategies cannot be evaluated because there are no agreed criteria for which are good or bad;
- there is little demonstrable relationship between strategies and outcomes of war;
- good strategies can seldom be formulated because of policymakers' biases;
- if good strategies are formulated, they cannot be executed because of organizations' limitations;
- prediction and control is fraud with difficulties due to political and military complexity[25].

While strategy is necessary, it has proven very difficult to devise, implement and execute meaningful and effective strategy. Those who experience or study wars find strong reasons to doubt that strategists can know enough about the causes, effects, and intervening variables to make the operations planned produce the outcomes desired[26]. However, he concludes, there is no alternative to engage in strategy unless one is willing to give up the use of force as an instrument of policy[27]. Although sensible strategy is not impossible, it is usually difficult and risky, and what works in one case may not work in another that seems similar. All this indeterminacy suggests some caution[28].

Colin Gray similarly warns of fundamental difficulties of strategy, some of which mirror those mentioned by Betts. First, competence in strategy requires mastery of a particular challenging complexity. The strategist needs to understand what is tactically and operationally possible in all geographical environments; what success or failure in each environment contributes to performance in the other environments; what that all means for military performance writ large; and what general military performance means to policy (and vise versa). Moreover the growing complexity of the subject renders it more difficult today than it was a century ago. As the character of force has diversified with the addition of the air, space, cyberspace and nuclear environments, the tasks of the strategist has grown ever more difficult in practice.

Second, by its very nature strategy is more demanding of the intellect and perhaps the imagination than is any structurally more simple activity - policy, operations, tactics, etc. Excellence in strategy requires the strategist to transcends simple categories of thought. The

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[23] Gray *Modern Strategy* , p.50.
[24] Ibid, p.47.
[25] Betts, p.5.
[26] Ibid.
[27] Ibid, p.47.
[28] Ibid, p.48.

strategist's task is not to create wise policy or successful schemes of military action, but rather to build and repair the bridges that connect the two.

Third, it is extraordinarily difficult to train people to be competent strategists. There is little in the training of professional politicians or soldiers that would equip them well for strategic responsibilities. The military professional is not taught how engagements should be used for the object of the war. Similarly, the rising politician is promoted for maturing political skills. Where strategy is the bridge between military and political actions, it is not readily apparent that someone is well versed in how to built it. But strategic excellence calls for a type of judgment that cannot be taught the same way or in the same degree as tactical excellence.

Fourth, strategy places unique physical and moral burdens on the would-be strategist. As Clausewitz stated, strategic performance can be degraded by danger, fatigue, and anxiety born of uncertainty. Finally, friction interferes. Friction is the cluster of factors that cause the implementation of a plan to veer away from intention. Friction, according to Clausewitz famous explanation, is the only concept that more or less corresponds to the factors that distinguish real war from war on paper. The reason why friction can be so damaging at the strategic level is because, by definition, that level must accommodate, integrate, and direct all of the activities that constitute war. At the strategic level of performance there is more that can go wrong[29]. Hence Clausewitz' introduction of the notion of genius as the quality of good commanders.

To reinforce the last point, the difficulty of strategy becomes also readily apparent when one considers the following list of elements – or rather pervasive and interpenetrating dimensions – a strategist must fuse to form strategy, or conversely, what factors affect the making and working of strategy[30]:

People and politics	**Preparation for war**	**War proper**
People	Economics	Military operations
Society	Logistics	Command
Culture	Organization	Geography
Politics	Military administration	Friction
Ethics	Information & intelligence	Adversary
	Strategic theory & doctrine	Time
	Technology	

Indeed, strategy matters but is also very difficult, and the same holds true for strategic theory.

Strategic theory

The theory in strategic theory

The importance of good strategy suggests strategic theory to be highly relevant, but the difficulties of strategy also promise developing good strategic theory to be highly problematic. Strategic theory is a strange animal indeed, and as theory it deviates in some

[29] This summary of factors is an excerpt of Colin Gray, *Explorations in Strategy* (Greenwood Press, Westport Connecticut, 1996), pp.8-11.
[30] Gray, *Modern Strategy*, pp.23-44.

important respects from what is generally considered "proper" scientific theory. Theory has many meanings and there are various sorts of theory. Theory can be defined as a fairly large amount of descriptive, correlational, and explanatory knowledge which has been assembled into a logical and coherent whole[31]. Theory can be described as a set of general propositions about the same subject, connected by relations of conjunction and implication, that by embedding knowledge in a meaningful structure, allows relevant properties of that subject to be explained and predicted[32]. Theory is also a symbolic construction. A theory is conjectural or hypothetical, contrasted in its uncertainty with the statement of fact as known truth. Theoretical means abstract, selecting from the materials of experience, but is also means conceptual, constructing from the selected materials something with no counterpart in experience at all[33]. Theories usually imply several more specific descriptive or causal hypotheses[34]. If their component parts do not satisfy certain minimal requirements of logic and of empirical testability, they should not be called theories. They may be called theoretical formulations, or frameworks, or conceptual schemes, or perhaps models, but not theories[35].

Theories may and do vary in their usefulness and value, according to their generality, their accuracy, and their explanatory power. Theory serves various purposes. It offers the most systematic and parsimonious means of codifying what we already know. If a theory is good it brings together the more powerful concepts and insights and the more relevant knowledge that has been generated via induction, analogy and deduction[36]. Second, theory puts things down in a system. The systematization effected by a theory has the consequence of simplifying laws and introducing order into congeries of fact. But this is a by-product of a more basic function of theory: to make sense of what would otherwise be inscrutable or unmeaning empirical findings. A theory is more than a synopsis of the moves that have been played (in the game of nature); it also sets forth some idea of the rules of the game, by which the moves become intelligible[37]. Thus theory provides the foundation from which we can move in the acquisition and codification of future knowledge. In sum, a good theory provides an intersection between what we already now and that which we seek to know[38].

With some caveats, this view on theory is generally applicable to strategic theory. Strategic theory concerns thoughts about making effective strategy and about the proper use of force. The strategic theorist speculates about the effect of particular military instruments upon the course of history[39]. The cardinal virtue of strategic theory, reasoning or planning is that it brings together, it connects, activities which otherwise easily could be treated as though they were autonomous realms[40]. What must be connected are the aforementioned 17 dimensions of strategy, because each influences the others. Although each dimension in itself can provide relevant insight if used as an approach to study a case, good strategic theory

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[31] J.D. Singer, 'Theorists and Empiricists: The Two Culture Problem in International Politics', in James Rosenau, Vincent Davis, Maurice East, *The Analysis of International Politics* (New York, 1972), p.88.

[32] Mirolav Nincic and Joseph Lepgold (ed), *Being Useful, Policy Relevance and International Relations Theory* (Ann Arbor, 2000), p.23.

[33] Abraham Kaplan, *The Conduct of Inquiry* (Chandler publishing Company, San Francisco, 1964), pp. 296-297.

[34] Gary King, Robert O. Keohane, Sidney Verba, *Designing Social Inquiry* (Princeton, New Jersey, 1994), p.19.

[35] Singer, pp.88-89.

[36] Ibid, p.89.

[37] Kaplan, p.302.

[38] Singer, p.90.

[39] Gray, *Modern Strategy,* p.124.

[40] Gray, *Explorations*, p.6.

must be holistic, paying due respect for the interdependency of the various elements and dimensions that give form to strategy[41].

There is no single all embracing formula explaining, describing and predicting strategy and its outcome. Instead, it belongs to the domain of social science, in which parsimony is only occasionally appropriate[42]. In the social sciences iron laws are quite rare. At best the social scientist can give not more than a probability that a particular action will be followed by the desired result[43]. The phenomena of social science are so complex, with many different influences or "causes" operating on a particular event, and our knowledge of these complex phenomena is still so imperfect, that few laws have been established. Even with much more theory and research we are likely to have only probability statements - statements that most phenomena of a given class will behave in such-and-such a way most of the time.

Clausewitz pointed out that a positive doctrine for warfare is simply not possible[44]. Theory need not be a positive doctrine, a sort of manual for action[45]. He criticizes those who attempt to do that anyway by stating that 'they aim at fixed values, but in war everything is uncertain, and calculations have to made with variable quantities. They direct the inquiry exclusively towards physical quantities, whereas all military action is intertwined with psychological forces and effects. They consider only unilateral action, whereas war consists of a continuous interaction of opposites'[46]. War is too complex.. Moreover it is filled with danger, chance, uncertainty, emotions, and differential talents of commanders. In that, strategic theory does not conform to standards of theory in physics in which parsimony or the development of general laws is an aim. As Garnett remarks, some of the most useful theories do not in any way meet the strict requirements of "scientific" theory. If "scientific" is associated with a predictive capacity of theory, indeed, most strategic theories fail.

The scope of strategic theory

But there is a second function of theory, and that is to explain. In this respect, what holds for the theory of international politics, holds also for strategic theory: despite the fact that generalization and hypotheses in the field of international politics enjoy only limited validity, they sometimes throw a good deal of light on state behavior in particular conditions and in particular periods of time[47]. If a strategic theory offers better ways of explaining victories and losses it already has much utility for evaluation and policy making, if it can provide some measure of plausible conditional prediction that a certain mode of behavior will result in a higher probability of success, it is extremely useful.

Interestingly this view on the nature and role of strategic theory is remarkably similar to the one offered by Alexander George when he discusses the nature and relevance of theory for foreign policy. There is an essential similarity between strategy and foreign policy

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[41] Ibid, pp.6-8, similarly see Gray, *Modern Strategy,* pp.24-26. As Clausewitz states, 'It would be disastrous to try to develop our understanding of strategy by analyzing these factors in isolation, since they are usually interconnected in each military action in manifold and intricate ways', Clausewitz, p.183. Clausewitz discerned the following types of strategic elements that affect the use of engagements: moral, physical, mathematical, geographical and statistical. See also p.183.

[42] Gary King, et al, p.20.

[43] Bruce Russett and Harvey Starr, *World Politics, A Menu for Choice,* San Fransico, 1981, p.32. Laws are hypotheses that are confirmed in virtually all of the classes of phenemena to which they are applied.

[44] Clausewitz, p.140.

[45] Ibid, p.141.

[46] Ibid, p.136. This critique was directed against Jomini and Bulow.

[47] John C. Garnett, *Commonsense and the Theory of International Politics*, London (1984), p.46.

(both aim to achieve a goal through a certain plan)[48]. Theory in this field assists in deciding whether and how to employ a particular strategy by offering an abstract conceptual model (or a quasi-deductive theory) of each strategy and general knowledge of the conditions that favor the success of a strategy and conversely, the conditions that make its success unlikely[49].

An abstract conceptual model of a strategy - such as deterrence and coercive diplomacy - identifies the critical variables of that strategy and the general logic that is associated with successful use of that instrument of policy. The abstract model itself is not a strategy but merely a starting point for constructing a strategy. The abstract model identifies only the general logic - that is the desired impact on the adversary's calculations and behavior - that is needed for it to be successful. But it does not indicate precisely what the policy maker has to do to induce that logic into the adversary's calculations. To achieve that result the policymaker has to tailor the abstract model into a specific strategy for the particular situation at hand[50].

The abstract conceptual model is neither a full-fledged deductive theory. A fully developed deductive theory of deterrence or coercive diplomacy, if properly constructed, could be used to predict whether the strategy would succeed or fail in a particular situation. To have this potency however, the abstract model would have to be operationalized. All its variable-components as well as the interaction among them would have to be capable of being specified and measured. Fully aware of the highly contextual, dynamic and interactive arena of international conflict, George readily admits that fully developed deductive theories of foreign policy strategies do not exist and will be difficult to develop[51].

The second category of knowledge is generic knowledge of conditions favoring a strategy. The limited contribution of abstract conceptual models can be compensated for somewhat by identifying conditions that, if present in a particular case, favor the success of a strategy. Generic knowledge of this kind can be obtained only by means of empirical research that systematically compares instances when the strategy succeeded with cases in which it failed. In doing so the investigator identifies variables and conditions that account for or explain the variance in the outcomes of a strategy. Generalizations are referred to as conditional when they identify factors that appear to have favored success of the strategy and other conditions that are associated with likely failure of the strategy. Given the complexity of international relations phenomena, it is most unlikely that valid universal generalizations will be discovered, neither should this be the aim. Instead, it is preferable to regard those conditions that do seem to have causal importance in explaining some successes of a strategy as favoring conditions. That is, the presence of these conditions in a particular case makes a strategy more likely to succeed. But favoring conditions are neither necessary nor sufficient for the success of a strategy[52].

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[48] As Walt notes 'Strategy is thus a 'policy science' in the manner described by Alexander George and Richard Smoke in *Deterrence in American Forgeign Policy: Theory and Practice',* Walt, p. 142, footnote 2.

[49] Alexander George, *Bridging the Gap, Theory and Practice in Foreign Policy*, United States Institute of Peace Press, Washington DC, 1993, p.117.

[50] Ibid, pp.117-118.

[51] Ibid, pp.119-120

[52] Ibid, pp.120-122. The third type of knowledge - an actor-specific behavioral model of the adversary - required for dealing effectively with other states policy makers need what is often referred to as a correct image of the opponent. Faulty images of each other are a source of misperceptions and miscalculations that have often led to major errors in policy, avoidable catastrophes, and missed opportunities. In addition, policymakers need to understand the adversary's image of them. George is very close to John Boyd's model, as will later become apparent, when George mentions that for establishing a correct image specific research is necessary on a particular opponent, on his belief

Such a division can also be discerned in strategic theory which knows various schools that derive their insight from various sources of inspiration and have qualified ranges of applicability. A similar observation holds true for strategic management theory. The existence of (at least) ten schools of thought betrays the complexity of organizational behavior. Gray distinguishes four levels to categorize strategic theories, and although each level has its merits, a general theory of war provides the most holistic approach and subsequently has the most value for commanders who, in order to shape strategy for a particular war, must understand how war in general, qua war works[53]:

1. A level that transcends time, environment, political and social conditions and technology (for instance Clausewitz and Sun Tzu).
2. A level that explains how the geographical and functional complexities of war and strategy interact and complement each other. (Corbett on naval warfare)
3. A level that explains how a particular kind or use of military power strategically affects the course of conflict as a whole. (Mahan, Douhet, Schelling on the role of maritime power, air power and nuclear power respectively)
4. A level that explains the character of war in a particular period, keyed to explicit assumptions about the capabilities of different kinds of military power and their terms of effective engagement. (the use of air power as a coercive tool)

General strategic theory educates politicians and commanders broadly as to the nature, structure, and dynamic workings of the instrument to which they might have to resort. The chief utility of a general theory of war and strategy lies in its ability not to point out lessons, but to isolate things that need thinking about. It must provide insight and questions, not answers[54]. Strategic theory in this sense educates the mind by providing intellectual organization, defining terms, it suggests connections among apparently disparate matters, and offers speculative consequentionalist postulates[55].

The foundation of modern strategic theory was laid by the classical strategists Clausewitz, Mahan and Corbett, who discovered, based on meticulous historical research, in more or less theoretical terms the nature of war and strategic behavior and the identity and practices and kinds of behavior likely to promote strategic success or strategic failure. Clausewitz in particular provides a system of thought on war and strategy[56]. It is probably the only true general theory of war and strategy[57]. It is testimony to Boyd that Gray, while observing poverty in contemporary general strategic theory, ranks Boyd among the few authors of the 20th Century that succeeded in some measure in developing a general theory, despite the substantial difficulties of such an endeavor.

Clausewitz provided also an analysis on the proper use of theory. Theory, according to Clausewitz, should cast a steady light on all phenomena so that we can more easily

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systems, on his way of dealing with cognitive and political constraints on rationality, on the way decisions are made, who the policy influentials are and what psychological, cultural and political variables shape and influence the adversary's goals, perceptions, calculations, and behavior. See pp.125-131.

[53] Gray, *Modern Strategy*, pp.125-126

[54] Ibid, p.128.

[55] Ibid, p.36.

[56]Ibid, pp.80-81. The similarity is striking between the historical approach followed by Clausewitz, Corbett and Mahan, and the importance they attach to proper critical study of history and the focussed comparative case study method advocated by George to obtain both conceptual knowledge and generic knowlefge of conditions favoring a strategy.

[57] Gray repeats this message quite a few times: see *Modern Strategy,* pp.84, 85, 126.

recognize and eliminate the weeds that always spring from ignorance; it should show how one thing is related to another and keep the important and unimportant separate. Theory cannot equip the mind with formula's for solving problems, nor can it make the narrow path on which the sole solution is supposed to lie by planting a hedge of principles on either side. But it can give the mind insight into the great mass of phenomena and of their relationships, then leave it free to rise into the higher realms of action[58].

And it is this feature in particular that strategists cherish in strategic theory, and subsequently it is the Clausewitzian view on theory that permeates this study, which is more concerned with explaining, providing insights and education than with predicting. Theory will have fulfilled its main task when it is used to analyze the constituent elements of war, to distinguish precisely what at first sight seems fused, to explain in full the properties of the means employed and to show their probable effects, to define clearly the nature of the ends in view, and to illuminate all phases of warfare in a thorough critical inquiry.

Theory then becomes a guide to anyone who wants to learn about war from books; it will light his way, ease his progress, train his judgment, and help him avoid pitfalls[59]. Although quite a few military theorists aim to uncover the single principle governing war and proving victory, and who aspire for scientific capacity to predict and control[60], the common expectation of military strategic theory today, and the one employed here, is, in Colin Gray's words, 'to educate the mind by providing intellectual organization, defining terms, suggesting connections among apparently disparate matters, and offering speculative consequentialist postulates'[61]. It must in particular provide insight into the dynamics of war.

This interpretation of the meaning and utility of theory, which deviates from the more positivist interpretations of science, is related to the reasons for employing and making theory. Clausewitz, Mahan, and John Boyd all aimed to educate military leaders. Clausewitz considered strategy a form of creative intellectual activity, and theory was meant to provide the foundation for this activity, to provide a point of reference for thought processes and to offer a way of thinking, not what to think. His aim was to provide a system of learning for those in higher levels of command[62]. Or in Clausewitz' own words, 'It is not *what* we have thought, but rather *how* we have thought it, that we consider to be our contribution to theory'[63]. In short, theory must help explain and understand. For the premier naval strategist Alfred Thayer Mahan the formulation of theory, or the construction of a philosophically complete system of explanation was either secondary or hostile to the accomplishment of his primary task which, like Clausewitz he considered to be the education of military commanders[64].

Boyd too was primarily interested in educating his audience. He attempted not so much to instill verities but to impart a way of thinking about war and strategy. Boyd was in some respects like Mahan who was concerned with the creation of a 'disciplined yet flexible

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[58] Clausewitz, O*n War*, p.578.

[59] Ibid, p.141.

[60] In fact, most authors on strategy aim to argue that a specific method will most likely under all circumstances provide victory. Famous authors such as Jomini, Douhet and Liddell Hart were not above that. Quincy Wright states on p.112 that the 'primary test of science is its capacity to predict and control',

[61] Gray, *Modern Strategy*, p.36.

[62] Jon Tetsuro Sumida, *Inventing Grand Strategy and Teaching Command* (The Woodrow Wilson Center Press, Washington, D.C., 1997), p.139.

[63] Ghyczy et al, *Clausewitz on Strategy,* p.185.

[64] See for Mahan's views on the purpose of theory, doctrine and history Sumida, *Inventing Grand Strategy and Teaching Command*, in particular chapter 6.

sensibility that would be capable of quick and sound judgment in spite of incomplete or misleading knowledge and risk of serious consequences in the event of error'[65]. Mahan made thorough attempts at systematizing but theory as such was an auxiliary, which served the purpose to point at, and recognize the existence or absence of general phenomena of war. It facilitated learning. Mahan in many respects agreed with Clausewitz's view on the role of theory when the latter stated that 'the influence of theoretical truths on practical life is always exerted more through critical analysis than through doctrine'[66]. Neither should one use 'elaborate scientific guidelines as if they were a kind of truth machine'[67]. Theory then is important because it helps to educate and it may shed new light on war. That, and not the aim of developing a general theory which like the Newtonian laws of physics holds up for long periods of time, is the purpose of strategic theory. It is in exactly this spirit that John Boyd formulated his assertions and theoretical constructs.

Strategic theory and practice

The educational feature of strategic theory does not imply its value is confined to the academic world. The science and theory of war, while they may seek explanations in sociology, psychology, or geography, are concerned primarily with the building of systems of thought which will guide the soldier, statesman, or citizen to appreciate the situation and to act so that victory may be won[68]. Strategic theory has a nasty feature in that it relates to matters of life and death. 'The strategist's task is to formulate a "theory" explaining how a state can ensure its security and further other interests', Stephen Walt asserted[69]. It therefore needs to perform in practice, just like medical science aims at deriving insights, at understanding the dynamics and interrelationships of the various parts of the human body, in order to achieve success in surgery and treatment. Strategic thinking, or 'theory' if one prefers, is nothing if not pragmatic. Strategy is a 'how to do it' study, a guide to accomplish something and doing it efficiently[70]. Strategy is an applied art or social science, and theory about is has merit in the measure of its value to those who must meet the practical challenges of strategy[71]. It is a theory for action. The question that matters in strategy is: Will the idea work? In that respect it is like other branches of politics and like any of the applied sciences, and not at all like pure science, where the function of theory is to describe, organize, and explain and not to prescribe[72]. No matter how abstract and general a theory of strategy may appear to be, that theory has to relate to the actual potential behavior of Roman legionaries, Napoleonic guardsmen, or American bomber crews[73].

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[65] Ibid, p.xix.
[66] Clausewitz, p.156.
[67] Ibid, p.168.
[68] Wright, p.149.
[69] Stephen M. Walt, 'The Search for a Science of Strategy', *International Security,* Summer 1987, Vol 12, no.1, pp.141.
[70] Bernard Brodie, *War and Politics* (MacMillan, New York, 1973), p.452.
[71] Gray, p.82. Baron Henri de Jomini and J.F.C. Fuller are among those that aspired to formulate a military theory that conformed to the standard Newtonian model of the natural sciences. And they have been duly criticized for their reductionism and deterministic approach. See for instance John Shy, 'Jomini' in Peter Paret, *Makers of Modern Strategy* (Princeton, NJ, 1986) for their reductionism and deterministic approach.
[72] Bernard Brodie, *War and Politics*, pp.452-453.
[73] Gray, *Modern Strategy*, pp.124-125.

Strategic theory often has an impact on the formulation of strategy in the real world.[74]. Following Clausewitz rather closely, George argues in his book that policy relevant generic knowledge aid policy analysis and a policy maker's judgment through providing the tools to make a sound diagnosis of a problem situation; and it can help identify an effective policy response for dealing with that problem. It has a diagnostic task and a prescriptive one, with an emphasis on the former[75]. Good theories according to him provide relevant and useful conceptual frameworks by means of which to understand the general requirements of a strategy and the general logic associated with its effective employment. Such theoretical-conceptual knowledge is critical for policymaking. And all policymakers make use of some such theory and conceptual frameworks, whether consciously or not. In employing a strategy they rely on assumptions, often tacit, about the strategy's general requirements and logic[76]. Indeed, as Gray observes, 'wherever one looks in modern strategic history one finds testimony to the influence of ideas…there is always a strategic theoretical dimension to the making, execution, and doing of strategy[77][…] The messy world of defense policy and the use of force provides both the permanent reason why strategic theory is important'[78].

The traffic between ideas and behavior in strategic affairs is continuous. As the intellectual history of strategy bears the stamp of particular perceptions and interpretations of strategic experience, so strategic behavior is shaped by the attitudes and ideas that we know as strategic culture. In the practical world of strategy, strategic ideas apply to experience, while strategic experience constitutes ideas in action[79]. Strategic theory provides a framework for formulating advice and aiding judgment. Ideas help shape behavior, even as they are shaped in turn by behavior[80].

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[74] At first sight Gray casts doubt about the causal relationship between strategic theory and strategic behavior. Strategic behavior can flow from the interaction of many factors, among which a particular book of general strategic theory is never likely to rank high. Because strategy is a practical subject, with, moreover, the most far-reaching of implications for society and individuals, those who would advise about it are obliged to provide answers to the questions posed by pragmatically minded political and military clients. The study of war and strategy is subsequently sidelined by the pressing needs of the state for immediate answers to problems such as weapons choice and deployment, or the use of airpower in irregular conflict. Strategy is an issue area understood by politicians, military leaders, and society at large with regard to specific circumstances of security and insecurity. Strategic theorists occupy the same historical space and time as do their "clients". As a result many works of strategy theory have a way of descending into the field of application, or applied strategic study. Who needs abstractions when concrete solutions are needed. See Gray (1999), p.122. George made a similar observation on the relevance of international relations theory and diplomatic practice and real world foreign policy making. Policy specialists have a strong aversion to the idea that theory can have relevance and potential utility for policymaking.

[75] Alexander George, *Bridging the Gap, Theory and Practice in Foreign Policy* (United States Institute of Peace Press, Washington DC, 1993), p.xx. He deliberately uses the term generic knowledge as a substitute for theory because in his experience policymakers are adverse to theory but interested in generic knowledge. See p.xix.

[76] Ibid, p.xviii.

[77] Gray, *Modern Strategy,* pp.35-36.

[78] Ibid, p.123.

[79] Ibid, p.134. In a later chapter this reflexive character of strategy will be discussed more in detail.

[80] Ibid, p.4.

Why strategic theorizing is difficult

"Good" strategic theory does not equate to an ability to provide certainty in predictions, yet the demands for pragmatism mean theory must be able to inform plans and actions with a rationale for achieving success. The problem facing strategic theorists is that the circumstance for which strategic theory is developed will be largely unknown and moreover unknowable much in advance of the moment of testing the strategic theory, though the uncertainty is itself a factor to be reckoned with in one's strategic doctrine[81]. Moreover, strategic theory is evolutionary and paradoxical. These factors imply strategic theory is dynamic in a fundamental way, and this character affects the potential for making good and lasting theory concerning strategy.

Strategic theory is evolutionary in the sense that theories are developed that take into account novel actors, such as states or terrorist groups, new technologies such as tanks, aircraft or nuclear weapons, or phenomena such as the impact of the industrial revolution or the rise of mass emotions in nationalistically and ideologically inspired wars[82]. The contemporary social context determines what the actors, weapons, aims, norms, etc. are that are employed in a purposeful manner in war, and as this social context evolves, so does (or should) strategic theory[83]. Strategists have had difficulty abstracting themselves from the features of a given war or period, and identifying the lasting characteristics that would apply to all contexts and all periods[84]. As a result their work generally reflect the war, or factors that affect it, as seen through the eyes of people living in their own time, imparting a contemporary color to their military thinking[85].

This affects the nature of theory development. In principle knowledge grows through a steady improvement of theory, which is achieved through a repetitious encounter of theory and reality. This is what Thomas Kuhn calls additive accumulation whereby one refines and expands on what one already knows[86]. The dynamic nature of strategy and war however are not conducive to a steady growth of knowledge because the object - war, actors, weapons, rules - alter constantly and in fairly rapid tempo, at least in the past 200 years. Subsequently strategic theory development does not follow a clear cumulative growth path in which new theories built upon former ones, improving the older ones or expanding their range of application. This has obvious consequences for evaluating novel strategic theories.

One could argue that contemporary strategic theory builds upon the foundation laid by the authoritive body of work developed by Clausewitz. His work *On War* may rightly be considered the Western paradigm for studying war and making strategy. Brodie considered

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[81]Brodie, p. 452.

[82] See for instance Ken Booth, 'The Evolution of Strategic Thinking', in John Baylis, Ken Booth, John Garnett & Phil Williams, *Contemporary Strategy*, Volume I, Second Edition (Holmes & Meier, New York, 1987).

[83] See for instance Wright, pp.151-152.

[84] Avi Kober, 'Nomology vs Historicism: Formative Factors in Modern Military Thought', *Defense Analysis,* Vol. 10, No. 3, 1994, p.268. Actually he also states that the way lessons are learned affect military theory. However, Kober fails to show to what extend it is markedly different in its effect on theory making as compared to the more thoroughly discussed factor of the nature of war.

[85] Wright, p. 271.

[86] This is what "normal science" does, according to Kuhn, in various parts of *The Structure of Scientific Revolutions*, (Chicago, 1970), see for instance p.6, 24, or 80.

Clausewitz's book not simply the greatest but the only truly great book on war[87], and his judgment is widely shared among the strategic theorists of many countries today[88]. But his work too is bound in its application by the fact that it was written after, and in reflection of, the Napoleonic period within a developing system of states[89]. It required subsequent authors to develop partial theories to account for the industrial revolution, for the development of the third dimension as an arena for war (air power theory), and for the phenomena of limited wars and wars between other actors than states. This has thus far not resulted in a new overarching general theory that incorporates these various building blocks and synthesizes them into a coherent entity. The reader then is left with an expanding number of partial theories, each of which has a limited range of applicability, be it bound by geography (continental, maritime, urban, jungle), dimension (air, land, sea), weapon technology and combat method (nuclear, terrorism, counter-insurgency, guerilla), etc.

The complexity and dynamic nature of war and strategy result in a situation regarding the state of theory not unlike the one that obtains in the study of conflict in general. As Sandole records, 'in order to prevent or otherwise deal with violent conflict and war, we must know something about the underlying factors: their identities, sequence, relative weights, combinations, and interactions. We require theory that would enable us to explain these processes, not only as an otherwise noteworthy academic objective, but as a prerequisite to attempting to manage, control, prevent or otherwise deal with them'. However, he quotes Bueno de Mesquita, 'the field has languished without appreciable evidence of scientific progress for more than two millennia'[90]. Vasquez has noted that 'the scientific study of war began with the hope and promise that the collection of reproducible evidence and its systematic analysis would result in a major breakthrough in our understanding of general factors associated with war and peace. That breakthrough has not occurred'[91]. This state of affairs is due, according to Sandole, to the multilevel and dynamic character of war[92].

This problematic evolutionary feature of strategic theory is reinforced by the *paradoxical nature of strategy and strategic theory*. Strategic theory is not neutral territory, but an arena of competition itself in that respect. Strategic theory needs to account for the fact that it is concerned with people that react, learn and anticipate, a characteristic Boyd in fact build his theory around. Students of social science have recognized that the persons and organizations with which the social sciences deal may be influenced by the scientific generalizations themselves. Thus once such a generalization has been formulated and has become known to the persons whose behavior it attempts to predict, those persons may react in ways different from their past behavior, the observation of which justified the generalization. Such generalizations, therefore, cannot have the scientific character that their

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[87] Bernard Brodie, 'The Continuing Relevance of *On War*', in Clausewitz, *On War,* p.53.

[88] Gray, *Modern Strategy,* p.82.

[89] In discussing the Clausewitzian "doctrine", Hugh Smith argues that Clausewitz notion of foreign policy presupposes a system of souvereign states. Furthermore this doctrine, which is normatively embedded in On War, includes the proposition that 'war is properly the business of states and their governments'; and 'war ought to be an instrument of policy, never and end in itself'. See Hugh Smith, 'The womb of war: Clausewitz and international politics', *Review of International Studies,* (1990), 16, pp.45, 55. Gray too observes that Clausewitz, by necessity, is a product of his time and regards war within a state-centric context. See Gray, *Modern Strategy,* pp.102-103.

[90] Sandole, pp.4-5.

[91] Cited in Sandole, p.6.

[92] Ibid, pp.9-11.

truth is independent of human beliefs and the influence of science on human affairs is somewhat paradoxical[93].

Luttwak employed this notion to good use when he observed that, precisely because a strategy worked once, it will likely be emulated or at least learned from, and subsequently strategist must devise new constructs and hypothesis that provide a plausible expectation for success[94]. Strategic theories arise after clashes of old views, in a somewhat Darwinian, or perhaps Kuhnian fashion; when promising ideas and propositions have been tried in battle, they elicit counter ideas negating the validity of formerly successful propositions. In similar fashion, the deterministic theory of nuclear strategy in the 20th Century, for instance, has given rise to strategic theories that uncover and emphasize the dynamic nature and processes of and in war, which in fact comes down to a rediscovery of the valuable work of von Clausewitz (and Boyd's work must be considered a similar response as well, as will be shown in the next chapter).

But even the general theory developed by Clausewitz generates its counter. Some authors point out that for some peoples and cultures war may have different purposes (symbolic, ritual or existential in stead of instrumental) and follow different rules, and may not be so linked and constrained by politics[95]. In other words, Clausewitz' work may be extremely important because of its intrinsic value and because it has shaped thinking about the nature of war and strategy, but it may also be constraining understanding precisely because it has become a paradigm, closing the eyes for the existence of other paradigms. In fact, one may argue that the current Western mode of thinking and waging war, which is founded on Clausewitzian principles, is giving rise to non-Clausewitzian styles of warfare, with obvious consequences for the state of strategic theory.

Kalevi Holsti, for instance points at the fundamentally different political processes in a large number of wars of the "Third Kind": 'most fundamentally, the assumption that the problem of war is primarily a problem of the relations between states has to be seriously questioned', because 'security between states in the Third World has become increasingly dependent upon security within those states. The problem of contemporary and future international politics is essentially a problem of domestic politics. The source of the problem is found in the nature of new states'[96]. Also the reasons for fighting cannot be understood within the nation-state framework: 'more fundamental is the clash over different conceptions of community and how these conceptions should be reflected in political arrangements and organizations[97].

What Holsti labeled "Wars of the Third Kind" Mary Kaldor considers "New Wars"[98]. She agrees with Holsti that "identity politics" is central: 'the exclusive claim to power on the basis of tribe, nation, clan or religious community. These identities are

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[93] Wright, pp.116-188. As will be discussed later, this notion was labelled "reflexive" by Anthony Giddens.

[94] Luttwak, *Strategy, the Logic of War and Peace* (Harvard University Press, Cambridge, Ma, 1987).

[95] This is the contested but nevertheless pertinent argument that Keegan, van Creveld and some others make. See for a concise discussion and refutation Christopher Bassford, 'John Keegan and the Grand Tradition of Trashing Clausewitz', *War and History*, Volume 1, No.3 (November 1994). For a recent study in military cultures which highlights the alternatives to the Western instrumentalist view of war, see for instance Christopher Coker, *Waging War Without Warriors, The Changing Culture of Military Conflict,* (IISS, London, 2002).

[96] Kalevi J. Holsti, *The State, War, and the State of War* (Cambridge University Press, Cambridge, 1996), pp.14, 15.

[97] Holsti, p.18.

[98] Kaldor, M., *New & Old Wars, Organized violence in a Global Era,* (Cambridge, 1999).

politically constituted'. Interestingly, war is not something that needs to be finished. These wars rage 'in regions where local production has declined and state revenues are very low, owing to widespread corruption'. In this context the warring states seek finance from external sources, Diaspora support, taxation of humanitarian aid and through negative redistribution of resources locally-looting, pillaging, enforcing unequal terms of trade through checkpoints and other restrictions, exhorting money, etc[99]. Moreover, 'all of these sources of finance depend on continued violence. The consequence is a set of predatory social relations that have a tendency to spread'[100]. Because the various warring parties share the aim of sowing fear and hatred, they operate in a way that is mutually re-enforcing, helping each other to create a climate of insecurity and suspicion'[101]. This echoes van Creveld's statement that 'there exists a sense in which war, more than any other human activity, can make sense only to the extent that it is experienced not as a means but as an end'[102].

Indeed, both agree with van Creveld that modern war is of intrastate nature in which the Western rules and conventions guiding and constraining the conduct of war do not apply at all. The distinction between combatant and non-combatant is irrelevant. Deliberately ignoring and destroying this distinction is an explicit part of strategy in these conflicts[103]. There are no fronts, no campaigns, no bases, no uniforms, no publicly displayed honors, and no respect for the territorial limits of states. In wars between communities as opposed to armies, everyone is automatically labeled a combatant merely by virtue of their identity. In wars of the third kind, the deadly game is played in every home, church, government office, school, highway and village[104].

Guerrilla and counter-insurgency doctrines are more applicable here where conventional battles of large armies are avoided. Military victory is not decisive, nor aimed at. Instead, territorial gains are aimed at through acquiring political power, not through military force. Weapons and methods to gain political power include ethnic cleansing, rape, assassination of key figures of the opponent, and terror[105]. Instead of conventional armies, the participants are irregular militant factions, terrorist groups and criminal organizations. 'This is a new age of warlordism' maintains Ralph Peters: 'paramilitary warriors-thugs whose talent for violence blossoms in civil war- defy legitimate governments and increasingly end up leading governments they have overturned'[106].

These wars are difficult to approach from the Clausewitzian paradigm, according to van Creveld: 'War as an instrument of state policy is a relatively new form of organized violence...the main purpose of the use of force in Europe for the past 350 years has been primarily to advance and/or protect the interests of the state. War has been political'. However, 'war as a continuation of politics by other means' does no longer apply 'when the stakes are highest and a community strains every sinew in a life and death struggle that the ordinary strategic terminology fails [...] to say that war is 'an instrument' serving the 'policy' of the community that 'wages' it is to stretch all three terms to the point of meaninglessness. Where the distinction between ends and means breaks down, even the idea of war fought 'for' something is only barely applicable. [...]war of this type [...] merges with policy, becomes

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[99] Mary Kaldor, 'Introduction', in Kaldor, M., ed., *Global Insecurity* (London, 2000), pp. 5-6.
[100] Kaldor, 'Introduction', pp.5-6.
[101] Kaldor, *New& Old Wars,* p.9.
[102] Martin van Creveld, *The Transformation of War* (New York, 1991), p.221.
[103] Van Creveld, p.202.
[104] Holsti, pp.36-39.
[105] Kaldor, *Global Insecurity*, p.6.
[106] Ralph Peters, 'The New Warrior Class', *Parameters,* Summer 1994, p.16.

policy, is policy'[107]. Subsequently, van Creveld warns, 'much of present day military power is simply irrelevant as an instrument for extending or defending political interest over much of the globe'[108].

Whereas this phenomenon occurs within these regions, and may not be the result of a counter to the Western concept of war and warfare, others point out in the discussion concerning asymmetric warfare that precisely because the West has been highly successful in a certain style of warfare, other countries or groups will not abide by those rules. Capturing UN observers during the crisis in Bosnia so as to paralyze NATO's bombing attacks can be seen as an example of such an asymmetric response. In stead of countering the West in the military dimension, actors (nations or others, such as warlord Aideed in Somalia) respond in the moral dimension[109].

One may not agree with van Creveld when he concludes *The Transformation of War* with the statement that 'should present trends continue, then the kind of war that is based on the division between government, army and people seems to be on its way out'. However, it is harder to disagree with the line in the same section where he posits that 'The nature of the entities by which war is made, the conventions by which it is surrounded, and the ends for which it is fought may change'. In reaction to the terrorist attacks of September 11, 2001 on New York and Washington authors such as Phillip Bobbit, John Lynn and Christopher Coker indeed make the argument that the West needs to reconceptualize war for the West's instrumental view of war is severely challenged by the clash with groups who experience war as existential[110].

With war and strategic behavior so fundamentally in flux, strategic theory cannot aspire for high standards of parsimony or general applicability and validity, nor one that holds out for a long period of time. Neither should one necessarily expect an all embracing theory to develop from the various partial theories, nor a theory with a high level of predictive capability, the standard of "hard science". Strategic theory falls squarely in the realm of political theory in that respect, where, as John Garnett asserts, even the possibility of a general theory is questioned because it rests on the assumption of some fixed underlying order, similar to the physical universe. In the social sciences, where chance and fortune are more evident, the notion of an underlying order waiting to be revealed is much less plausible; hence the idea of a general theory is questionable[111].

Indeed, what the discussion above reveals is that, in matters of war, even if an underlying pattern is discovered and some level of predictability established, the paradoxical nature of strategy guarantees that the pattern will be altered. If social theory differs from the

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[107] Van Creveld, p.142-143.

[108] Ibid, p.27.

[109] See for instance Byman, D., Kenneth Polak and Matthew Waxman, 'Coercing Saddam Hussein: Lessons from the Past', *Survival,* vol. 40, no.3, 1998, pp.127-51; Posen, B.R., 'The War for Kosovo; Serbia's Political-Military Strategy', *International Security,* Vol. 24, No. 4, 2000, pp.39-84; Arreguin-Toft, I., 'How the Weak Win; A Theory of Asymmetric Conflict', *International Security,* Vol. 26, No.1, 2001, pp.93-128; Scales, R.H., 'Adaptive Enemies: Dealing With the Strategic Threat after 2010', *Strategic Review,* vol.27, no.1, 1999, pp.5-14; Metz, S., 'Strategic Asymmetry', *Military Review,* July-August 2001, pp.23-31, Biddle, S., 'The Past as Prologue: Assessing Theories of Future Warfare', *Security Studies,* 8, no.1, 1998, pp.1-74; Dunlap, C.J., 'Technology: Recomplicating Moral Life for the Nation's Defender's', *Parameters,* Autumn, 1999, pp. 24-53.

[110] See John Lynn, *Battle, A History of Combat and Culture* (Westview Press, Boulder Colorado, 2003), in particular the Epilogue; Christopher Coker, *Waging War Without Warriors* (IISS, London, 2002); and Phillip Bobbit, *The Shield of Achilles* (Penguin, London, 2002), in particular Prologue and chapters 10-13.

[111] Garnett (1984), p.28.

model of theory posited by the natural sciences, strategic theory then may in some peoples eyes not deserve that label at all, and really these theories are more sets of propositions, hypotheses and models. In any case, this proves that not only making strategy is difficult, but that strategic theorizing is equally challenging, even daunting. The activities of a strategic theorist can perhaps be likened to the one who attempts to build a house on the muddy bank of a fast flowing river. The patch constantly changes form, depth, substance and location due to the turbulence of the river. Moreover, it shifts and deforms because of the construction activities. The very fact that one places a stone so as to construct a foundation alters the environment. So those who attempt to write a strategic theory, general or partial, should not be judged too hard if their theories do not live up to high standards of the "hard" sciences in terms of comprehensiveness, consistence, range of applicability and predictability.

How strategic theory develops: formative factors

Sources of inspiration and for understanding

Strategic theory takes it inspiration from many sources. Mintzberg's observation concerning strategic management literature that 'all kinds of fields make important contributions to our understanding of the strategy process' is equally relevant for military strategy. In addition to fields such as psychology on human cognition, political science on public policy making, military history on strategies in conflict, he illustrates how biology can be insightful (the analogy of adaptation of species for examining positioning strategies) and how quantum mechanics and chaos theory may provide insight into how organizations change[112]. Elsewhere he shows how schools in strategic management theory are informed by specific disciplines such as systems theory, cybernetics, anthropology and economics[113]. The applied nature of strategic management requires a multidimensional view, incorporating diverse complexities, rationalities and strategies. Certainly there is a danger of becoming too eclectic in an integrative effort, but the whole strategy field is multiparadigmatic by nature, as one author notes[114]. And this tendency to borrow from other disciplines has accelerated[115]. This is in line with modern social theory. As one sociologist remarks,

> Contemporary social theory is notable for drawing on extra-disciplinary resources…external intellectual influences have become priceless sources of theoretical innovations[116].

This also applies to strategic theory. As Quincy Wright stated long ago, the discipline [of the theory of war or the art of war] extends into science, history, and philosophy as well as practice. Insights for explanation and the formulation of advice may be sought in sociology, psychology, political science, economics, history, international law. All may assist in 'building

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[112] Mintzberg et al, pp.8-9.
[113] Quoted in Volberda, p.7.
[114] Regner, in Volberda, p.45.
[115] J.-C. Spender, 'Business Policy and Strategy as a Professional Field', in Volberda, p.39.
[116] Todd Stillman, 'Introduction: Metatheorizing Contemporary Social Theorists', in George Ritzer, *The Blackwell Companion to Major Contemporary Social Theorists* (Blackwell Publishing, Oxford, 2003), pp.4-5. See for a similar position also A. van Braam, *Filosofie van de Bestuurswetenschappen* (College Uitgevers, Amersfoort, 1992), in particular pp.39, 53-59, where he asserts that fields such as management theory and public administration theory are eclectic and multidisciplinary and should aspire no more than to establish itself firmely as an integrative science, with an ideal to become interdisciplinary.

of systems of thought which will guide the soldier, general, statesman, or citizen to appreciate the situation and to act so that victory may be won'[117].

This is indeed what Boyd did. Considering the nature of and method applied in Boyd's work, understanding his work, and appreciating it, will require an examination from a variety of angles, taking insights from a number of disciplines and bodies of knowledge. Boyd adopted a holistic multidisciplinary approach, and an awareness of his sources of inspiration is essential. The next three chapters therefor describe the various factors that influenced and shaped Boyd's work. Understanding the formative factors of Boyd's work will offer a conceptual lens through which to read, understand and appreciate Boyd's presentations and arguments. They shed light on the reasons why he developed his arguments the way he did, as well as the meaning of his statements.

As sociologist Todd Stillman observes on social theory and social theorists, understanding the context in which theories are formed is useful for assessing the strength and limitations of a theory. Theorists are influenced by both intellectual and social factors. These factors can be subdivided into factors internal to the discipline and factors external to the discipline. Internal intellectual factors include the influence of schools and traditions of thought on a theorist. This includes cognitive paradigms, changes in paradigms, and metatheoretical tool. External intellectual factors include ideas borrowed from other disciplines. Internal social factors include the influence of social networks on a theorist's work. External social factors include the impact of historical change on the structure and institutions of the society being theorized[118]. All of these influences can be traced in Boyd's work.

Recent studies into the formative factors of strategic theory too suggest that several but specific factors shape and explain the development of a certain theory of conflict in a particular period, in a particular country or by a specific author. Both Azar Gat and Avi Kober have highlighted how formative factors such as listed below influenced the development of strategic theory in a specific time[119]. Each one will briefly be discussed to clarify the dynamic.

- the nature of war during successive periods;
- the specific strategic circumstances of the countries involved;
- the personal and professional experience of the particular thinker;
- the intellectual and cultural climate of the period in question;

Experience, predecessors and pressing needs

The nature of war affected writers such as Clausewitz, Jomini, Mahan and Liddell Hart. Clausewitz and Jomini where deeply affected by the drift towards total war, a process that had started during the French Revolution and continued during the Napoleonic wars, and their thinking is dominated by the role of the masses in war[120]. The work of Jomini and Mahan reflect the growing emphasis on the logistic factor in modern war, fought between large armies which, in everything connected with armament, equipment and food and other

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[117] Wright, p.149.
[118] Stillman, in Ritzer, p.3.
[119] Avi Kober (1994), p.268. Actually he also states that the way lessons are learned affect military theory. However, Kober fails to show to what extend it is markedly different in its effect on theory making as compared to the more thoroughly discussed factor of the nature of war.
[120] Ibid, p.272.

supplies, depend upon large-scale support from the civilian rear, and much of their thinking is devoted to the relationship between the bases of operations and the lines of operations and logistics[121]. The works of Liddell Hart, Fuller, Douhet and Mitchell reflect the trauma of the First World War, the mechanization of the battlefield and the increasing and intensifying involvement of society in war, despite the fact that they develop different solutions to the problem of the vast destruction of modern war[122]. Jablonksi adds the naval warfare theorist Julian Corbett to this list[123]. The theorist of nuclear war where, of course, influenced by the instantaneous destruction of Hiroshima and Nagasaki.

Specific strategic circumstances of their home country also affect the formation of strategic theory of an author. Clausewitz' work is distinctly continental, reflecting both his experience and the Prussian geo-strategic predicament. Douhet did not conceal the fact that the formulation of his ideas with regard to defeating the enemy through aerial bombing of the civilian population and the industrial infrastructure was influenced by the strategic position of Italy. Mitchell addressed the vulnerability of the US for strategic bombardment[124]. Julian Corbett wrote in a period in which England "ruled the waves" as an imperialist power. Mao altered Marx' theory of revolutinary war to suit the Chinese agrarian society. Instead of Marx' proletariat, in the Chinese socio-economic context, for Mao the peasantry played a key role in the revolution and guerrilla warfare[125]. Even as recently as the 1990's, we can see how specific strategic circumstances can inspire strategic debate. The dilemma's of the ethnic wars in the Balkan led to a new search for the dynamics of coercive diplomacy can military strategies as part of that.

Personal experience is particularly evident is the works of Clausewitz and Jomini, who both took part in battles during the Napoleonic Wars, although that by itself does not explain the fundamental insights in the nature of war that Clausewitz in particular developed. The command experiences of Douhet en Mitchell and the didactic responsibilities of Corbett and Mahan have often been noted as important factors for explaining their work.

All of these factors combine in Azar Gat's comparison of Clausewitz and Liddell Hart. Despite differences in character and style, there are striking similarities in their approach to strategy. According to Gat, 'both thinkers reacted to cataclysmic and epoch-making wars which had resulted in a national trauma and profound intellectual transformation. In both, their experiences produced a violent reaction against past military theory and practice, held to be responsible for the disaster. Both advanced a new model of military theory, which they held universally valid and which involved an unhistorical approach to the special conditions that had determined the pattern of the past. Both were not just 'idly theorizing' but developed and preached their ideas out of consuming commitment to their countries' future'[126]. This description could equally be applied to John Boyd. Boyd's work comprises a specific intellectual response to the military problems of the US armed forces in the immediate aftermath of the Vietnam War and his arguments are colored by this predicament in the sense that he aimed to change a specific mindset and a doctrine that, in his view, was dysfunctional.

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121 Ibid, p.273.
122 Ibid.
123 David Jablonsky, *Roots of Strategy, Book 4,* (Stackpole Books, Mechanicsburg, Pa, 1999).
124 Ibid, p.22
125 Kober, p.276.
126 Azar Gat, *Fascist and Liberal Visions of War,* (Oxford, Clarendon Press, 1998), p.175.

Science and Strategic Theory

Dominant scientific currents can, as part of a *Zeitgeist*, have a significant impact on the formulation of military theory. Strategic theory is the result of a dialectic process, as Azar Gat explains:

> New and significant intellectual constructions usually emerge at times of historical challenges, fundamental change or paradigmatic shifts, when prevailing ways of interpreting and coping with reality no longer seem adequate. They express human efforts to come to grips with new developments and integrate them within meaningful frameworks. Rather then being alone in their views, the thinkers who generate them usually make their names by early sensing, conceptualizing, and turning into philosophical and political programmes the feelings and notions which are then beginning to emerge, more or less hazily, around them. The edifices thus created then dominate until they themselves are rendered inadequate by new paradigmatic changes[127].

Although Gat, together with Kober, in line with Stillman, point at the cultural and intellectual climate that acts as a source of ideas, viewpoints and methods, it is nevertheless a generally understudied and ill-appreciated influence on military theory, in contrast to the ones discussed in the previous chapter. That warrants a proper introduction on this formative factor, especially in light of the fact that that Boyd's work is strongly influenced by scientific insights, as he himself admits in the *Abstract* of *A Discourse*. Another motivation for a detailed introduction of the relation between science and strategy lies in the argument that not a small part of Boyd contribution to strategic theory may lie in exactly his introduction of the language of (then) novel scientific concepts into the study of strategy and formulation of doctrine.

Both Gat and Kober agree that nineteenth century military thought was 'dominated by two contending conceptions of the nature of military theory, formulated during the age of Enlightenment and the Romantic period, in the eighteenth and early nineteenth century respectively. Broadly defined, they represent the two fundamental positions towards the study of man and human institutions which emerged in the wake of the scientific revolution of the seventeenth century. One of these looked to the exact and natural sciences as a model to be adopted and applied. The other, by contrast, maintained that the humanities were different in nature from the sciences and could never be studied by the same methods'[128].

Modern views on the nature of military theory originated from the most intensely philosophical period in European history. They were formed in response to the all-pervasive, epoch-making, and bitterly conflicting intellectual climates of the Enlightenment on the one hand, and Counter-Enlightenment or Romanticism on the other. The very idea that something called military theory existed was the product of the intellectual gospel of the Enlightenment. Stimulated by the spectacular successes of the natural sciences, the men of the Enlightenment sought to bring everything under the domination of reason by creating orderly sciences and disciplines in all spheres of human endeavor. Dominating Europe from the middle of the eighteenth century, the military school of the Enlightenment was burning with an overriding sense of vocation to form a universal theory of war, based on immutable rules and principles, systematically taught, and applied to changing circumstances by the general's creative genius.

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[127] Gat (1998), p.306.
[128] Ibid, pp. vii, viii.

The ideal of Newtonian science excited the military thinkers of the enlightenment and gave rise to an ever-present yearning to infuse the study of war with the maximum mathematical precision and certainty possible. Indeed, the military thinkers of the Enlightenment maintained that the art of war was also susceptible to the systematic formulation, based on rules and principles of universal validity, which had been revealed in the campaigns of the great military leaders of history[129]. Hence it was Jomini who won fame by updating the theoretical outlook of the Enlightenment to produce a striking schematization of Napoleon's aggressive rationale of operations.

By the turn of the century, however, a new sweeping intellectual movement, largely hostile to the ideas of the Enlightenment, was emerging throughout Europe. The Romantics stressed the complexity and diversity of human reality, which could not be reduced to abstract formulas and which was dominated by emotions, creativity, and the historic conditions of each period. It was in this framework that a new outlook on the nature of military theory was formed in the works of writers such as Clausewitz, breaching the hitherto absolute hegemony of the military school of the Enlightenment[130]. Clausewitz did not abandon the Newtonian approach to studying war. Clausewitz was a "Social Newtonian" in his methodology in the sense that to Newton 'phenomena are the data of experience'[131]. And Clausewitz deliberately inserted Newtonian, mechanistic, metaphors in his work such as the concepts of friction and center of gravity. Yet he recognized that the social world differs from the natural world. Science for Clausewitz is a sociology of science that treats social phenomena. A science that analyses social facts and social processes is a science of human activities, not a science of the elements of nature or solar activities[132]. Behavior in war does not evolve according to a mathematical construction. Hence Clausewitz' emphasis on the interactive nature of war, the influence of the dialectic of wills, the importance of experience, fear, emotion, intuition, etc.

The ideas of both Jomini and Clausewitz could only take root and flourish where they found the climate of ideas favorable[133]. Romanticism found its zenith in German literature, philosophy form the late 1810s to the 1830s, exerting a profound and lasting influence even on the intellectual opponents of the movement. By the 1840s, however, the tide of Romanticism was ebbing throughout Europe, and it was the descendants of the Enlightenment who dominated the mid-century. Favored by a remarkable scientific and technological advance, which spread the culture of science, positivism, in its broadest sense, became the prevalent *état d'esprit.* The progressive application of the scientific methods of observation and induction to the more complex sciences of man and society would elevate these disciplines too from their state of infancy. This climate of ideas was favorable to the theoretical legacy of the military school of the Enlightenment[134].

Science then works not necessarily in a direct manner on military theory, although it might of course, as it was in the cases of Clausewitz and Jomini. But in general 'it was not that soldiers in the nineteenth century were either very interested in, or knowledgeable about,

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[129] Gat, *The Origins of Military Thought* (Oxford, 1989), p.25.

[130] Gat, *The Development of Military Thought: The Nineteenth Century*, (Clarendon Press, Oxford, 1992), p.1. See also Gat, *A History of Military Thought, From the Enlightenment to the Cold War* (Oxford University Press, Oxford, 2001), Book I, pp.141-151 for a short discussion of the shifting intellectual *Zeitgeist* which occurred around 1800.

[131] Amos Perlmutter, 'Carl von Clausewitz, Enlightement Philosopher: A Comparative Analysis', *The Journal of Strategic Studies,* Volume 11, March 1988, number 12, p.16.

[132] Ibid, p.12.

[133] Gat (1992), p.2.

[134] Ibid.

the major intellectual currents that dominated their times, although most military thinkers - by nature people of intellectual inclination - were remarkable conscious of them […] military outlook was in some important respects almost predetermined by the prevailing cultural perspectives[135].

In the same vein as Azar Gat, Pellegrini argues that one also needs to look at the broad scientific climate, the prevailing scientific paradigm or the popular perception of 'new" or "fashionable" scientific insights and concepts of the day, as part of the *Zeitgeist*[136]. These provide metaphors for expression, new ideas and concepts for analysis and explanation and sometimes novel insights for discovering new patterns of causality. In *On War* the influence of science and philosophy becomes manifest in several guises: the use of scientific metaphors; the use of a scientific framework for investigation; and the use of concepts he derived from science and adapted to military theory. The Newtonian paradigm and the cultural dominance of the mechanistic view of the world appear in metaphors Clausewitz employs to describe the nature of war. His idea of the trinity of people, the army and the government, exert an influence on war like an object suspended between three magnets[137]. Other such scientific phenomena appear such as fulcrum, pendulums, polarity, electricity and of course, friction and center of gravity[138]. Throughout the entire book, indirect references to Newton's laws of motion were used both as a concept and as a metaphor to describe the interaction between armies.

Considering Clausewitz's intended audience these metaphors were useful since they quickly describe the nature of the concepts he was attempting to show. However, they went beyond mere superficial similarities to describe the action taking place. In that Newton's laws of motion and Newtonian science were used throughout the entire 18th century, to describe all forms of human endeavor, the use of these metaphors were appropriate. Clausewitz was, moreover, describing the use of force. The act of war was considered an application of force, *violence*, and this force was subject to the same factors as the force described in Newton's laws of motion: inertia, momentum, resistance, and friction. Force is the unifying theme for both Newton and Clausewitz[139]. Essentially, the book described the use of force under different conditions and at different levels. It showed what factors inhibit the use of force and keep real war from being absolute war. Like Newton, Clausewitz felt the need to postulate an absolute form of the phenomenon he was investigating as a fixed reference point in order to allow him to describe real war, and to uncover those factors that make real war different from absolute war: friction, chance and uncertainty.

And it is in explaining these things that separate real from absolute war that Clausewitz had to refer to the nature of man, and not science. This is also where his critique

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[135] Ibid, pp.2, 3. See also Peter Paret, who argues that Clausewitz used concepts learned from other writers, together with ideas that were the common property of his generation. Both in method and in terminology he was influenced by the philosophers of the Enlightenment and of German idealism. Such thinkers as Kant, Herder, and Fichte inspired him not only directly through their works but also through the filter of German historical writings that was influenced by them. Paret writes that Clausewitz, like other Germans of his class, attended lectures on logic, ethics, and science as well as reading nonprofessional articles on philosophy. See Peter Paret, *Clausewitz and the State* (New York, 1976), p.84.

[136] Robert P. Pellegrini, *The Links Between Science and Philosophy and Military Theory, Understanding the Past; Implications for the Future,* Master Thesis, SAAS, (Maxwell AFB, Alabama, June, 1995), p.33. This study was later published as a monograph by Air University Press, August 1997

[137] Clausewitz (1976), p.89.

[138] Pellegrini, p.37.

[139] Ibid, p.39.

on Jomini springs from, and his reference to Kantian philosophy begins[140]: in war not only physical forces are active, but also moral forces. The most pervasive Kantian concept in *On War* is that the universe (and, therefore, war) had to be described in both the physical and moral domains. The effects of fear, courage, and uncertainty are fundamental for explaining the dynamic of war, but Newtonian science and the Enlightenment philosophies were poorly equipped to illuminate such concepts[141]. Since it was man's moral domain that most often produced uncertainties about the physical aspects of war, it was what made war more difficult and more problematic. Thus, by combining one framework that was able to describe the physical aspects of war with another framework that was best able to describe the moral aspects of war based on the nature of man, he was able to describe what he felt was the true nature of the phenomenon of war. Other examples include J.F.C Fuller's work which was explicitly inspired by an ideal to do for military science what Newton did for physics. Moreover, his outlook towards international relations and war was explicitly based on the social-Darwinist philosophy of Herbert Spencer.

But science can also play a less obvious, but nevertheless equally influential, even detrimental role. In another study on the relation between philosophy, science and military theory (and foreshadowing the advances in Chaos and Complexity theory and their application to the social world) Barry Watts argues strongly that military theorists better take heed of their implicit scientific assumptions. He shows how implicit and explicit deterministic reasoning and analysis lay at heart of some of the strategic errors in practice and in theory that occurred in the latter half of the 20th Century. After an examination of strategic theory and practice, in particular in the field of strategic application of air power and nuclear warfare, he blames 'Laplacian determinism', construed as a dominant deterministic *Weltanschauung* adopted by physicist in the century following Newton's death[142]. Laplace established that the solar system was stable and completely determined by physical laws, hence entirely predictable.

From Mitchell's *Winged Defense* through Brodie's *Strategy in the Missile Age*, mainstream US air power theorists largely overlooked friction, which is to say the collective factors that distinguish real war from war on paper[143]. Referring to the planning and execution of the Combined Bomber Offensive (CBO) during World War II he states that American airmen have tended to be overzealous in their enthusiasm for pet formulas and engineering-type of calculations, ignoring historical contradictory facts and assuming a static opponent. Not only were the CBO plan's predictions concerning bombing effects offered with the quantitative precision of a physical science, they were expressly portrayed as effects that would occur if the requisite bombing forces were made available. The thinking behind the planning was mechanistic in the specific sense of not getting involved in the action-reaction typical of combat between land armies[144]. He claims that contemporary thought concerning nuclear strategy was similarly infatuated with calculations and formulas.

Watts points out that instead of such a Laplacian *Weltanschauung*, military theory should be based on the assumption that uncertainty is inherent in the physical and social world, and unsolvable. He favors a more organic image of war in which human nature and behavior in war forms the foundation for military theory[145]. The Clausewitzian concept of

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[140] Ibid, p.41.
[141] Ibid, p.45.
[142] Barry Watts, *The Foundations of US Air Doctrine, the Problem of Friction in War* (Air University Press, Maxwell AFB, Alabama), 1984, p.106.
[143] Ibid, p.105.
[144] Ibid, p.108.
[145] ibid, p.116.

friction, which is infused with the notion of unpredictability and uncertainty stemming from the interactive nature of strategy and battle, and from the limits of human cognition, should be at the heart of it[146]. In fact, enhancing friction in the opponent's system is considered a prime stratagem[147]. He bolsters his argument with referring to Albert Einstein, Werner Heisenberg, Kurt Gödel and Claude Shannon who laid the physical and mathematical foundation for the philosophical insight that human knowledge is limited by definition[148]. All information is imperfect. There is no absolute knowledge, he quotes Jacob Bronowski, an author whose work Boyd too had studied[149].

With an eye on contemporary scientific developments, and with direct reference to the work of John Boyd, Pellegrini expects that the shift from the Newtonian framework of cause and effect determinism to the new science concept of probabilities and trends (as embedded in chaos and complexity theory), as well as the shift from the force of heavy mechanics to the new particle wave theories of force, will change man's concept of the battlefield, emphasizing the capability for rapid observation and action[150]. While the Newton's metaphor of the "Majestic Clockwork" may have influenced military theory during large parts of the past 200 years, this model was seriously undermined by the discovery of quantum mechanics and the Special and General Laws of Physics that show that man's understanding of the universe will always be incomplete and tenuous. Work in biology (especially DNA and the workings of the human brain), artificial intelligence and Chaos and Complexity Theory now suggest, according to Pellegrini, that the world is composed of complex systems which interact with, and adapt to, each other making it even more difficult to obtain knowledge about how the universe functions[151]. In that, Pellegrini nicely captured the essence of the scientific *Zeitgeist* during which Boyd developed his ideas.

The formative factors of Boyd's *A Discourse*

Thus, science and philosophy provide frameworks for investigation and systems of knowledge for the military theorist, consciously as well as unconsciously, alongside factors such as experience and organizational context of a strategist. This leads to the subject and structure of the next three chapters in which the following four categories of influences that can be discerned in Boyd's work will be addressed:

- Boyd's professional background;
- The strategic and defense-political context of the US in the period in which Boyd developed his ideas;
- Boyd's study of military theory and history;
- Boyd's keen and evolving interest in scientific developments and the scientific *Zeitgeist* during which he developed his ideas on military strategy.

All four will be explored in some detail, for a premise of this study is that understanding Boyd requires awareness about his formative factors, in particular in light of the fact that one

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146 ibid. p.119, 121.
147 Ibid, p.120.
148 This is not incidentally similar to Boyd's use of these scientists. Watts was thoroughly familiar with Boyd's work and actually cites Boyd and the OODA cylce in his endnotes, see pp. 127. In fact he extend his appreciation to Boyd for assisting him in completing the book.
149 Ibid, p.109.
150 Ibid, p.iii.
151 Ibid, p.8.

has to rely on only his presentations. Understanding the formative factors will provide a conceptual lens to read and interpret Boyd's work with, in particular the awareness of the intellectual and cultural climate of the period. This factor – the scientific *Zeitgeist* or Boyd's intellectual environment and background - is addressed in Chapters 4 and 5, while the next chapter deals with the more traditional and self-explanatory formative factors; Boyd's professional experience, military history, including existing strategic theory, and the strategic and defense-political context of the US in the seventies and eighties, which may be considered as the seeds from which his strategic theory sprang and as the soil in which the seeds were growing.

3. THE SEEDS OF A THEORY AND THE FERTILE SOIL

He who can handle the quickest rate of change survives
John Boyd[1]

There is no such thing as a logical method of having new ideas. Discovery contains an irrational element or a creative intuition.
Karl Popper[2]

The seed of a theory; Boyd's military life

Flying fighters

The OODA loop now is so familiar - it has become a truism - that one has a hard time understanding why it was novel to the various audiences Boyd lectured for when the concept was presented in the seventies and eighties and why it was considered so relevant so as to become so influential as suggested in chapter 1. But the OODA loop construct did not just appear in a flash of insight. Boyd developed it through studying, analyzing and synthesizing, in short, through learning about military history and theory. It was a thoroughly creative process, which (besides his interest in science, the topic of chapters 4 and 5) has its roots in his early career, his involvement with the design of fighter aircraft and his interest in military history that followed from research projects asociated with designing fighters. His ideas flowered because of the fertile soil Boyd found when he developed his thoughts in increasingly coherent form. These three factors will in turn be addressed in this chapter.

As is evident from the chronology of key dates and events below, Boyd's ideas materialized over the span of several decades and gained coherent conceptual form only after his retirement in 1975[3]. Two decades separate his first and last presentation. The years following his retirement were marked by the aftershocks of the Vietnam War, which were felt throughout the US armed forces. But his formative period began with flying fighters in the US Air Force. His military career started in 1945, when at age 18, he enlisted in the Army and served in the occupation of Japan. Shortly after getting out of the Army, Boyd attended the University of Iowa on the GI Bill and enrolled in Air Force ROTC. In 1952, after graduating from college, Boyd attended Air Force pilot training at Williams Air Force Base in Arizona. There air-to-air combat was an eye-opener and he managed to persuade his commander to change his posting from flying bomber aircraft to fighters. In the Winter of 1952-1953 was subsequently assigned to Korea with the 51st Fighter Interceptor Wing, which operated the F-86 Sabre.

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[1] Final slide of *A New Conception of Air to Air Combat*, August 4, 1976.
[2] Karl Popper, *The Logic of Scientific Discovery*, (New York, 1968), p. 32.
[3] This list is based on Cowan, pp. 29-30, and Hammond, p.155.

1927 Born in Erie, Pennsylvania
1946 Drafted into the US Army, served with occupation forces in Japan
1952 Attended USAF pilot training at Williams Air Force Base, Arizona
1953 Flew 22 combat sorties in the F-86 Sabre in the 51st Fighter Interceptor Wing during the Korean War
1954 Attended the Fighter Weapons School Instructor Course and remained as an instructor at the school
1957 Published 1st article on air combat in the Fighter Weapons School Newsletter
1960 Aerial Attack Study is published for the first time
1961 Attended Georgia Tech University, received B.S. Industrial Engineering, in 1962
1962 Stationed at Eglin AFB, Florida as an engineer. Developed concepts of Energy Maneuverability
1966 Sent to Pentagon to begin work on the FX fighter project, which would become the F-15 Eagle
1970-1975 Worked in the Office of the Secretary of Defense (OSD). Began work in the Reform Movement. Retired from active duty in 1975
1975 continued working as a civilian in OSD. Began studying and writing about conflict and warfare
1976 completes *New conception for Air-to-Air Combat*
1976 First draft of *Destruction and Creation* completed
1977 First draft of *Patterns of Conflict* completed
1982 First draft *Organic Designs for Command and Control* completed
1986 First draft of *The Strategic Game of ? and ?* completed
1987 Final versions of *Organic Designs for Command and Control* and *The Strategic Game of ? and ?* complete
1987 widespread dissemination of *A Discourse on Winning and Losing,* which includes previous works
1992 *Conceptual Spiral* completed and added to *A Discourse*
1995 *The Essence of Winning and Losing (The Big Sqeeze)* completed
1997 Colonel Boyd died March 9

According to Hammond, what Boyd learned and did there constituted the basis for nearly everything he thought and did later. It was a truly transformational experience and provided the foundation for all of his later contributions, not only in air-to-air tactics, energy maneuverability, and aircraft design but also in his development of OODA loops, his thinking on strategy and maneuver warfare, and ultimately his thought on time and thinking itself[4].

What intrigued him was that despite flying in F-86 aircraft with a lower ceiling, a wider turn radius and slower maximum speed than its rival, the Russian Mig-15, the kill ratio was 10:1 in favor of the F-86 during the Korean War. Varying quality of training on both sides affected this ratio with US training level far exceeding that of the North Korean pilots. Still, this could not explain all, if for no other anomaly that de North-Koreans often achieved numerical superiority during air-to-air combat. What also contributed was the bubble canopy of the F-86, which provided a distinct advantage over the constrained view offered by the Mig-15 canopy in visually detecting enemy aircraft. But Boyd was convinced another element was at play as well, a question he took with him to the next position, together with his considerable tactical prowess, 'the guts of his real education'[5].

Boyd was assigned to the USAF Fighter Weapons School at Nellis Air Force Base near Las Vegas first as a student, and following graduation, as a fighter weapons ad tactics instructor. This school focused on air-to-ground and air-to-air gunnery. Air combat tactics was a neglected subject, something Boyd corrected immediately. In the capacity of tactics instructor he acquired the reputation of "40 second Boyd" which amounted to a bet that he could beat any pilot within 40 seconds in a 1 versus 1 air combat set up, a bet he usually won. More importantly he trusted his insights on tactics on paper, publishing several articles in the professional journal of the Fighter Weapons School.

[4] Hammond, p.35.
[5] Ibid, p.39.

Slowly his writings matured. In 1960, at the age of 33, he published what is still considered the encyclopedia on air-to-air combat; *Aerial Attack Study*. In 147 pages it details every maneuver possible, in words and graphic illustrations, for a pilot to use in a dogfight. An important feature of it was that Boyd did not advocate one maneuver over another but it represented the options available to the pilot and his opponent in relation to each other. He wanted to show people a variety of moves and countermoves to have in a repertoire. Its content became part of an official Air Force Manual on air-to-air tactics and was disseminated through official and informal channels to other services in time for good use during the Vietnam War. Not one new maneuver has been added since, illustrating the comprehensiveness of Boyd's effort and subsequently this publication, in various guises still forms the basis in all jet air forces today[6]. Thus, he changed the nature of the premier air tactics school of the US Air Force.

In the Summer of 1960 he moved to Atlanta, Georgia, to get a degree in industrial engineering at Georgia Tech. At Nellis he became aware that, if he wanted to make further headway with the discoveries he had made, he needed to expand his intellectual tool kit with knowledge on mathematics. Industrial engineering would add physics, production lines, thermodynamics, and other fields. At Georgia Tech his interest lay not in the mathematical details, but in the underlying concepts. Here he developed the taste for synthesis. And this resulted in another remarkable and very important contribution to air combat, an insight that brought him back to the question concerning the relative excellence of the F-86 in Korea.

At Georgia Tech Boyd wrestled with the study of thermodynamics. Thermodynamics concerns the study of energy. The Second Law of Thermodynamics is called the law of entropy, and postulates that in a closed system the transfer of heat (energy) goes in one direction, from a high temperature to a low temperature. If two separate volumes of water, one with high and one with low temperature, are mixed, the highly ordered states of the separate volumes disappear and are replaced by a less ordered state. The temperature changes until the temperature across the entire system is uniform, and it is non-reversible. The entropy in the system has increased. The system has moved from order to disorder. In engineering the concept refers to the fact that more usable energy always goes into the system than comes out. No system is 100% effective[7].

Using the insight from thermodynamics he discovered he could explain air-to-air combat in terms of energy relationships, in which altitude is potential energy to be traded for speed - kinetic energy - and vise versa. Turns became energy consuming maneuvers, with the rate of consumption depending on the number of g-forces of the turn, and engine power an energy provider for gaining altitude, gaining speed or sustaining a turn, or a combination of these. These relationships could be expressed in calculable equations and the outcomes could be plotted in graphs displaying energy/maneuverability characteristics of a fighter. The values at various points form the 'flight envelope' of an aircraft. By overlaying and comparing such graphs of different fighters the speed/altitude areas of relative advantage became immediately obvious. Moreover, it would provide invaluable information for aircraft designers for they could see under what conditions where, when and how an aircraft could gain an advantage. It was 'as fundamental and as significant to aviation as Newton was to physics', Coram rightly notes[8].

This was a brilliant and novel insight, if still only in theory. However it required expensive computer time to make calculations and explore this insight. He managed to

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[6] Hammond, pp.44, 46-47; Cowan, pp.11-12.

[7] See Coram, pp.127-134 for an anecdotal account of the way Boyd gained this insight and made the analogy to air combat.

[8] Ibid, p.127.

graduate in 1962 and get a posting to Eglin Air Force Base in Florida, where the USAF System Command was located, which houses extensive computing capacity. Thus he could continue his research, albeit covertly, as his project was not endorsed officially by the USAF. This resulted in energy maneuverability theory, or EM theory.

EM theory revolutionized fighter design and caused some stir on the sides when first comparisons of US and latest generation Soviet fighters indicated that the latter (Mig-17, Mig-19 and Mig-21) possessed superior energy-maneuverability characteristics. EM was truly revolutionary. It provided dynamic rather than static analysis pictures of aircraft performances across a range of altitudes, g forces, and turning radii and gave a scorecard of its maneuver capabilities. But it offered not only a tool for assessment, but also design parameters in the development of tactics and doctrine for air combat engagements. His accomplishments were honored with the Air Force Systems Command Scientific Achievement Award. Not surprisingly this work led to a position at the Pentagon where people were having problems with the new FX fighter program[9].

Designing fighters

Boyd left Eglin in the Fall of 1966 and was assigned to the Operational Requirements Team in the office of the Deputy for Research and Development at US Air Force Headquarters in the Pentagon. With only a brief interruption for service in Southeast Asia in 1972-1973, it would be Boyd's home for the next 22 years. At the Pentagon he was assigned to work on the design of the next-generation air superiority fighter for the Air Force; the FX project. The latest dedicated air superiority fighter within the USAF inventory had been the F-86 of Korean War fame. Since then fighter aircraft had become more complex, more expensive, heavier and less maneuverable. The result was a range of fighters able to conduct offensive air support missions while still possessing some air combat capabilities, but in dogfights these aircraft lost out to latest generation Soviet dedicated air superiority fighters. While loss ratios over Korea were 10:1, in the skies over Vietnam F-100, F-105 and F-4 aircraft scored dismal ratios of 1:1, sometimes peaking at 2.4:1.

Several factors contributed to this. There were doctrinal faults. North Vietnamese air bases were off limits, violating the doctrinal tenet that air superiority is a sine qua non for offensive operations against other targets. Predictable tactics and flying corridors exacerbated the problem. The faith in air-to-air missiles proved premature. Evasive maneuvers to escape from interception by Surface to Air Missiles were not taught. US units and technological performance improved over time. However, the structural design problems affecting fighter maneuverability could of course not be solved. This applied in particular to the backbone of the US air units in the latter phase of the Vietnam War, the F-4. This was a robust but very heavy fighter-bomber designed originally for operating from carrier flight decks. In addition its visibility was poor. The US Air Force required a new and better air superiority aircraft.

This was to be delivered by the FX project. The FX followed after the F-111 debacle. The F-111 project sprang from the need to marry to operational requirements of both the US Navy for a fighter aircraft and the USAF requirement for a replacement for the F-105 long range strike aircraft. This flawed plan emanated from the office of then secretary of Defense McNamara, who aimed to achieve economies of scale similar to his experience at the Ford Motor Company. The result was the F-111A attack version with acceptable performances, and a disastrous F-111B fighter, a program which was subsequently canceled. However, the FX too promised to be a heavy fighter with a complex swing wing lay out.

[9] See Hammond, pp.52-61 and Cowan pp.12-13.

This situation also reflected the dominance of the "bomber community" within the US Air Force. Within the context of the Cold War during the fifties and sixties, strategic bombing was the prime role of the US Air Force. This thinking was also applied to gaining air superiority, which was to be achieved by bombing enemy air bases. Tactical air power was a neglected subject and tactical air units were not considered to core business of the USAF.

When Boyd entered this project he carried out EM tests and began questioning the swing-wing advantages in light of the structural and weight design penalties. He rejected the FX proposal and, together with technical expert went on the look for options to reduce the weight while increasing its maneuverability. What Boyd and some others around him aimed for was keeping costs down while ensuring maximum relevant performance vis à vis current Soviet counterparts. To accomplish this it was necessary to omit all subsystems not absolutely essential to the mission, to resist the temptation to use unproved advanced technology and to eliminate the requirements for complex avionics, high top speeds, and excessive ranges[10].

Their case was strengthened by the presence of a group of former fighter aces from World War II and the Korean War whom had now achieved general officers rank, and who, in 1965, had drafted a paper underscoring the need for a an air superiority fighter, not a multi-mission hybrid. This went against the grain of conventional wisdom within the USAF. With high level backing Boyd and a number of other mid-level military and civilian technical experts within the Pentagon transformed the USAF approach to air superiority between 1966 and 1972[11]. What assisted them also was the rude shock of the 1967 Domodovedo Air Show in Moscow where the soviets showcased their latest generation of combat aircraft (the Mig-23, Mig-25 and Mig-27). By 1968 it had become official policy that the USAF needed a first line tactical fighter that was designed primarily for air to air combat.

Boyd's continued efforts and his EM concept in no small measure contributed to the subsequent development of the F-15 fighter with excellent performances. In fact, various sources acknowledge that no one else had as much to do with the definition of the F-15 as Boyd. However, still unsatisfied with the high costs and still less than optimum performance due to seemingly unavoidable design compromises resulting in weight increases, Boyd and a few others from within the Pentagon and industry, a group dubbed 'the Fighter Mafia', decided an even lighter and less complex aircraft would give the air superiority capabilities sought after.

Central in this effort was the notion of "agility", a concept later to emerge in Boyd's work on strategy. With EM theory Boyd proved the F-86 advantage in Korea was in particular due to its ability to transition from one maneuver to another faster than the Mig-15. The notion of fast transient maneuvering as the key to winning was to remain with Boyd when he developed his thoughts on military success in general. For now, using EM theory he could show that superior maneuvrering capability, combined with better training and cockpit design offering an advantage in time and superior "situational awareness" mitigated the Mig-15 speed and turn advantage. The new light weight fighter would have unprecedented capability for "fast transients" in addition to a high thrust to weight ratio which would produce the required energy maneuverability.

Despite USAF reluctance and without official backing the fighter mafia designed an "austere fighter", the F-XX, and presented their case to various Pentagon officials. His

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[10] Coram deals extensively with Boyd's involvement in the design of the F-15 and the F-16 in Part II, pp. 123-256.

[11] Richard P. Hallion, *Storm over Iraq, Air Power and the Gulf War*, (Smithsonian Institute Press, Washington D.C.), 1992, p.38. This section is derived from Hallion, pp. 27-54, Cowan, pp.13-15 and Hammond, pp.67-100. All attest to Boyd's immense influence.

involvement with fighter development did not end with Boyd's short assignment to Thailand from April 1972-April 1973. The bureaucratic processes behind these programs have been discussed elsewhere in detail[12]. Suffice here to conclude that the end result was a Light Weight Fighter fly-off competition between the YF-16 and YF-17 (later to develop into the F-18), fighters with unsurpassed maneuverability, excellent visibility, high acceleration and sustained turning capability and relatively low costs. These types have proved their worth in the inventories in most Western air forces.

The last design Boyd had an influence on was the A-10, and, interestingly, his involvement with the A-10 development would influence Boyd for it was one of two projects that induced him to study military history. The A-10 was designed for Close Air Support and killing tanks, an entirely different mission than gaining air superiority. CAS missions normally are flown close to the ground and over the frontline. Subsequently, CAS aircraft are exposed to intense ground to air threat. When invited to look at the project by a close colleague, Boyd subsequently needed to develop a new set of trade-off studies and design parameters. German World War II experts were interviewed to learn about German tactics, the time required to detect and attack ground targets and the maximum time available for aiming and delivering ordnance before air defense systems were cued for effective engagement of the attacking aircraft. This exposed him to the need to look into the history of Close Air Support and air-ground coordination, and German military tactics and strategy of World War II in general[13]. The A-10 too, proved its worth, most notably during Operation Desert Storm where it demonstrated an awesome capability for taking out tanks combined with the ability to absorb considerable damage.

From Air Combat to a general theory of war

From this research he discovered that grasping the essentials of military victory required a thorough reading through military history. In a time that more air force officers could quote Peter Drucker than Clausewitz, Boyd climbed inside the minds of every theoretician from 400 B.C. to the present[14]. Out of this forray into military history the first sketches of *Patterns of Conflict* emerged the first draft of which would be ready in 1977. In it he makes a seemingly radical and perhaps unwarranted jump from air combat to operational art. The transition from air combat theory to strategic theory occurred in 1975 when he started working on a presentation titled *A New conception for Air to Air Combat*, while working on *Patterns of Conflict* and *Destruction and Creation* simultaneously. While *A New conception for Air to Air Combat* is not included in *A Discourse*, it is the stepping stone between two periods. In it he combines insights he had already developed in his research for *Destruction and Creation* with his knowledge of air-to-air combat, and the suggestions he advances here are directly incorporated in *Patterns of Conflict*, the briefing that was going to form the main body of *A Discourse* together with *Destruction and Creation*.

A New conception for Air to Air Combat was produced because of a request by NASA. On August 4, 1976 he finished this research. In it he looks again at the issue of maneuverability due to the fact that in the fly-off competition the YF-16 had unexpectedly dramatically outperformed the YF-18 while EM diagrams had predicted a close contest. Test pilots however lauded the YF-16 capability for sudden very tight "buttonhook turns" (albeit

[12] See Hammond and Hallion for instance.
[13] Hammond, pp.121-123.
[14] Burton, pp.46, 49.

at the cost of airspeed depletion) which brought them inside the turn circle of the YF-18 while still being able to gain energy and maintain high turn rates even at low speeds.

Maneuverability is defined as the 'ability to change altitude, airspeed and direction in any combination'. His develops the insight that in air-to-air combat, one needs 'a fighter that can be used to initiate and control engagement opportunities -yet has a fast transient ("natural hook") that can be used to either force an overshoot by an attacker or to stay inside a hard turning defender'[15]. From this insight he expands the idea and formulates the suggestion that:

> in order to win or gain superiority - we should operate at a faster tempo than our adversaries or inside our adversaries time scales…such activity will make us appear ambiguous (non predictable) thereby generate confusion and disorder among our adversaries.

He adds that these suggestions are in accordance with 'Gödel's Proof, The Heisenberg Principle and the Second Law of Thermodynamics', ideas central to *Destruction and Creation*[16]. These ideas posit, according to Boyd, that 'we cannot determine the character and nature of a system within itself and efforts to do so will only generate confusion and disorder'[17]. Thus, he continues while making the giant leap from air-to-air combat to warfare in general:

> Fast transients (faster tempo) together with synthesis associated with Gödel, Heisenberg, and the Second Law suggest a New Conception for Air-to-Air Combat and for Waging War.

Boyd next elaborates this new conception. In one's actions one should:

> exploit operational and technical features to generate a rapidly changing environment (quick/clear observations, fast tempo, fast transients, quick kill).

Containing key themes that appears in later presentations, Boyd asserts that furthermore one should:

> inhibit an adversaries capacity to adapt to adapt to such an environment (suppress or distort observations).

The goals of such actions is to:

> unstructure adversaries system into a "hodge podge" of confusion and disorder by causing him to over or under react because of activity that appears uncertain, ambiguous or chaotic[18].

The last slide contains Boyd's "message", one that similarly informs his later work:

> he who can handle the quickest rate of change survives.[19]

Boyd's influence on Western fighter design and development thus was tremendous. Starting with his tour in Korea he developed his insights in the essentials of success in air-to-air combat: the ability for fast transient maneuvers coupled to a superior situational awareness.

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[15] *A New conception for Air-to-Air Combat* slides 6, 18, underlining in original.
[16] Ibid, p.19.
[17] Ibid, p.21.
[18] Ibid, p.22.
[19] Ibid, p.23.

He developed the ability to see air combat as a contest of moves and countermoves in time, a contest in which a repertoire of moves and the agility to transition from one to another quickly and accurately in regard the opponent's options was essential. He managed to develop the intellectual and analytical tool kit to translate his insights from practice into better weapon systems. Because of this insight, and armed with it, he became involved in concept definition, basic engineering and setting performance characteristics of the generation of fighter aircraft that to a large extent defined Western air power and air forces from the 1980's and well into the first decade of the 21st Century. He changed the art of designing fighters. Boyd's methodology showed trade-off parameters in the design and it brought rationality to the design processes by showing the net contribution of optional technical modifications and equipment. Importantly, his work on fighter design provided also the core of his strategic thinking.

Already the core of Boyd's later ideas appears in the pivotal presentation *A New Conception for Air-to-Air Combat*, albeit in rudimentary form. Those few themes above resurface in subsequent work in expanded and sometimes slightly adjusted form. The ability to adapt, and a strategy aimed at undermining the opponent's ability to do so feature prominently as key themes in Boyd's theory for winning. At the time, thinking about operating at a quicker tempo, not just faster, than the adversary was a new concept in waging war, as was the expression of military operations within the context of the process of adaptation.

Reading History

Rediscovering old masters

One month later, on September 3, 1976 he completed the eleven-page paper *Destruction and Creation* which manifests Boyd's growing interest in various scientific disciplines which would become a distinctive formative factor of Boyd's thinking. At about the same time work on *Patterns of Conflict* resulted in a first draft. *Patterns of Conflict* points clearly at the most obvious and initially also dominant formative factor: military history and existing strategic theories. This presentation slowly evolved through several "Warps" into a coherent framework that formed the vehicle for arguing doctrinal change within the US military establishment.

Even a casual reading of his main presentation, *Patterns of Conflict*, will suffice to convey the suggestion that Boyd was influenced directly by various strategic theories and his study of military history and, moreover, that his ideas bear close resemblance to those of a variety of authors. His study covered every known strategist from Sun Tzu, Genghis Kahn and the Mongols, Maurice de Saxe, Pierre de Bourcet, Compte de Guibert, Napoleon, Baron de Jomini and Karl von Clausewitz, Stonewall Jackson, Robert E. Lee, Ulysses S. Grant, Alfred von Schlieffen, Eric ovn Ludendorff, the British theorist Julian Corbett, J.F.C. Fuller, T.E. Lawrence and Basil Liddell Hart, the German theorists/practitioners Heinz Guderian, Eric von Mainstein, Hermann Balck, Erwin Rommel, as well as theorists of revolutionary and guerrilla warfare such as Karl Marx and Vo Nguyen Giap, to name the most familiar ones.

The bibliography of this presentation also includes books on specific battles and wars (for instance D-Day, Yom Kippur, Vietnam), biographies of and autobiographies by soldiers, generals and statesmen (Napoleon, Mao Tse-Tung, Patton, Rommel). As can be gleaned from Annex B, these books cover the tactical, technical, psychological, operational, the strategic as well as the political dimension. Some deal with deception and intelligence, others with the Greek art of war, or command and control or tank-tactics. Nuclear strategy

and air power theorists are notably absent from the list. Interestingly, non-Western approaches (Soviet strategy and guerrilla warfare) feature prominently. So Boyd deliberately exposed himself to a wealth of perspectives, issues, levels of problems and a variety of theories and analyses. In addition he read various secondary studies on military history. Interestingly he read history backwards; he started with the 20th Century and ended with Sun Tzu. This approach highlighted continuity and recurring patterns in stead of radical breaks and revolutionary technical developments.

It is simply beyond the scope of this study to make a synopsis of all the major works on strategy Boyd read and show the extent of their influence on Boyd. The rationale of the selection of these authors lies in the close relationship between the ideas contained in their work and those of Boyd. One could add Mao Tse Tung or Vo Nguyen Giap and André Beaufre. If his larger set of personal papers is taken into account one could also add Karl Marx and Lenin. The strategic concepts embedded in their work however are sufficiently represented in the following survey, and in some cases Boyd incorporates large sections of text in his presentations that are sufficiently self-explanatory to show what influence their ideas have had on Boyd.

Rediscovering flexibility and fluidity

To a certain extent the argument is valid that Boyd offered merely a synthesis of existing theories, a contemporary one, important and timely regarding the context of the 1970s and 1980s, but only a synthesis. Boyd plundered, or alternatively, created a synthesis of military history and strategic theories. He incorporated well-known historical examples and theorists in his presentations. In *Patterns of Conflict* he closely followed the historical development J.F.C. Fuller laid out in *The Conduct of War*, including Fuller's less than positive views on Clausewitz (which Fuller shared with T.E. Lawrence and Basil Liddell Hart). Boyd shows how European armed forces lost the art of maneuvre warfare in the Napoleonic era and discusses the rise and disasters of attritional warfare that occurred in the 19th Century. In this of course Boyd found a similarity with the situation of the US armed forces in the aftermath of the Vietnam War.

Indeed, Boyd's work suggests that when it comes to Boyd's views on combat, he found inspiration with authors who are united in their focus on achieving a measure of control over the enemy, on adaptation, on perception, and one achieving destabilizing effects throughout the enemy system in stead of the more traditional focus on attritting the enemy in a prolonged head-to-head battle. These authors display a balanced understanding of the cognitive dimension, in concert with the physical, more than those strategists who focus primarily on the physical aspects of the defeating the enemy in battle.

One such author was the British theorist of naval strategy Julian Corbett, who in 1911 focussed on limited war[20]. He developed the idea of sea control not through the wholesale destruction of the enemy fleet, but through the exertion of control over the movement of that fleet by maintaining a fine balance betweeen dispersion and concentration of one's own fleet, by superior knowledge concerning enemy whereabouts, and by a superior capability to concentrate if and where necessary.

A similar idea Boyd recognized in T.E. Lawrence's work who compared the sea with the desert, the environment of the operations of Arab guerrilla fighters he commanded against the Turks during the First World War. Lawrence is noteworthy also for the

[20] Julian S. Corbett, *Some Principles of Maritime Strategy* (Naval Institute Press, Annapolis, Maryland, 1988, originaly published in 1911).

intellectual theme that is hidden within the story. Lawrence's account manifests a deliberately conducted analysis of a dominant conceptualization of war which he was equipped with through his education at Oxford to determine the validity of this frame of reference for the environment he found himself in. It depicts strategic theory as a conceptual lense which is relevant and adequate only in a specific context.

As Lawrence noted 'in military theory I was tolerably read, my Oxford curiosity having taken me past Napoleon to Clausewitz and his school, to Caemmerer and Moltke, and the recent Frenchmen[…] Clausewitz was intellectually so much the master of them, and his book so logical and fascinating, that unconsciously I accepted his finality….my interest had been abstract, concerned with the theory and philosophy of warfare especially from the metaphysical side. Now, now in the field everything had been concrete…I began to recall suitable maxims on the conduct of modern scientific war. But they would not fit, and it worried me'[21].

Lawrence could not find a concept suitable to the Arab revolts and the socio-political-military context in any of the works Jomini, Foch, Moltke, Clausewitz, etc. All these authors had in common a focus on the destruction of the enemy's armed forces by only one method, battle[22]. This would not do for the Arab irregulars fighting the stronger Turks. There were no nations in war, no mass mobilization was possible. Its whole character was different and therefore the concept for victory too should be different. 'Ours seemed unlike the ritual of which Foch was priest', he noted[23]. So Lawrence started to consider the 'whole house of war' in its structural Lawrence went back to the 18th pre Napoleonic era of limited war and naval war fighting concepts.

He decided to use the vastness of the desert against the Turks. Constantly guarding every single important object was infeasible for the Turkish army, no matter how vast their number. Lawrence's cards would be speed and time, not hitting power[24]. The Turkish army was like a plant, immobile, firm-rooted, nourished through long stems to the head. In contrast, the Arabs would be an idea, an influence, a thing intangible, invulnerable, without front or back, drifting about like a gas, vapor. He opted for a war of detachment, not of contact. The time, place and object, the decision of what was critical would always be his[25]. According to Lawrence, the character of operations should be like naval war, in mobility, ubiquity, independence of bases and communications, ignoring of ground features, of strategic area's, of fixed directions, of fixed points. Tactics should be "tip and run", not pushes but strokes. One should never try to improve an advantage. One should use the smallest force in the quickest time at the farthest place[26]. The Arab attacks would focus on destroying the 'minerals' of the Turkish army. The army was dependent on rail transport, so the death of a Turkish bridge or rail, machine gun or charge of high explosive was more profitable than the death of a Turk. At the same time he would "arrange the mind" of the "crowd" – the local population – his own troops, and that of the enemy. There may be humiliating material limits, but no moral impossibilities, so the scope of diathetical activities was unbounded, he noted[27].

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[21] T.E. Lawrence, *The Seven Pillars of Wisdom*, Wordsworth Editions, (Ware, Hertfordshire, 1997), p.177.
[22] Ibid, p.178.
[23] Ibid, p.179.
[24] Ibid, p.185-186.
[25] Ibid, pp.182-184.
[26]Lawrence (1936), pp.188-190, as quoted in Gat, pp 154-155.
[27] Lawrence, p.185.

Lawrence wrote Liddell Hart that for irregular warfare, as Lawrence had used it, one could as easily write war of movement. Lawrence belonged with J.F.C. Fuller and Liddell Hart, to those who contributed to the rediscovery of flexibility and maneuver, in other words, those who developed an alternative to the disastrous attritionist mindset that reigned from Napoleon till the trench warfare of 1914-1918, theorists Boyd would find much inspiration in, and in their work he discovered much commonality with his own ideas.

Brain-warfare

The influence of Fuller and Liddell Hart on Boyd appears throughout *A Discourse*, both in content as well as in approach. To begin with on page 11 of *Patterns of Conflict* Boyd refers to J.F.C. Fuller's book *The Conduct of War* as good starting points for his investigation. *The Conduct of War, 1789-1961: A Study of the Impact of the French, Industrial and Russian Revolutions on War and Its Conduct* , as the full title runs, was published in 1961, but was in essence a "refurbished" and undated version of several earlier books[28]. Boyd found inspiration in Fuller's view on military history, virtually adopting large parts of both the structure and content of Fuller's book in the first halve of *Patterns of Conflict* when Boyd tells the story of Napoleon and the effects of the Industrial Revolution on warfare.

He argued that the Great War was based on a gigantic misconception of the true purpose of war, which is to enforce the policy of a nation at the least cost to itself an to the enemy and, consequently to the world, for so intricately are the resources of civilized states interwoven that to destroy any one country is simultaneously to wound all other nations. Militarily, he wrote, since the Prussian victories of 1866 and 1870 the military doctrines of Europe had been founded on the two fallacies that policy is best enforced by destruction and that military perfection is based on numbers of soldiers, and he blames Clausewitz among others for this, as would Lawrence and Liddell Hart.

Fuller claimed that the military had misunderstood the modern nature of war. In the age of the internal combustion engine human masses had become insignificant in comparison with technological advance and perfection. The physical epoch had come to an end, the moral epoch was dawning. There was no longer a need to literally destroy the enemy's armies in the field. Aircraft using gas would disable, demoralize and paralyze unarmored troops, surface ships and civilian populations and infrastructures alike. Armored forces would paralyze, demoralize and cause the disintegration of armies by striking at their rear communications and command system. Paralysis and collapse were central themes.

Boyd incorporated these view on mobile mechanized warfare, the precursor of Blitzkrieg, as the German general Heinz Guderian would later acknowledge, and whose biography (*Panzer Leader*) Boyd would also read while completing *Patterns of Conflict*[29]. In *The*

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[28] Azart Gat (1998), p.33.

[29] Azar Gat (1998), p.33. Gat cites from Guderian's work. Interestingly, Fuller drew on Social Darwinism to develop a theory of military development in history. In Fuller time, Darwin's work was revolutionary and it affected the Zeitgeist. Its major influence on society was the Social Darwinist philosophy, which held that individuals, countries, and whole races evolved through competition and war, and that only the best adapted to the environment would thrive. What was best, survived; what survived grew more distinct and specialized, and thrived in its environment. The idea of *survival of the fittest* was actually coined by the philosopher Herbert Spencer, and Darwinism exerted an influence on Fuller through him. It was Spencer who made current the term "evolution" rather than the older purely biological term "epigenisis" based on his desire to describe a general process that was not limited to biology. Spencer wrote that war was the prime mechanism of evolution among societies. Those societies that could effectively fight wars survived and flourished while those that could not

Conduct of War Boyd found reference to the idea that between action and will there exists an intimate connection, as Fuller stated: action without will loses coordination; without a directing brain an army is reduced to a mob. The fighting power of an army lies in its organization which can be destroyed either by wearing it down or by rendering inoperative his power of command – "brain warfare"[30].

Central to his argument is the notion that paralysis should be the aim in war and that the mental and moral dimensions should be the prime target of a military operation. Fuller insisted that "brain warfare" was the most effective and efficient way to destroy the enemy's military organization and hence its military strength. To economize the application of military force, one needed to produce the instantaneous effects of a "shot through the head", rather than the slow bleed of successive, slight body wounds[31].

Boyd also adopted Fuller's concept of the three spheres of war - the physical, the mental, and the moral, dimensions. Respectively, these spheres dealt with destruction of the enemy's physical strength (fighting power), disorganization of his mental processes (thinking power), and disintegration of his moral will to resist (staying power). Fuller added that forces operating within these spheres did so in synergistic, not isolated, ways. Thus in stead of just focusing on the physical aspects of the enemy, the conduct of modern war should aim at moral and mental objectives and undermine rather than literally destroy the enemy.

He realized however explicitly that the tank would produce its own counter measures and he foresaw the anti tank gun and anti armor mine, which would in a new cycle of evolution limit the advantage of the tank[32]. Fuller recognized that technological, tactical and doctrinal developments lead to counter- developments. War and its tools developed in an evolutionary scheme. This was in line with Fuller's positivist, evolutionary and dialectical interpretation of history. Fuller's book describes the transformation from rural to urbanized and industrialized civilization. Within this transformation an evolutionary pendulum lay embedded of weapon power, slowly or rapidly swinging from the offensive to the protective and back again in harmony with the speed of civil progress. Every measure enjoys a period of success following its introduction, but thereby provokes countermeasures to redress the balance. In this light his deliberate and extensive inclusion of Marxist and Leninist theories of revolutionary war also can be seen as part of the dialectic cycle of one forms of warfare leading to another mode of warfare. Fuller called this 'the constant tactical factor' which lay at the root of the law of military evolution', a view that permeates *The Conduct of War* as well as Boyd's *Patterns of Conflict* which contains various section in which a specific style of warfare is contrasted with its logical counter, including the Marxist, Leninist and Maoist versions of revolutionary warfare[33].

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dwindled and disappeared. The ability to wage war also affected the social, political, economic and even religious organs of each society. See Pellegrini, and also Antulio J. Echevarria II, *After Clausewitz, German Military Thinkers Before the First World War,* (University Press of Kansas, 2000), p.186; and in particular Brian Holden Reid, *J.F.C. Fuller, Military Thinker,* (St. Martin's Press, New York, 1987), 1-30.

[30] J.F.C. Fuller, *The Conduct of War, 1789-1961: A Study of the Impact of the French, Industrial and Russian Revolutions on War and Its Conduct* (New Brunswick, New Jersey, 1961), p.242-243.

[31] Ibid.

[32] Azar Gat (1998), p. 40.

[33] Ibid, p.39.

The Indirect Approach

The foregoing authors found their ideas incorporated in the influential arguments put forward by Basil Liddell Hart[34], and Boyd's work in turn bears close resemblance to the ideas of Liddell Hart, not surprising considering the fact that Boyd had read if not all, at least most of his work[35]. His most popular an well-known book is *Strategy*[36] which was published in its original form as *The Decisive Wars of History* in the mid-1920s. He used it to develop his idea of the "Indirect Approach", which over time became elevated to a general rule and ultimately a philosophical basis for the analysis of all war at all levels.

Like Fuller the search for a stratagem that would avoid the massacres of WWI was to occupy Liddell Hart during the interbellum and again like Fuller, Liddell Hart criticized the political and military leadership of WWI. Liddell Hart, and Boyd in his wake, used the ideas of the French Neo-Napoleonic School of the late 19th and the early 20th Century to attack the strategies of the major powers in the 19th century and WWI that were based on Clausewitz's faulty or incomplete analysis. This school unraveled the origins and nature of Napoleonic strategy and took a critical look at Clausewitz's interpretation of that strategy. The French school laid the foundations for a much deeper and fuller understanding of Napoleon's generalship and system of operation than had been offered by Jomini's analysis. In dissecting Napoleon's campaigns, the school emphasized Napoleon's clear determination of the decisive point and line of advance, the resolute and carefully coordinated marches and rapid concentration of all forces to overwhelm the enemy. Equally they highlighted the flexibility of his operational formation, the "battalion carré", loosely dispersed until the last moment and maintaining its freedom of action to operate and strike in all directions.

These principles, already proposed by De Bourcet in the 18th century, had helped to leave the opponent in the dark and guessing regarding Napoleon's intentions and ultimate line of attack. The pattern had been *dispersion and only then concentration* (vide Corbett here), with each of Napoleon's operational plan having many branches or alternative options. The school also highlighted the use of deception, feints and diversions to create surprise, disorientation and miscalculation on the enemy's part. They countered Clausewitz's claim that Napoleon had never engaged in strategic envelopment by citing the many instances of Napoleon's maneuvers against the enemy's rear, one of the most fundamental patterns of Napoleonic strategy[37].

Liddell Hart's criticism of Clausewitz center on what he considered the three dominant theories in *On War*: the theory of absolute warfare, with its corollary of the nation in arms; the theory that one must concentrate fire against the main enemy; and the theory that the true objective in war is the enemy's armed forces so that everything is subject to the supreme law of battle[38]. Clausewitz had been the "mahdi of mass" and mutual massacre and Foch in the pre-war era had been the amplifier for Clausewitz's more extreme notes[39]. Boyd would agree and devote five pages for critique on Clausewitz.

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[34] For the evidence of Liddell Hart's plagiatism see Gat (1998), pp. 146-150.

[35] The bibliography attached to *Patterns of Conflict* shows Boyd studied the following six works by Liddell Hart: *A Science of Infantery Tactics Simplified* (1926); *The Future of Infantery* (1933); *The Ghost of Napoleon* (1934); *The German Generals Talk* (1948); and *Strategy* (1967).

[36] For this study I used the second revised edition of 1967, the one Boyd also read.

[37] Gat, pp.150-153.

[38] Ibid.

[39] Jay Luvaas, 'Clausewitz: Fuller and Liddell Hart', *Journal of Strategic Studies*, 9 (1986), p.209.

Boyd also resembles Liddell Hart in his didactic method. Liddell Hart had a message and was not out to make good history[40]. Against a background of a sweeping reversal of attitudes in Britain towards WWI and the phenomenon of war itself, Liddell Hart undertook a wholesale revision of the accepted precepts of military theory. Synthesizing Fuller, the French School, Lawrence and Corbett, Liddell Hart projected a mirror image of nineteenth century warfare and view of the past, which had been formulated on the Continent in the age of nationalism. Eighteenth century warfare, discredited and despised by the men of the 19th century became an example to be emulated and revived. The Napoleonic model became the Napoleonic fallacy. Clausewitz became the false prophet. Total war was to be replaced by limited war and the effort to gain victory by crushing the enemy's power substituted by a calculated action, mindful of the subsequent peace. The decisive clash of forces in a major battle to be replaced by indirect means. War was not milling; it was wrestling, or better ju-jitsu. The most effective indirect approach is one that lures or startles the opponent into a false move – so that, as in ju-jitsu, his own effort is turned into the lever of his overthrow[41]. Boyd copied this line of reasoning, or at least so strongly agreed with this way of constructing the argument that he formulated a very close image of Liddell Hart's argument.

In *Strategy: The Indirect Approach* Liddell Hart strives to show that the achievements of the great captains of all ages had rarely been brought about by the direct clash of forces but all usually involved the prior psychological and physical dislocation of the enemy. He argues that 'the most decisive victory is of no value if a nation be bled white while gaining it'[42]. It should be the aim then of grand strategy to discover and pierce the Achilles heel of the opposing government's power to make war. And strategy, in turn, should seek to penetrate a joint in the harness of the opposing forces. To strike with strong effect one must strike at weakness. It is thus more potent as well as more economical to disarm the enemy than to attempt his destruction by hard fighting. Thus, following Fuller, he states that *a strategist should think in terms of paralyzing, not of killing.*

Even on the lower plane of warfare, a man killed is merely one man less, whereas a man unnerved is a highly infectious carrier of fear, capable of spreading an epidemic of panic. On a higher plane of warfare, the impression made on the mind of the opposing commander can nullify the whole fighting power his troops possess, and on a still higher plane, psychological pressure on the government of a country may suffice to cancel all the resources at its command - so that the sword drops from a paralyzed hand[43].

The role of Grand Strategy is thus to coordinate and direct all the resources of a nation or band of nations towards the attainment of the political object of the war. It should both calculate and develop the economic resources and man power of nations in order to sustain the fighting services. But not only the material forces determine the outcome of war. Also the moral forces of the people should be mobilized, their spirit and motivation raised. A good cause is a sword as well as armor. Likewise, chivalry can be a most effective weapon

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[40] Liddell Hart has been thoroughly criticized for his methods, his sloppy history and his misinterpretation of Clausewitz and the actions of senior military figures in WWI. See for instance John Mearsheimer, *Liddell Hart and the Weight of History* (Ithaca, New York, 1988). However, recently more and more authors acknowledge that Liddell Hart's later work is more sophisticated and original, that indeed the Blitzkrieg practitioners were inspired by Fuller and Liddel Hart and that his interpretations of Clausewitz is not too wide off the mark altogether, in particular in view on the meaning of the famous Clausewitzian dictum of war as a 'continuation of policy by other means'. See for instance Alex Dachev, 'Liddell Hart's Big Idea', *Review of International Studies* (1999), 25, pp.29-48.

[41] Danchev, p.33.

[42] Liddell Hart, *Strategy*, p.212.

[43] Ibid.

in weakening the opponent's will to resist as well as augmenting moral strength[44]. In *Patterns of Conflict* Boyd includes the idea of a good cause as a strategic asset in his own advise concerning grand strategy, an idea he would expand upon in *The Strategic Game of ? and ?* in a section titled 'A Moral Design for Grand Strategy'.

Next comes strategy which has as its purpose not to overcome resistance but to diminish the possibility of enemy resistance and it seeks to fulfill this purpose by exploiting the elements of movement and surprise[45]. Strategy has for its purpose the reduction of fighting to the slenderest possible proportions[46]. Even if the decisive battle be the goal, the aim of strategy must be to bring about this battle under the most advantageous circumstances. And the more advantageous the circumstances, the less, proportionally, will be the fighting. *The perfection of strategy would be, therefore, to produce a decision without any serious fighting*[47]. For the aim of a nation is generally not seeking destruction but maintenance of its security and that aim is fulfilled if the threat is removed, if the enemy is led to abandon his purpose[48]. The aim of a strategist is *not so much to seek battle as to seek a strategic situation so advantageous that if it does not of itself produce the decision, its continuation by a battle is sure to achieve this.* In other words*, dislocation is the aim of strategy, its sequel may be either the enemy's dissolution or his easier disruption in battle*[49]. Dissolution may involve some partial measure of fighting, but this has not the character of a battle.

In the psychological sphere, dislocation is the result of the impression on the commander's mind of the physical effects just listed. The impression is strongly accentuated if his realization of his being at a disadvantage is *sudden* and if he feels that he is unable to counter the enemy's move. *Psychological dislocation fundamentally springs from this sense of being trapped.* This is the reason why this feeling often follows an enemy move against one's rear. The brain is much more sensitive to any menace to its back. In contrast, a move directly on an opponent consolidates his balance, physical and psychological, and it thus increases his resisting power. Thus, Liddell Hart argues, a move around the enemy's front against his rear has the aim not only of avoiding resistance on its way but in its issue. In the profoundest sense, it takes the *line of least resistance*. However, as this is known to any enemy that is worth his mettle, this move needs to be combined with the equivalent in the psychological sphere; an attack along the *line of least expectation*[50]. Tempo also comes into play here. Movement generates surprise and surprise gives impetus to movement, for a movement which is accelerated or changes its direction inevitably carries with it a degree of surprise while surprise smoothes the path of movement by hindering the enemy's counter measures and counter movements[51].

The moves against the enemy's rear or the threat of it have the purpose of distraction in the sense that it is meant to deprive the enemy of his freedom of action. It should cause a distention of his forces or their diversion to unprofitable ends, so that they are too widely distributed and too committed elsewhere to have the power of interfering with one's own decisively intended move. In the psychological sphere the same effect is

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[44] Ibid, pp.321-322.
[45] Ibid, p.323.
[46] Ibid, p.324.
[47] Ibid, my emphasis.
[48] Ibid, p.325.
[49] Ibid, my emphasis partly.
[50] Ibid, p.327. Emphasize in original. Here we see Liddell Hart outlining an idea similar to the concept of Ch'i and Cheng; the unorthodox and the orthodox and the idea of shaping the opponent, as will be explained in more detail below.
[51] Ibid.

sought by playing upon the fears of and by deceiving the opposing command. To mystify and mislead constitutes distraction while surprise is the essential cause of dislocation. As Liddell Hart posits: '*It is through the distraction of the commander's mind that the distraction of his forces follows. The loss of his freedom of action is the sequel to the loss of his freedom of conception*'[52]. The mental and the physical are two faces of the same coin and only when they are combined and one pays attention to the psychological as much as to the physical, is strategy truly an indirect approach, calculated to dislocate the opponent's balance[53].

Corbett's ideas resurface when Liddell Hart explains that an army should always be so distributed that its parts can aid each other and combine to produce the maximum possible concentration of force at one place, while the minimum force necessary is used elsewhere to prepare the success of the concentration. Effective concentration can only be obtained when the opposing forces are dispersed, and, usually, in order to ensure this, one's own forces must be widely distributed. Thus, Liddell Hart asserts, true concentration is the product of dispersion[54].

Another result of the interactive nature of war, and connected to the idea of getting the opponent off his guard, is that to ensure one objective you should have alternative objectives as well. If you take a line that threatens alternative objectives, you distract his mind and forces, an idea Boyd was to come to refer to as the use of *Nebenpunkte*, next to *Schwerpukte*, or Centers of Gravity. This, moreover, is the most economic method of distraction for it allows you to keep the largest proportion of your force available on your real line of operation thus reconciling the greatest possible concentration with the necessity of dispersion[55]. Bourcet had this in mind when he stated that every plan should have several branches so that one or two of those branches cannot fail to produce success. It is expressed in the term "to put the enemy on the horns of a dilemma". Underlying this is Liddell Hart's conviction, one shared by Boyd, that '*Adaptability is the law which governs survival in war as in life - war being but a concentrated form of the human struggle against environment*[56]. To be practical, any plan must take account of the enemy's power to frustrate it; the best chance of overcoming such obstruction is to have a plan that can be easily varied to fit the circumstances met[57]. To keep such adaptability, while still keeping the initiative, the best way is to operate along the line which offers alternative objectives. These notions apply equally well to tactics as they do to strategy and their underlying essential truth is that for success two major problems must be solved: dislocation and exploitation[58].

All these ideas would find their place in Boyd's work most clearly in *Patterns of War* in which he constantly emphasizes the relevance of movement on the psychological dimension. Indeed, reading this book in the aftermath of the defeat of one of the two world's superpowers at the hands of technologically unsophisticated guerrilla fighters, Boyd must have found inspiration in these words.

Liddell Hart is considered the conceptual father of the Blitzkrieg concept Germany developed during the Interbellum, a concept Boyd took a deep interest in. *Patterns of Conflict* includes statements of several German high ranking tank commanders such as Guderian, von Manstein, Balck and Rommel, and the bibliography includes many studies on the Blitzkrieg concept. Not surprisingly then that Boyd's work can be easily understood as

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[52] ibid, p.329. Emphasis is mine.
[53] Ibid.
[54] Ibid.
[55] Ibid, p.330.
[56] Ibid. Emphasis is mine.
[57] Ibid, p.330. This resembles the concept of "to accord with the enemy" in Sun Tzu's *The Art of War*.
[58] Ibid, pp. 335-336.

standing in a direct theoretical line with that of Liddell Hart. Boyd was to include most if not all of the principles in *Patterns of Conflict*, mingling them with the practice of Blitzkrieg observed during the Second World War. What Liddell Hart terms the Indirect Approach, Boyd refers to as Maneuver Conflict, one of three kinds of human conflict. Moreover, Boyd included the ideas concerning grand strategy and the virtue of short wars in his own work. Although Boyd conceptually expands considerably on Liddell Hart's ideas, the parallels between Boyd and Liddell Hart run deep.

Boyd's conceptual father: Sun Tzu

The final strategist surveyed is Sun Tzu, who must be considered the true conceptual albeit ancient father of Boyd's work. Already in 1981 Michael Gordon noted in an article on the Military Reform Movement that '*Patterns of Conflict* draws on the writings of Chinese philosopher Sun Tzu'[59]. Indeed, this presentation in various places presents ideas of Sun Tzu and Sun Tzu's ideas form one of the starting points of the briefing as well as reappearing at the beginning of the concluding part. Coram claims that *The Art of War* became Boyd's Rosetta stone, the work he returned to again and again. It is the only theoretical book on war that Boyd did not find fundamentally flawed. He eventually owned seven translations, each with long passages underlined and with copious marginalia[60]. Sun Tzu's book encapsulates many elements of theories developed by Fuller and Liddell Hart who even paid tribute to Sun Tzu in *Strategy*. Moreover, in contrast to the others, in *The Art of War* Boyd found the core concepts for Maneuver Conflict as well as for Moral Conflict, which captures the essence of revolutionary war. In effect, Boyd was to adopt Sun Tzu's entire philosophy of war and a somewhat elaborate discussion on Sun Tzu's ideas is therefore warranted, if not for the reason that without detailed discussion of several concepts parts of *Patterns of Conflict* will remain unclear[61].

The first is one of several strategic ideas is the one of *preservation.* War is the most important issue a state should concern itself with, according to Sun Tzu. It is a matter of life and death and it will determine the fate of a state. A state should be able to wage war effectively. A state should therefore always be prepared for war, be vigilant and possess a ready, capable force for deterrence as well as for war fighting. War is to be avoided as much and as long as possible because inherent in war is the chance of catastrophe for the state. Besides, war is a very costly affair for all involved. Therefore statecraft should aim to avoid war. To solve crisis it should use regular diplomatic means, as well as irregular, what we would perhaps consider devious and illegitimate means, such as assassination of the enemy's ruler or his generals, bribing key figures around the ruler and persuading his allies to change sides. War was only justifiable when all possible alternatives have been exhausted and must be entertained with the utmost seriousness and restraint. The commander must be in pursuit of a quick termination and preservation of life and resources, not only one's own but also those of the opponent. If war must be fought, it must be fought at a minimum of cost. War must constantly be fought with the need to be able to resume normal life and relations after hostilities in mind[62].

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[59] In Hammond, p.105.

[60] Coram, p.331.

[61] The following is based on my chapter titled 'Asymmetric Warfare: Rediscovering the Essence of Strategy', in John Olson, *Asymmetric Warfare* (Oslo, 2002).

[62] In an agrarian society, which cannot replenish lost crops and lost labor force rapidly, serious losses had possibly serious repercussions. This lies behind familiar statements such as: 'To win a hundred victories in a hundred battles is not the pinnacle of excellence. Subjugating the enemy's army without

The wish for preservation also informs *Grand Strategy*. Throughout the book Sun Tzu mandates careful planning and the formulation of an overall strategy before commencing a campaign. The focus of all planning in grand strategy and military operations must be the development and maintenance of a prosperous, contented populace whose willing allegiance to their rules is unquestioned. Whenever possible 'victory' should be achieved through diplomatic coercion, thwarting the enemy's plans and alliances and frustrating his strategy. Only when a state is threatened by an enemy with military action or refuses to give in to demands otherwise, should the government resort to armed conflict. And even then, a clash of arms is not preferred[63].

A crucial activity for a ruler is to keep a constant eye on one's relative power position or what we would perhaps call the state of national security. The Chinese term that is associated with this is *shih*. *Shih* is an ambiguous concept and is used at all levels, not just the grand strategic level[64]. It has a cluster of meanings such as situation, circumstances, outward shape, force, influence, authority, latent energy, tactical power, positional advantage and strategic advantage[65]. The *shih* constantly shifts according to what is happening in the internal and external environment of the state. At anyone time the *shih* is formed by intangible factors such as morale, opportunity, timing, psychology and logistics. A suitable term for it is 'strategic configurations of power'. A ruler needs to be constantly scanning his environment. *Shih* indicates that the business of war does not occur as some independent and isolated event, but unfolds within the broader field of unique natural, social and political conditions. These conditions and relations among them are constantly changing. *Shih* is a continuum and one's position on it can be discerned and influenced.

Foreknowledge. Knowledge is essential for security. For a correct estimate of one's *shih* a ruler needs foreknowledge about the entire environment is required at all levels of activity and, unlike Clausewitz's belief, it is possible to have 'complete knowledge'. It is not the attainment of absolute certainty, but the formation of a correct interpretation of the situation, a recognition of the relevant patterns, a very important theme in Boyd's work. The quest for information however is not an absolute, it must be understood in two senses. First, one needs better understanding than the opponent, not perfect, but better, hence one's efforts to conceal one's plans and positions. Second, we need to understand foreknowledge in the same vein as the Chinese concept of knowledge in general. It comes from being able to discern patterns and relations and it is holistic in the sense that an object can only be understood in light of its context.

Foreknowledge does not equate with absolute certainty. Foreknowledge is a relational concept in that it gives advantage to that side that is better able to form proper judgment on the basis of the observed facts and to that side that better knows what to look for. It is penetrating understanding about changes and their meaning[66]. Even if one has

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fighting is the true pinnacle of excellence'; and: 'Thus one who excels at employing the military subjugates other people's armies without engaging in battle, captures other people's fortified cities without attacking them and destroys other people's states without prolonged fighting. He must fight under Heaven with the paramount aim of preservation.

[63] See for instance Sawyer, Ch 3, p.177: 'the highest realization of warfare is to attack the enemy plans; next is to attack their alliances; next to attack their army and the lowest to attack their fortified cities'.

[64] Although in the classical Chinese philosophical framework our common division in grand strategic, strategic, operational and tactical levels do not make any sense for they are interwoven.

[65] For some additional meanings see Ames, p. 73.

[66] Ibid, ch 9, p.203. Here is a crucial part for understanding the meaning of Sun Tzu's quest for information. 'thus the general who has penetrating understanding of the advantages of the nine changes knows how to employ the army. If a general does not have a penetrating understanding of the

perfect information, so Chapter 9 reads, but does not have a penetrating understanding of its meaning, if one does not see the patterns, it is of no value. Information must be coupled to judgment, and here we can see the parallels with Boyd's emphasis on the element of Orientation in the OODA loop. Orientation contains the element of experience, intuition, judgment, schemata, etc. Judgment is key, as in Boyd's view. Without judgment, data mean nothing. So it is not necessarily the one with more information who will come out victorious, it is the one with better judgment, the one who is better at discerning patterns.

Moreover, it is a judgment of highly dynamic situation. Sun Tzu only claims that one who excels at warfare can tell when a situation will offer chances for victory or defeat, realizing that this particular impression of *shih* is a snapshot from a distance on a particular time. The closer war and battle approach in time and space, the finer becomes the detail of Sun Tzu's investigations, all the way down to indicators of the actions of an army setting up camp and the order of flags in tactical formations.

Sun Tzu's Strategems. In chapters 1 and 3 Sun Tzu reveals his ideas of how to conduct a campaign once the estimate of *shih* has indicated that it is both necessary and feasible to embark on war. These ideas would become very much Boyd's own:

> Warfare is the Tao of deception. Thus although you are capable, display incapability to them. When committed to employing your forces, feign inactivity. When your objective is nearby, make it appear as if distant; when far away, create the illusion of being nearby. Display profits to entice him. Create disorder (in their forces) and take them[67]. If they are substantial, prepare for them; if they are strong, avoid them. If they are angry, perturb them; be deferential to foster their arrogance. If they are rested, force them to exert themselves. If they are united, cause them to be separated. Attack where they are unprepared. Go forth where they will not expect it. These are the ways military strategists are victorious. They cannot be spoken of in advance[68].

Several related concepts are later further developed. These derive from the idea that strategy is about *getting the enemy off balance, about creating disharmony and chaos*. Sun Tzu focuses upon manipulating, shaping the enemy, thereby creating an opportunity for an easy (as in less costly than in a direct set peace battle) victory by applying maximum power at the appropriate time and place(s). Through confusion about one's own position, through the subsequent dislocation of his forces and their state of disorder will the enemy be weakened.

Sun Tzu offers a meriad of strategic and tactical factors, which span the mental, the moral and the physical dimensions, that together with the grand strategic factors such as the quality of the alliances of the opponent, combine to get the enemy off balance[69]. The aim is to get the opponent in a position or situation against which the all the potential energy of

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nine changes, even though he is familiar with the topography, he will not be able to realize the advantages of terrain…even though he is familiar with the five advantages, he will not be able to control men.

[67]The idea that order and disorder are important notion in The Art of War is further substantiated at ch.7, p.198-199, 'in order await the disordered', and 'do not intercept well ordere flags, do not attack well regulated formations; do not attack animated troops'.

[68] This comes from Sawyer, ch.1, p.168.

[69] Although it may seem that confusion is all that matters to Sun Tzu, numbers and physical aspects frequently appear in his deliberations. In ch. 3 he brings the relative strength of opponents in relations to possible actions such as 'if your strength is ten times theirs, surround them; if five then attack him, if double, then divide your force…if outmatched, you can avoid him'. Thus a small enemy that acts inflexible will become the captives of a large enemy.

one's army can be released with the maximum effect, that is, against a disorganized and locally inferior force. The basic idea is to go forth where they do not expect it and attack where they are not prepared[70]. Battle must be avoided until one is certain that a favorable balance of power (and that means not just in number) has been created[71]. This is what is really behind the familiar statements:

> One who knows when he can fight, and when he cannot fight, will be victorious[72],
>
> One who knows the enemy and knows himself will not be endangered in a hundred engagements[73].
>
> Subjugating the enemy's army without fighting is the true pinnacle of excellence[74]

These must be understood within a logical context of the aim for preservation and the aim of fighting an enemy who is completely off balance and about to collapse. The chances of getting the enemy off balance are magnified by adhering to the following concepts, which can be considered as modes of behavior, or effects one wants to accomplish. All these elements surface in Boyd's work:

According with the enemy	Formlessness & being Unfathomable
Foreknowledge	High Tempo
Cohesion	Variety & Flexibility
Surprise	Orthodox & Unorthodox
Deception & Deceit	Vacuous & Substantial

His mechanism starts with the assumption that one can shape an opponent through the principle of *'according with the enemy'*, or adaptability. This concept underlies the idea of getting the enemy off balance. It requires (battlefield level-)*foreknowledge* and *cohesion*. Together these three concepts gird the scheme of getting the opponent off balance by the use of *surprise through deception and deceit*, and the methods Sun Tzu proposes to achieve surprise: the idea of *formlessness and being unfathomable*, *maintaining a high tempo*, *ensuring variety and flexibility in actions*, *the idea of using the unorthodox and orthodox*, and finally of knowing how to discern *the vacuous and substantial*.

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[70] Sawyer, ch. 6, p.191.

[71]Several statements relate to this mechanism: 'Those that excelled in warfare first made themselves unconquerable in order to await (the moment) the enemy could be conquered. Being unconquerable lies with yourself; being conquerable lies with the enemy. Those …referred to as excelling at warfare conquered those who were easy to defeat… Their victories were free of errors. One who is free from error directs his measures towards certain victory, conquering those who are already conquered. Thus the one who excels at warfare first establishes himself in a position where he cannot be defeated while not losing any opportunity to defeat the enemy. For this reason the victorious army first realizes the conditions for victory and then seeks to engage in battle'[71]. 'The one who excels at moving the enemy deploys in a configuration to which the enemy must respond. He offers something the enemy must seize. With profit he moves them, with the foundation he awaits them. Thus one who excels at warfare seeks victory through the strategic configurations of power, not from reliance on men'.

[72] Ibid, ch. 3, p.178.

[73] Ibid, ch. 1, p.179.

[74] Ibid, ch. 3, p.177.

According with the enemy is the assumption that one can shape the opponent and for that on should act in accord with the opponents actions. This is an essential idea in Chinese philosophy and it is expressed as *yin*. Every situation has its give and take and can be turned into an opportunity. *Yin* involves responsiveness to one's context, to adapt oneself to a situation in such a manner as to take full advantage of the defining circumstances, and to avail oneself of the possibilities of the situation in achieving one's own purposes:

> Do not fix any time for battle, assess and react to the enemy in order to determine the strategy for battle[75].

Yin requires sensitivity and adaptability. Sensitivity is necessary to register the full range of forces that define one's situation, and on the basis of this awareness, to anticipate the various possibilities that can ensue. Adaptability refers to the conscious fluidity of one's own disposition. One can only turn prevailing circumstances to account if one maintains an attitude of readiness and flexibility. One must adapt oneself to the enemy's changing posture as naturally and as effortlessly as flowing water winding down a hillside[76]. The concept of fluidity, manifested in the statement below, is one that is also embedded within Boyd's work[77]. *Yin* means shifting your position so adroitly and imperceptible that, from the enemy's perspective, you are inscrutable[78]. To accord with the opponent one needs to know the opponent's aims, plans and position of forces as well as the character of the commander. And this leads us to a second look at *foreknowledge*, this time more specific for the strategic and tactical level as opposed to the grand strategic level we have dealt with before.

Foreknowledge is essential for the grand strategic level, but it permeates the whole body of thought. It means something different at each level of war. Sun Tzu specifies the different answers a general would want to know at a certain level. Each level has different issues to address in different levels of detail. At the tactical levels a general needs to know the number of campfires in the enemy camp and the sounds that emanate from it, etc. Foreknowledge make possible the other concepts such as deception, being fathomless and formless, attacking the vacuous, the use of orthodox and the unorthodox[79].

Maintaining Cohesion is another important prerequisite for creating and exploiting disorder. There are many references to methods a commander can employ to maintain cohesion among his troops. It depends on the commander taking well care of his troops, preserving them, handing out praise as well as punishment where and when it is due but being fair, disciplined and strict. The corollary of attacking when the *ch'i*, or spirit, of the enemy troops is low is that one should guard one's own *ch'i* so as to 'with the rested await

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[75] Ibid, ch. 11, p 224.

[76] Ames, p 84.

[77] See Sawyer, ch 7, p 193: 'The army's disposition if force (*hsing*) is like water. Water's configuration avoids heights and races downward. The army's disposition of force avoids the substantial and strikes the vacuous. Water configures its flow in accord with the terrain; the army controls its victory in accord with the enemy. Thus the army does not maintain any constant strategic configuration of power (*shih*), water has no constant shape. One who is able to change and transform in accord with the enemy and wrest victory is termed spiritual'.

[78] Ames, p 84.

[79] Gaining foreknowledge can be done through spies and through knowing the tell tale signs of armies on the move as Sun Tzu indicates in chapter 9: 'if large numbers of trees move, they are approaching. If the army is turbulent, the general lacks severity, if they kill their horses and eat the meat, the army lacks grain. One whose troops repeatedly congregate in small groups here and there, whispering together, has lost the masses', etc.

the fatigued, with the sated await the hungry'[80]. Elsewhere Sun Tzu says that the troops should be looked upon as beloved children[81]. Other factors that appear as motivating and unifying factors are penetrating deeply into enemy terrain and in general the commander, officers and troops sharing exposure to risk. A commander should thus being able to direct his troops as though commanding one man[82] and 'one whose upper and lower ranks have the same desires' (and will thus be victorious)[83] so he can 'in order await the disordered'[84]. Trust, fairness, integrity, leadership and discipline are modern terms for this, ones Boyd would also incorporate.

Surprise, Deception and deceit. Without *surprise* at some stage in the encounter with the opponent it will be difficult to mass superior force at a certain point. Surprise is achieved through the interaction, the reinforcing effect of several methods applied simultaneously[85]. It involves the employment of deception and deceit. For instance, it is achieved by moving separated and keep the opponent guessing where one will unite, or if one is united, one can disperse again in the hope that the opponent has united and thereby committed his forces. Troop deployments or the image thereof are used together with disinformation from (expendable) spies, as well as feigning certain activities that serve as indicators of upcoming operations to the trained eye of the opposing commander, all serve the end of deceiving the opponent. Of course all efforts to deceive must be matched by making sure one's real intentions and movements are shrouded in *secrecy* and with this we arrive at the concept of being *unfathomable* and *formless*.

Being unfathomable and formless. Sun Tzu stresses the need for a commander to be unfathomable and obscure, never revealing his plans or intentions even to his own troops[86]. Being unfathomable through deception and deceit will cause the opposing commander to be confused or forced to respond in a way that is not according to his initial plan. He is forced to react especially when he suddenly discovers that his opponent is moving to an object that he needs to defend. Thus he is shaped. These ideas surface in the statement:

> One who excels at moving the enemy deploys in a configuration to which the enemy must respond. He offers something that the enemy must seize. With profit he moves them, with the foundation he awaits them[87].

Related to deception and being unfathomable is the idea of being *formless*. Whenever the army deploys onto the battlefield, its configuration, being immediately apparent, will evoke a reaction (he too is according with the enemy) in the enemy. Whether the enemy will then modify his original anticipations, vary his tactics or view the events as confirming a

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[80] Ibid, ch. 7, p.199.
[81] Ibid, ch.10, p. 215
[82] Ibid, ch.11, p. 224.
[83] Ibid, ch.3, p.178.
[84] Ibid, ch.7, p.199.
[85] Sun Tzu's military thought has frequently been erroneously identified solely with deceit and deception. These two term however connect ideas that ultimately need to produce surprise. Only twice do deception and deceit appear explicitly in the book. The most famous one is found in Chapter 1 where it is stated that 'warfare is the Tao of deception. Thus although you are capable, display incapability to them. When committed to employing your forces, feign inactivity. When your objective is nearby, make it appear as if distant; when far away, create the illusion of being nearby'. The second one appears in Chapter 7 and states that 'thus the army is established by deceit, moves for advantage, and changes through segmenting and reuniting'.
[86] Ibid, ch.11, p.222.
[87] Ibid, ch. 5, p.188.

preconceived battle plan depends upon his evaluation of the unfolding situation. By being formless, that is: without having a recognizable configuration, this evaluation becomes rather difficult. Thus being formless also implies being unfathomable. False appearances kept secret in turn help being unfathomable. Formless can also mean that one lacks an identifiable mass and the enemy cannot discern a pattern or a main body, again perhaps due to the true physical dispersion of our forces or through being unfathomable and employing deceit and being successful in deception activities. Not knowing our position and in order to defend what he treasures or to cover the possible routes we can go he must disperse his forces[88].

*Speed, Rapidity***.** These tactics aim at getting the opponent dislocated and confused. To enhance the creation of confusion, and being unfathomable, one should also use superior speed and rapidity. Speed, rapidity of movement and attacks help in shaping the opponent and wear him down[89]. The same holds true for the concepts of *Variety and flexibility*. This is reflected in:

> Men all know the disposition by which we attain victory, but no one knows the configuration through which we control the victory. Thus a victorious battle (strategy) is not repeated, the configurations of response to the enemy are inexhaustible[90].

A particular kind of this is captured in the concept of *The orthodox (cheng) and the unorthodox (ch'i)*. There is one set of polar opposites whose multitude of variations is also inexhaustible and which also leads to the enemy being completely wrong footed. This is the concept of *using the orthodox (cheng) and the unorthodox (ch'i)*. It is an important set of polar opposites and one Boyd would frequently refer to. They can be translated as the 'straightforward method and the crafty method' or 'the direct method and the indirect method'. Ch'i and Cheng must be understood in the widest sense as meaning energy, strategy, ideas, forces (moral, mental and physical). The point is that one can use force (and not forces as in specific types of units) in both conventional, traditional or imaginative unconventional ways in dealing with an opponent. Nothing in itself is either straightforward or crafty, direct or indirect. Characteristic of the concept is the fact that the unorthodox can become the orthodox. Whether it is one or the other depends on what one thinks one's opponent will expect in the particular circumstances of the battle.

The concept of *ch'i* and *cheng* is about conceptualizing, characterizing, manipulating forces within, and by exploiting, an enemy's expectation. When a frontal attack is expected, a conclusion derived from one's previous strategy and tactics and one's disposition of forces at that particular moment, then that is the orthodox and an enveloping movement will be the unorthodox. The concept also refers to the functions of forces; to fix the opponent is the orthodox but the coup the grace will be delivered by the unorthodox in a flanking attack[91].

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[88] This is mirrored in: 'if I determine the enemy's disposition of forces while I have no perceptible form, I can concentrate my forces while the enemy is fragmented. If we are concentrated into a single force while he is fragmented into ten, then we can attack him with ten times his strength. Thus we are many and the enemy is few. If we attack his few with our many, those whom we engage in battle will be severely constrained'. And furthermore in: 'the location where we will engage the enemy must not become known to them. If it is not known, then the positions that they must prepare to defend are numerous. If the positions the enemy prepares to defend are numerous, then the forces we engage will be few'[88].

[89] Ibid, ch.11, p. 220.

[90] Ibid, ch.6, p.193.

[91] See Sawyer ch.5, p.187: 'In general in battle one engages with the orthodox and gains victory through the unorthodox [….] the changes of the unorthodox and orthodox can never be completely

The extraordinary forces are used to take the enemy by surprise. Indeed, what is unorthodox and orthodox, expected or strange, direct or indirect, regular or irregular, extraordinary or normal (to name a few meanings of *cheng* and *ch'i*) is dependent on the opponent, so the actions of both sides are again mutually influenced. Here we see again a concept that aims to get the opponent off balance, this time using the expectations of the opponent's commander and employing forces in ways, times, places, movements and formations he does not expect it. It is important to note that Sun Tzu does not advocate one above the other, the indirect nor the direct but stresses the novel combination of both[92]. It is from the interaction of the unorthodox and the orthodox that the enemy is confused, demoralized, disorganized, dislocated, looking at the wrong direction etc. Variation and novel combinations of types of forces, of maneuvers and methods of deception and deceit are important.

However, understanding the enemy's dispositions (*hsing*) and his potential power (*shih*) and knowing how to apply the concept of the orthodox and unorthodox is not enough. It is incomplete unless one knows how to target one's forces against the enemy's disposition and power. The commander must have an appreciation for the concept of the polar opposites *emptiness (hsu) and fullness, or solidness (shih)*, or the *vacuous* and *substantial*. *Hsu* means empty or weak in a sense that goes beyond the physical. To be empty in the *Hsu* sense can indicate a poorly defended position or a well defended position with weak morale, lack of legitimate purpose or feeble leadership. *Hsu* indicates the crevices in an opponent's defenses which allow penetration. Conversely, *shih* can be a strongly defended position or a capable force that has every positive quality. It has high morale, strong leadership and its actions are in accord with its moral code. The problem is that no position of force is permanently solid (nor empty for that matter) and Sun Tzu sees this as a way of providing the opponent with the dilemma we already stumbled upon: what to defend and what to attack[93].

The correct use of the concept of the emptiness and solidness combined with the effects of previous concepts, creates a situation where one will be able to find and attack a weak spot in the enemy's defenses. By being formless, unfathomable and quick, the opponent will need to disperse, as we have seen, and by attacking or moving towards objects he values we disrupt his plans and disperse his units even further. Thus we create a situation where the opponent does indeed have identifiable strong points and weaknesses, which we can subsequently exploit by suddenly concentrating our force there and have superiority in mental, moral and physical power.

The Art of War contains a comprehensive holistic view, which provides a general theory of war. Boyd's work resembles *The Art of War* in that both stress context, connections, change and recognizing patterns as prime factors for cognition. Boyd follows Sun Tzu again when the latter argues that any favorable outcome of a conflict is the result of multiple methods applied simultaneously at several levels and reinforcing one another and shaping conditions for others to be effective. War is not only the affair of armies. In formulating strategy one should address the entire enemy system. At the grand strategic level this is manifest in the list of strategies available which include diplomatic, economic and military methods. At the military strategic level, operational and tactical level we see it in the interactions of the supporting concepts which all, at the different levels, aim to get the enemy off balance, to isolate sections of the opponent at different aggregation levels of his system. Actions are not exclusively aimed at one particular domain, be it the physical or

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exhausted. The unorthodox and the orthodox mutually produce each other, just like an endless cycle. Who can exhaust them?'

[92] Saywer has a good discussion on this on pp.147-150, but see also Hamlett, pp.13-15 and O'Dowd and Waldon, 'Sun Tzu for Strategists', *Comparative Strategy*, Volume 10, 1991, p.30.

[93] The source for this section is O'Dowd and Waldron, p.31-32.

mental or moral, instead they aim to impact at least two at the same time. They aim at disrupting connections (moral, informational, spatial, ideational, logistical) between the ruler and his people; between the commander and his troops, and between units, by physically separating them, isolating them, dislocating them, by morally disrupting cohesion through creating distrust and decreasing support for the ruler by thwarting his plans and taking away his army, spreading false information, bribing officials[94] and diplomatic pressure, disrupting his alliances and generally chipping away at the power base of a ruler and the legitimacy and integrity of his actions. Through the combination of unanticipated physical movement actions aim to confuse (mental sphere) and work on the moral fiber of the enemy. Through the use of secrecy, rapid movements and attacks, by attacking where not expected, by combined use of orthodox and unorthodox methods the enemy is dislocated and confused and numerically inferior, which works on the morale of the troops. The simultaneous use of multiple methods affect moral, mental and physical aspects of the enemy's system through all the levels of it.

And this leads to the essence of *The Art of War*. Viewed in the most abstract way Sun Tzu has the following strategic advice: *Preserve harmony, create chaos and achieve victory by continually keeping the enemy off balance through a superior capability to adapt.* Like Boyd, Sun Tzu targeted harmony. *Disrupting harmony, at all levels, is the objective of warfare.* The first page of the first chapter deals with the important aspect of maintaining harmony. The political goals of warfare could be achieved by creating a state of chaos in the enemy's society, which in the days of Sun Tzu meant the destruction of the psychological, social and political order, which was the ideal of classical Chinese society. Sun Tzu believed the goal of warfare was to destroy the conditions of prosperity and order that formed the link between the ruler and his people. If the link was broken, then the rulers' claim for legitimacy was forfeited. The creation of a state of chaos meant the moral failure of a rule of leader and the shift of moral leadership to the opposition; a rebel, usurper or invader[95]. Sun Tzu also lists disorganization, distrust, ruin, collapse, flight and insubordination as factors that can undermine an army, factors that induce chaos and lead the commander away from a state of harmony. Boyd incorporates this theme in the types of conflict he thinks strategically the soundest: Maneuver Conflict and Moral Conflict, two types which straddle the military and the non-military dimension between them.

The means to achieve this goal is having a superior capability to adapt. As in Boyd's work, Sun Tzu's work revolves around the notion of adaptability. The whole idea of preservation of harmony at all levels, of inducing chaos at all levels, about acquiring information and being formless, fathomless and about maintaining secrecy, etc, are about the need to maintain the capability to adapt. And the prime concept that reflects this is the idea that *one should accord with the enemy*. It reflects the understanding that the opponent behaves unpredictable and one's efforts should be aimed at constantly monitoring the state of the opponent and his options, and towards attempts to shape these options and limit their range and variety. Adapting means looking at the opponent's responses, which are reflections of his attempts to adapt. Boyd's work is very close to *The Art of War* in spirit. There are very close parallels in the prime role of information accorded in strategy, in the role of perception, in the attention for pattern recognition, in the importance of tempo, surprise, novelty and mismatches. Indeed, if there is one strategic author Boyd must conceptually be related and compared

[94] Although not covered here, anyone interested in subverting a government from within should take a look at the T'ai K'ung's Six Secret Teachings in The Seven Military Classics of Ancient China.
[95] O'Dowd and Waldron, p. 27.

with, it is Sun Tzu. And the ideas of Sun Tzu were far from common knowledge in the US armed forces during the mid-seventies.

Fertile soil: The US Military After Vietnam

While his fighter background provided him with important notions about success in a highly competitive and fluid environment and as such is indispensable for understanding Boyd's work, it is also necessary to pay attention to the mood of the period during which Boyd examined military history and developed *A Discourse*. In the aftermath of the Vietnam War, the US military and political environment which Boyd was part of, offered a receptive background which not only welcomed novel ideas, but also provided a stimulating and fertile environment for translating ideas into practice.

Following his return in 1973 from Thailand, were he worked on a classified intelligence operation[96], Boyd, along with the rest of the Fighter Mafia, became part, even the nucleus, of what was labeled the Military Reform Movement, an involvement Boyd was to continue with zeal after his retirement on 1 September 1975. This amorphous group consisted of serving and retired military officers, journalists, academics, experts from industry as well as high-ranking politicians such as Newt Gingrich, Gary Hart, Sam Nunn and Dick Cheney. There was no official agenda but a shared intent on improving the way the US Department of Defense did business in the wake of the Vietnam War. From 1976 to 1986 they rallied against the ever upward spiraling complexity and costs of military equipment, driven not necessarily be sound operational requirement as by industrial interests and a faith in technology on the part of Pentagon officials.

Boyd became one of the key persons. The reform movement was glued together by Boyd's reputation and his ideas that slowly matured in the initial *Patterns of Conflict* briefing[97]. Boyd remained active as a (deliberately) non-paid consultant to the Office of the Secretary of Defense[98]. Around him the reform movement expanded in numbers of followers, visibility and in influence.

While the reform movement and Boyd's role in it is interesting for understanding US defense policy, and demonstrates yet from another angle Boyd's status, for understanding Boyd's work this movement was important for other reasons. The expanding network exposed an increasing number of people in various offices and from all services and political parties to Boyd's ideas. Boyd kept on expanding *Patterns of Conflict* and briefed the evolving content to the growing number and variety of people he gained access to. It brought him in touch with people who in their own way were trying to change the US military and incorporate the lessons of the Vietnam War, and who were looking for valuable ideas for change.

Another factor emanating from this environment that influenced his work was the prevailing approach in US defense planning. The reform movement revolted against this managerial approach and the "culture of procurement", which was characterized by an emphasis on the tangibles of war, such as the state of military technology and the quantity of fighter aircraft, tanks and naval vessels, and the firepower potential on the battlefield. Defense planning was considered a rather straightforward and rational exercise in

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[96] See for Boyd's command experience in Thailand, see Coram, chapter 19.

[97] See Hammond, pp.101-117. Hammond cites various sources and quotes several noted authors to make his case that Boyd was a key figure in the military reform movement. Also, Coram, chapters 25 to 31, in particular chapter 25.

[98] Or almost unpaid: he did receive symbolic payment in order to retain access to the Pentagon. I am endebted to Chet Richards for this remark.

calculation, based on the assumption that indeed it was possible to make some pretty accurate predictions concerning the nature of combat engagements with future foes. There was a distinct overvaluation of systems analysis in stategic debate and defence policy, Brodie observed in 1973[99].

Colin Gray offers additional insights into the strategic and military cultural mood that characterized this period, and against which Boyd and the Reform Group railed. From the early 1950s to the late 1980s, the dominant school of strategic theory followed an ahistorical, apolitical method of calculating purportedly correct "answers" to defense problems. Both liberal and conservative analysts in the defense community showed a naive faith in the tradition of Baron Henri de Jomini. The American engineering spirit sought to reduce strategic problems to equations. A tendency existed to seek refuge in technology from hard problems of strategy and policy. The American way in defense preparation as well as war has emphasized the technical and logistical rather than the well-informed and operationally agile.

Moreover, change in the military was determined by organizational interests. The roots of modern American military strategies lie buried in the country's three most powerful institutions: the army, the navy and air force. Though many people outside the military institutions, including academics and presidents may propose military strategies and concepts, these can be implemented only if and when military institutions accept and pursue them. The environments (land, sea and air) largely determine the technologies, the tactics, and the character of the operational goals[100].

As James Fallows (an associate of Boyd) warned in 1981, this approach to defense planning and war manifested a neglect of the "intangibles" of war, such as leadership, doctrine, morale, personal skills, combat experience, tactical ingenuity, information and strategy. It ignored or dismissed the fundamentally uncertain nature of war. Not surprisingly Boyd's work focused exactly on those intangibles and critiqued the managerial mindset, which he equated with the attritional style of warfare that employed predictable linear tactics and numerical superiority to bleed to enemy to death[101]. Boyd, in a series of of profound briefings, began to remind everyone: 'Machines don't fight wars. Terrain doesn't fight wars. Humans fight wars. You must get into the minds of humans. That's where the battles are won'. This aspect had been totally missing from the debates in the Pentagon[102].

There were various programs ongoing in the different services to improve military hardware, to introduce more realistic training and to update military doctrine so as to reflect the nature of operational challenges US military units would face outside of the confines of the Cold War. Still, the strategic discourse during the Vietnam War was dominated by nuclear strategy. In the development of strategic theory the period of the mid-fifties to mid sixties of the twentieth century is sometimes referred to as the 'golden age' of contemporary

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[99] Brodie (1973), p.473.

[100] See Colin Gray, 'Strategy in the Nuclear Age', in Williamson Murray, MacGregor Knox and Alvin Bernstein, *The Making of Strategy, Rulers, States, and War*, (Cambridge University Press, Cambridge, 1994), pp.587-593.

[101] See James Fallows, *National Defense* (Random House, New York, 1981), pp.15-17. For detailed discussions and sometimes overt defence of the prevailing defence planning system see for instance Lee D. Olvey, Henry A. Leonard and Bruce E. Arlinghaus, *Industrial Capacity and Defense Planning* (Lexington Books, Lexngton, Massechussets, 1983), which interestingly includes a foreword by a leading defence company.

[102] Burton, p.43.

strategic thinking[103]. If so, it was dominated by progress in theoretical notions concerning the threat and/or use of nuclear weapons within the context of the bi-polar world and it was golden for those involved in nuclear strategy making. This discourse reflected political concerns in the US concerning international security. Since the Korean War the US saw itself as 'world policeman dedicated to combating Communism wherever it appeared' and this policy culminated in the Vietnam War. US defense policy revolved around questions concerning nuclear strategy and capabilities[104]. Nuclear missions were emphasized and conventional weapons and training minimized. Strategic nuclear forces were considered up to well in the sixties an instrument to prevent war at all levels[105].

Although there was a constant debate concerning the right balance of conventional and nuclear capabilities, conventional forces were discussed within the context of deterrence and the debates were mostly focusing on the European theatre, and the dominant mode in strategy was one of annihilation of the enemy[106]. Limited wars (in terms of threat and interests at stake and the overall level of national effort required for sustaining the war) such as the one in Vietnam had only a very limited influence on the orientation of the US armed services when choices had to made concerning system development, acquisitions and doctrine[107].

The consequence of this was a general neglect of the operational level of war and inappropriate military doctrine when faced with North-Vietnamese guerrilla attacks[108]. The Vietnam War was in that respect a defining experience, revealing the consequences of the nation's previous fixation on nuclear strategy at the expense of adequate preparations for conventional war. It provided a wake-up call regarding the kinds of defenses the United States and members of NATO would have to contend with in configuring themselves for a possible future counteroffensive against Soviet and Warsaw Pact forces in Central Europe[109].

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[103] See for instance Ken Booth, 'The Evolution of Strategic Thinking', p. 35, in John Baylis, Ken Booth, John Garnett and Phil Williams, *Contemporary Strategy, Theories and Policies*, (New York, 1975).

[104] Larry H. Addington, *The Patterns of War Since the Eighteenth Century* (Indiana University Press, Bloomington, second edition, 1994), p.290. For a concise discussion of nuclear strategy from 1945-1985, see Lawrence Freedman, 'The First Two Generations of Nuclear Strategists', in Peter Paret (ed), *Makers of Modern Strategy* (Princeton, NJ, 1986).

[105] Benjamin Lambeth, *The Transformation of American Air Power,* (RAND, Santa Monica, 2000), p.35.

[106] Russell F. Weighly, *The American Way of War, A History of United States Military Strategy and Policy,* (MacMillan Publishing Co, New York, 1973) p.476. In Europe US units were stationed to share risk and signal commitment, as well as to act as a trigger. They were not expected to hold off a large scale Soviet invasion with conventional for long, and defense plans in the 1960's did not exceed 90 days of conventional fighting. See Phil Williams, 'United States Defence Policy', in Baylis, et al (1975), pp.196-206.

[107] See for instance Andrew Krepinevich, *The Army and Vietnam* (Johns Hopkins University Press, Baltimore, 1986), chapter 2; Stephen Peter Rosen, *Winning the Next War*, (Cornell University Press, Ithaca, 1991), chapter 1; Deborak Avant, *Political Institutions and Military Change,* (Cornell University Press, Ithaca, 1994), chapter 3.

[108] Hallion blames the dominant nuclear strategic discourse for a USAF institutional bias towards nuclear capabilities, stating that 'it was in Vietnam that the shortsightedness of overemphasizing nuclear war-fighting became most apparent'. The USAF, even its tactical component, was geared towards a nuclear war. One might have expected that Korea would have demonstrated the fallacy of such a one-sided defense orientation, but it was considered an exception. Under the rubric 'New Look' nuclear warfare contingency planning predominated. Valuable experience in air support was lost and had to be won the hard way again in Vietnam. See Hallion, pp.15-19.

[109] Ibid, p.48.

Turbulent environment

This conviction was shared by all US services. Vietnam revealed deep deficiencies in all four services and in response each of the services drew the appropriate lessons from Vietnam and reacted with determined and, in some cases, quite far-reaching reforms[110]. None of the services had been able to formulate a coherent military strategy, if there was one feasible in the first place, for the challenges of Vietnam except the insistence on pursuing a war wining strategy in stead of the half-hearted "signaling" approach of Johnson and McNamara. Yet each remained badly divided on the details of implementation, with each typically advocating his own service's wherewithal as the preferred answer to the challenge[111].

So after Vietnam, the US Army, US Navy and US Marines were keenly aware of the doctrinal problems they were facing, despite the fact that in particular the US Army had experimented with the Air Mobile Division and achieved remarkable but often underappreciated tactical successes[112]. Indeed, of all the armed forces in the 1960s, the Army most perfectly conformed to the doctrine of Flexible Response and its emphasis on non-nuclear action[113]. Yet the US Army, along with the other services experienced problems concerning morale of troops, drug abuse, desertion, mutiny[114]. Naveh cites US Army general Don Starry who noted in 1985, after a long and difficult process of formulating new operational level doctrine, that 'for all practical purposes, the study of operations ended in the US Army after World War II. Perhaps the belief that nuclear weapons meant the end of conventional land warfare was to blame, but whatever the cause, the knowledge of large units operations declined continually even with the object lesson of Korea before us'. The US Marines, for their part, adhered to true and trusted principles of amphibious warfare and thus maintained a narrow focus of their mission.

Thus, Vietnam's impact on the American military was dramatic[115]. Indeed, the period from Jimmy Carter's presidency to Ronald Reagan's second term was one of intense soul-searching and turmoil within the US defense establishment. There was confusion about national security strategy, national military strategy, the transition from conscription to an all-volunteer force, military relevant technologies, arms control, fights among the services on individual weapons systems and just why the war had been lost. The military had to reinvent itself after military defeat and steel itself for challenges at both ends of the spectrum[116]. While most military professionals believed that the Vietnam War had been ineptly conceived and badly run and disillusionment with political and military leadership inculcated an attitude of mistrust that manifested itself in bitterness toward senior military and civilian leadership, it also drove a zealous desire for internal reform[117].

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110 Ibid, p.54.
111 Ibid, p.49.
112 See for a short but representative summary of (mostly tactical) things that went right, for instance Lambeth and Hallion, pp.21-23. Vietnam saw the use of 'smart' weapons, excellent air-ground coordination, widespread effective employment of air mobile operations with helicopters and the development of the armed helicopter.
113 Addington, p.291.
114 Hallion, pp.17-18.
115 Ibid.
116 Hammond, p.106.
117 Hallion, p.18.

The Israeli experience during 1973, despite considerable differences with the Vietnam experience[118], only reinforced the impression among US military that conventional war fighting capabilities needed to be addressed and that operational level doctrine needed serious attention[119]. With Egypt armed with the latest Soviet equipment, in particular SAM systems, The United States and its NATO allies got an arresting preview of what an all-out showdown with the newly expanded Soviet conventional force posture might entail. It demonstrated the extent of the Soviet military buildup from 1965-1972. Not only did the Soviets achieve acknowledged parity with the US in both number and quality in the crucial realm of intercontinental and submarine-launched ballistic missiles, it also upgraded its forward-deployed conventional forces[120]. The 1979 Soviet invasion in Afghanistan provided a midcourse reminder of the US armed service's need to reshape and recast themselves.

This was neither a simple process nor one that led to immediate changes in military effectiveness. Instead, numerous changes had to occur before planners could be confident that the services had the kind of forces, body of thought and doctrine, and weapons to confront various levels of warfare ranging from support to client states in Third World conflict to actual large-scale commitment of American forces in, for example, a NATO-Warsaw Pact war. This was a bottom-up driven process rather than a Carter presidency defense policy guided effort. While the Reagan-era defense build-up after 1980 greatly accelerated, expanded, and encouraged this get-well process, progress (in particular during the latter halve of the 1970s) was mostly the result of programs, initiatives and experiments undertaken by the services, spurred on by 'mid-level' managers and combat veterans who wanted to redress the procedural, organizational, doctrinal, and equipment shortcomings of the Vietnam era[121], a process in which Boyd was closely involved. While Brodie's remark that the military profession provides some of the most barren soil for the nurture of independence of thinking may be correct in principle[122], in this period after - and because of - the Vietnam War an environment thus emerged in which new ideas on doctrine and strategy would find fertile soil and indeed, Boyd's ideas evolved in symbiotic fashion with efforts of different services to develop new and appropriate doctrinal frameworks[123].

Adaptive Marines

Reform within the US military occurred along various axes and was an arduous process. Hardware improvements were one axis of transformation. The US Navy registered significant gains in terms of hardware, including the addition of Aegis class highly advanced air defense ships and cruise missiles, its basic orientation was not altered and consisted mainly of hunting down Soviet submarines and protecting the sea lanes connecting the US and Europe, and neutralizing any Soviet air or naval force that might contest American control of the high seas worldwide. The US Army modernized its equipment inventory by

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118 See Hallion for a sobering note on the perception that the Middle East conflicts could be related to lessons learned of the Vietnam War.

119 Lambeth, p.69; Naveh, p.254.

120 Lambeth, pp.54-55.

121 Ibid, pp. 55-56.

122 Brodie (1973), p.458.

123 To underline the willingness to embrace the new, Paul Johnston remarks that in the 1980s the US Army welcomed maneuver warfare with open arms, indicating the institutional response to innovative ideas was quite different from the attitude of the British Army in the Interwar years as it tried to develop armored warfare doctrine. See Paul Johnston, 'Doctrine is not Enough: the Effect of Doctrine on the Behavior of Armies', *Parameters*, Autumn 2000, pp.30-39.

the introduction of the M1 Abrams tank, the M2 Bradley armored vehicle, the AH-64 Apache attack helicopter, the UH-60 Blackhawk utility helicopter. In the decade from 1975 to 1985 the US Air Force improved its inventory of precision weapons, electronic warfare assets, its capability to suppress enemy air defenses, the ability to operate at low level, during night and adverse weather conditions. Finally, stealth technology was developed. These technological advances were coupled to improvements in training with the creation of large complexes from where large formations of fighters, bombers, and supporting aircraft could exercise in a highly realistic environment against air and SAM systems mimicking Soviet assets and tactics[124].

But Boyd must be credited for providing the conceptual heart of the dominant and perhaps most relevant theme characterizing the transformation within the US armed services. Feeding upon technological progress in the field of precision munitions, armor and surveillance equipment, and in turn inspiring technological developments[125], both the US Army and US Marines made a transition from a defensive orientation and attrition mentality towards a new concept of maneuver warfare aimed at engaging attacking enemy forces both close and deep simultaneously, and with heavy reliance on air support. This implied a move away from a focus on linear operations, a reliance on overwhelming force and massive firepower towards a style of operation based consisting of multiple thrusts, surprise, deception, non-linear fluid actions aimed at uncovering enemy weaknesses and an emphasis on achieving disintegration, shattering the cohesion among enemy units and their action, rather than destruction by a continuous and predictable battering of enemy strong points. Integral with this shift was a rediscovery of the operational – or theater - level of war.

The US Marines adopted the maneuvrist approach for a number of reasons. The Vietnam experience had convinced them that the American way of attrition warfare was not a successful means of warfare. Moreover they realized they had neither the numbers nor the equipment to survive in the European environment where large scale armored and mechanized units were supposed to clash. Within NATO they were subsequently assigned the mission to guard NATO's northern front in Norway. Still, here too they faced the prospect of a big battle. With concurrent debates on the actual relevance of large amphibious operations, many in the Corps deemed it necessary to think about changing the way they thought it should prepare and fight in future wars.

Boyd played a very active part in this process and was closely associated with leading advocates of doctrinal change within the US Marines. In particular from 1979 onwards several Marine Corps officers later to achieve high ranks were exposed to Boyd's ideas through lectures and discussions Boyd had with them on their invitation. His maturing ideas were incorporated in experiments ongoing in the Amphibious Warfare School in discussions within the Marine Corps Development Center (which is the doctrine development organization). Both institutions aimed to find an alternative to the attrition style war fighting with linear tactics and a focus on fighting enemy strong points.

Boyd shared these concerns. Attrition warfare is merely a matter of sacrificing men and treasure to win battles. It does not require superior mental capacity, strategy or great generalship as long as one side had the firepower and manpower to overwhelm the enemy. But Boyd drew radically different conclusions than the historian Russell Weighly, who, in his study of *The American Way of War* of 1973, concurred with Admiral Wylie's remarks that

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[124] See Lambeth, pp.59-81.

[125] Andrew Latham, 'A Braudelian Perspective on the Revolution in Military Affairs', *European Journal of International Relations*, Vol.8(2), p.238.

conventional military force and any military form of military strategy had lost its utility in light of the experience of Vietnam and the ever threatening specter of nuclear war[126].

Instead, Boyd found different approaches to warfare, ones that would cost fewer American lives, in German maneuver warfare and Eastern philosophies such as the work of Sun Tzu. The Marines thus found the alternative in Boyd's emphasis on speed, tempo, variety, surprise, trust, initiative, movement, the moral and mental dimensions over technology, superiority in numbers and massed fire power, items the Corps was short of. Boyd argued for non-linear tactics, avoiding and bypassing enemy positions, venturing deep into enemy territory without too much concern for one's own flanks. The prize was not territory but time, surprise and shock. Such tactics would force the enemy to react. It would create the impression marines were everywhere and could strike anytime anyplace. Instead of focusing on terrain and the amphibious landing, Boyd learned them to focus on the enemy. Maneuver warfare was not a new concept of course, but the way Boyd presented it was[127].

Boyd's ideas were translated after a decade of lectures, briefings and debates in Marine Corps doctrine, explicitly including Boyd's systems theoretical and chaoplexity perspective as will be explained in the following chapters[128]. In 1994 the US Marine Corps adopted nonlinear dynamics, and the ideas of Complexity Theory, realizing that they provided an underlying basis for the Marine doctrine of maneuver warfare embodied in the capstone manual Warfighting. One of the authors later described war as 'an organic exchange of energy, matter, and information between open, linked hierarchies according to the laws of far-from-equilibrium thermodynamics'[129]. Indeed, it was in this novel conceptualization that the new US Marine doctrine constituted a major breakthrough, as David Alberts and Thomas Czerwinski assert[130]. The relevance of Boyd's contribution can be judged by the fact that he was bestowed the distinguished title of 'honorable marine' and that the US Marine Corps University Boyd's houses Boyd's collection of papers on specific request by the commandant of the US Marine Corps.

Boyd and tanks

The US Army responded in a different manner. First it chose to orient itself on the main challenge: countering a surprise Warsaw Pact armored assault against NATO[131]. It considered the involvement in counterinsurgency in Vietnam as an aberration and a mistake to be avoided, while the 1973 war in the Middle East provided sufficient rationale for focusing on conventional warfare. Moreover, Europe was the undisputed core of US foreign policy aimed at the containment of the Soviet Union and its defense the central role for US troops, a position only reinforced under the tenure of then Secretary of Defense James Schlesinger. Schlesinger aimed to re-establish European confidence in the American commitment to the defense of Europe[132]. US military thinking thus reverted to the sort of

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126 Weighley (1973), pp.475-77.

127 Cowan, p.19.

128 Cowan, pp. 23-28; Hammond, pp.195-96, Coram, chapters 27-28.

129 John Schmitt, 'Command and (Out of) Control: The Military Implications of Complexity Theory', in David Alberts and Thomas Czerwinski, *Complexity, Global Politics and National Security,* National Defence University Press, Washington D.C. 1998) chapter 9.

130 Ibid, preface, p.2.

131 See General Donn A. Starry, 'Tactical Evolution – FM 100-5', *Military Review*, August 1978, pp. 2-11, for an account by one of the leading senior officers of this reorientation process.

132 Richard Lock-Pullan, "'An Inward Looking Time": The United States Army, 1973-1976', *The Journal of Military History*, 67 (April 2003), p.485.

campaign with which it was most comfortable, and which had been validated during the Second World War, based on technically superior, skillfully orchestrated and highly mobile firepower geared to eliminating the opposing force[133].

Secondly, the re-orientation constituted also an organizational need, as the Army was in critical decline. The Army was so utterly run-down in the aftermath of, and due to the Vietnam War, that it had to focus first on its principal mission. In 1972 only four of the Army's thirteen active divisions were rated as ready for combat. Moreover, development of doctrine, equipment, training and education had stood still for nearly a decade. Additionally, Army units in Europe had been used as a rotation base for short tours in Vietnam, resulting in an inability to maintain military proficiency there. On top of these problems, the Army faced the challenge of transitioning from a force based on mobilization and conscription towards a fully professional Army[134].

Not surprisingly, within the Army swelled a huge level of disillusionment and a chronic need for reform[135]. US Army leadership thought the solution against the superior numbers and offensive doctrine lay in a synergistic marshalling of the alliance's air and ground assets against identifiable weak spots in the Warsaw Pact's concept of operations. This led to several doctrinal experiments, publications and debates. In 1976 the US Army Active Defense Field Manual 100-5 was published, which aroused a debate within the US Army and within the Military Reform Movement, and which drew severe comments by Boyd in his lectures for US Army officers.

Critics said it placed too much emphasis on the defense and 'winning the first battle'n, ignoring the psychological dimension of warfare, and focused too narrowly on Europe[136]. Indeed, US Army leadership focused not on the most likely conflict but on the one with the largest consequences and on the belief that the battle in Central Europe would be the most demanding mission the US Army could be assigned. Whatever its flaws, the manual did succeed in making the officer corps care about doctrine and it led to a renaissance of professional discourse on how the army should fight[137]. In 1981 one junior officer noted with some sense of understatement that 'the sobering perception that our historic firepower-attrition method of warfare offers a recipe of defeat has begun to surface in military journals'[138]. And he was right.

The military reform movement played a large role in this debate by responding to, and debating US Army doctrinal publications and Boyd again was closely associated with the leading reformers in the US Army (such as Huba Wass the Czege) and like minded policy advisers (such as senator Gary Hart's aide for military affairs Bill Lind, who authored a book titled *Maneuver Warfare,* which was entirely based on Boyd's ideas). They offered the

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133 Lawrence Freedman, 'The Third World War?', *Survival,* vol.43, no.4, Winter 2001-02, p. 69.

134 Lock-Pullan, pp.486-490.

135 See for an illustration of this for intance Major Marc B. Powe, 'The US Army After The Fall of Vietnam', *Military Review*, February 1976, pp.3-17.

136 See for instance William (Bill) Lind, 'Some Doctrinal Questions for the United States Army', *Military Review*, March, 1977, pp. 54-65; Archer Jones, 'The New FM 100-5: A View From the Ivory Tower', *Military Review*, February 1977, pp. 27-36; Major John M. Oseth, 'FM 100-5 Revisited: A Need for Better "Foundations Concepts"?', *Military Review*, March 1980, pp. 13-19; Lieutenant Colonel Huba Wass de Czege, and Lieutenant Colonel L.D. Holder, 'The New FM 100-5', *Military Review*, July 1982, pp. 24-35.

137 Conrad C. Crane, *Avoiding Vietnam: The US Army's Response to Defeat in Southeast Asia,* (Strategic Studies Institute, US Army Carlisle Barracks, September 2002), pp. v, 4. Donn Starry too saw this as one of the merits of the 1976 version of FM 100-5.

138 Captain Anthony Coroalles, 'Maneuver to Win: A Realistic Alternative', *Military Review*, September 1981, p.35.

alternative of the maneuver school of warfare. Several army officers noted Boyd's presentations he gave at the Marines Corps, and the positive reaction of the Marines[139]. Subsequently, following the publication of FM 100-5, topics such as Blitzkrieg, Auftragstaktik, Schwerpunkt, and new leadership principles, the ideas of Sun Tzu, J.F.C Fuller and B.H. Liddell Hart, the merits of maneuver warfare versus attrition type warfare, the concept of the operational level of war, the determinants of successful change in armies, Soviet Operational Art, and even Genghis Khan, frequently appeared in articles, all themes present in Boyd's work that evolved during that time[140].

Boyd's influence was also explicit. The young captain's explanation of Boyd's message at the time sheds light on the measure of Boyd's influence as well as on the state of development of Boyd's thinking in 1979-1981. Coroalles explains that Boyd rediscovered the philosophers and practitioners of maneuver warfare such as Alexander, Genghis Khan, Maurice de Saxe, de Bourcet, Guibert, J.F.C. Fuller and Heinz, Guderian. Next he offers Boyd's ideas to lay out the alternative to the attrition method. As he states:

> Colonel Boyd observed that in any conflict all combatants go through repeated cycles of an observation – orientation – decision –action (OODA) loop[…]The potentially victorious combatant is the one with the OODA loop which is consistently quicker than his opponent (including the time required to transition from one cycle to another). As this opponent repeatedly cycles faster than his opponent, the opponent finds he is losing control of the situation[…]his countermeasures are overcome by the rapidly unfolding events and become ineffective in coping with each other. He finds himself increasingly unable to react. Suddenly, he realizes there is nothing else he can do to control the situation or turn it to his advantage. At this point he has lost. In essence his command circuits have been overloaded, thereby making his decisions too slow for the developing situation […] all that remain are uncoordinated smaller units incapable of coordinated action. The enemy's defeat in detail is the eventual outcome[141].

This method would require continuous high tempo operations, a focus on creating and exposing flanks and rears, a concentration on weaknesses instead of enemy's strengths. Firepower would be used primarily for disrupting the enemy and not solely for its attrition effect. It would require furthermore mission tactics or Auftragstaktik for the party which can consistently operate the longest without new orders will inevitably have the greater advantage over an opponent awaiting orders after every action. Such a command style requires mutual trust and a reliance on small-unit initiative[142].

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[139] Ibid. Coroalles for instance refers to an article in *The Marine Corps Gazette* titled 'winning through maneuver' of December 1979 by captain Miller.

[140] See for instance, Colonel Wayne A. Downing, 'Firepower, Attrition, Maneuver, US Army Doctrine: A Challenge for the 1980s and Beyond', *Military Review*, January 1981, pp. 64-73; Roger Beaumont, 'On the Wehrmacht Mystique', *Military Review*, January 1981, pp. 44-56; Archer Jones, 'FM 100-5: A view from the Ivory Tower', *Military Review*, May 1984, pp. 17-22; Major General John Woodmansee, 'Blitzkrieg and the AirlandBattle', *Military Review*, August 1984, pp.21-39; Colonel Huba Wass de Czege, 'How to Change an Army', *Military Review,* November 1984, pp. 32-49; Captain Antulio J. Echevarria II, 'Auftragstaktik: in its Proper Perspective', *Military Review*, October 1986, pp. 50-56; Daniel Hughes, 'Abuses of German Military History', *Military Review*, December 1986, pp. 66-76; Major General Edward Atkeson, 'The Operational Level of War', *Military Review*, March 1987, pp. 28-36.

[141] Coroalles, pp. 37-38.

[142] Ibid, p.38.

The debates resulted via the improved 1986 FM 100-5 edition into the AirLand Battle concept and the Follow On Forces Attack plan[143]. And as Naveh asserts:

> the transition from the traditional paradigm of attrition by means of superior technology and tactics to one of advanced operational maneuver comprises the essence of the evolutionary process in the US armed forces and the community of military theoreticians[144].

It involved a refocusing of attention toward the moral and human dimensions of battle, introducing into the US doctrine the clarifying notion of the operational level of war and a return to the fundamental principles of attaining victory and appreciation of immeasurable of combat such as leadership, initiative and the commander's intuitive sense of time and maneuver[145]. It was a 'Kuhnistian venture' and at heart lay an approach to war that was based on intellectual innovation rather than sheer material superiority[146]. A short discussion of this venture will illustrate both Boyd's important role, as well as the fact that Boyd's ideas which were maturing in this period, were influenced by the agenda of the reform movement which was focussed on inspiring change.

Naveh proves and Coram suggests it was the activity of the civilian reformers which ignited the cognitive crisis and set in motion the professional debate of the late 1970s. Boyd is considered one of five intellectuals which served as the catalyst of the conceptual reform[147]. The intellectual innovation was inspired first and foremost by Boyd, as Naveh in various sections demonstrates[148]. Naveh, Hammond, Coram and before them, US senator Gary Hart, assert that Boyd was in many respects the intellectual leader of the group[149]. Boyd's ideas, including the OODA loop construct, were considered the philosophical basis[150]. As William Lind stated in an article in the *Marine Corps Gazette*, later repeated by another author in *Military Review, '*The Boyd Theory is the background for maneuver warfare doctrine'[151]. Boyd was also unique in being the only (former) military officer to intellectually contribute to the military reform[152].

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[143] Good short descriptions are provided by Hallion, pp.72-82 and Lambeth, pp.83-91. Two short studies are, and Richard M. Swain, 'Filling the Void: The Operational Art and the US Army', in B.J.C. McKercher and Michael A. Hennessy*, The Operational Art, Developments in the Theories of War*, (Preager, Westport, 1996). For a very detailed account see Naveh, chapters 7 and 8.

[144] Naveh, p.251.

[145] Lambeth, p.91; and General William Richardson, 'FM 100-5, The AirLandBattle in 1986', *Military Review*, March 1986, pp. 4-11 (Richardson was the commander of the organization responsible for the publication of the new doctrine).

[146] Naveh, pp.252-56.

[147] Ibid, p.258.

[148] See for reference to Boyd and the OODA loop in the development of US Army doctrine in particular pp. 256-262, 297, 301.

[149] Ibid, p. 279, note 35.

[150] Ibid, p.260.

[151] See Lieutenant Colonel Mark Hamilton, 'Maneuver Warfare and All That', *Military Review*, January 1987, p.3; Willian Lind, 'Defining Maneuver Warfare for the Marine Corps', *Marine Corps Gazette*, March 1980, p.56.

[152] Naveh, p.257. Later, in a often noted article, Lind and four co-authors again acknowledged that Boyd was to be credited for rediscovering the art of maneuver warfare in his work and the OODA loop theory. See William Lind, Colonel Keith Nightengale, Captain John Schmitt, Colonel Joseph Sutton, Lieutenant Colonel G.I. Wilson, 'The Changing Face of War, Into the Fourth Generation', *Military Review*, October 1989, p. 4.

Boyd contributed with his conception of the operational principles of the relational maneuver: disruption of synergy among the elements combining the rival system; simultaneous engagement of the operational components, structured hierarchically along the entire depth of the opposing system; and development of operational momentum, exceeding the relative reaction capability of the rival system[153]. Boyd, according to Naveh, citing various sources, perceived the operational maneuver, which he sometimes called the OODA Loop, as a succession of actions guided by the logic of making a rival system irrelevant in the context of its own aim. He formed the idea of operational shock as the rationale of the functioning of military systems and determined the coherent nature of the linkage between maneuver and its consequence. This offered a cognitive basis for the creation of a future operational paradigm.

Boyd argued that the effectuation of operational shock obliged the director of the maneuvering system to muster his cognitive and mechanical efforts through a continuous systemic process combining the following functions: a deliberate contrivance of an operational weakness or flaw in the rival's system's layout; distortion of the operational rival's consciousness by manipulative deception that would detach his apprehension from the strategic reality; and the assemblage of the various mechanical activities into a main strike directed at the rival's system's operational weakness[154]. The result was not a radically new perspective on warfare, but the marriage of new technology with operational concepts that Patton or Guderian would have been comfortable with - a rapid operational tempo, *Auftragstaktik*, seamless combined arms operations, and so forth[155].

Boyd's influence was not only due to the merits of his arguments alone. Boyd had no objection to air his views and critique if necessary through the national media. In the Spring of 1981, his theories burst into the national scene with articles in for instance the *Washington Post* and *Atlanta Constitution* running titles such as 'New War Theory Shoots Down Old War Ideas'. Not surprisingly this gained his ideas attention but also gained him enemies. He deliberately embarassed the leadership of the US military, in particularly the US Army by asserting that there were no real military theorists practicing their craft in the US. They had been replaced by scientist and technologists, people who had no idea about a concept such as Sun Tzu's Cheng/Ch'i. But the US Army did take notice, or rather, plagiarized his work[156]. As in the case of Boyd's involvement with the US Marine Corps, in the US Army too Boyd's ideas were in particular readily accepted by the relative young field-grade officers, wereas more senior leaders tended to hang on to established ideas[157].

Five years after Boyd had begun lecturing *Patterns of Conflict* the US Army formally changed its doctrinal course. Boyd's ideas were interpreted almost literally into four basic tenets comprising the conceptual skeleton of the Airland Battle doctrine: initiative, agility, depth and synchronization[158]. Initiative meant maintaining an offensive spirit, not in the foolish sense of the French army in the first years of World War I, but, rather, in the constant effort to seize or retain independence of action. It emphasized that subordinates must be able to act independently within the framework of an overall plan. Depth meant combining elements of time, distance, and resources across the entire spread of a battlefield to prevent an enemy from concentrating his firepower and maneuvering freely. Agility

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153 Ibid, p.258.
154 Naveh, p.258.
155 Steven Metz, 'The Next Twist of the RMA', *Parameters,*Autumn, 2000, p.40.
156 Burton, pp.43-44.
157 Ibid, p.51.
158 Department of Defense, *Field Manual 100-5, Operations,* (Washington DC, Department of the Army, 1982), Section 2-1.

emphasized being more responsive, anticipatory, and flexible in decision-making and movement than an enemy to avoid enemy strength and exploit vulnerabilities. Finally, synchronization emphasized coordinated action and an all-pervading unity of effort[159].

The great relevance of the American theoretical adventure derives from the fact that it represents the first conscious attempt of any Western army to apply a systemic approach to the field of operations. In the course of its new conceptual enterprise, resulting from the post-Vietnam professional perplexity, American military mentality moved from an addiction to attrition based on tactical parochialism and technology to the adoption of the operational maneuver[160]. However, the true significance of this period for the US Army was not the crafting of AirLand Battle, but the inculcation of a tradition of creativity and introspection. It institutionalized creativity and conceptual thinking in the US Army[161].

A Discourse as product of interaction

Thus, his work matured in direct response to an obvious requirement and by virtue of the interaction with his audience. His work reflects the themes discussed at the time while these discussions were influenced either directly by Boyd or through Boyd's group of followers. Boyd developed, expanded and articulated his own thoughts in part in response to the debates and his interaction with the military and civilian audiences. As Coram remarked, Boyd needed the dialectic of debate[162]. This explains also the format of a presentation to convey his ideas. The reason why he chose to make slides instead of a book lies in the fact that in his view slides were a better tool for communication, in particular in the military environment which has a visually oriented culture in which overhead slides featured prominently, and slide shows can be expanded and amended, books not quite that easily.

Indeed, Boyd recognized that his work was never going to be complete[163]. The slides were his medium to get his point across. As one author who walked the halls of the Pentagon stated, 'Boyd was a tireless briefer […] and indeed made a major contribution to an entirely new Pentagon *Zeitgeist* on the use of force'[164]. Using his slides as an educational tool, he guided his audiences through his ideas. He made them go through the same step by step process of analysis and synthesis. To understand Boyd nowadays, one needs to regard his slides as the manifestation of this learning process. Reading his slides must be considered a learning process, for not the OODA loop is the message, but getting to that insight is.

But it was also a discourse, a two way process. And while Hammond rightly observed that 'there is little doubt that Boyd's hundreds of *Patterns of Conflict* briefings around the Pentagon and throughout the US military had prepared the ground for a different approach to war fighting for the American military'[165], equally, this interaction and the background of the interaction produced *A Discourse*; they stimulated the growth of ideas and conceptual innovation in two ways. First, the condition, the institutional problems, the recent experiences and needs of the US armed services provided an input in the nature of the

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159 Hallion, pp. 77-78.
160 Naveh, p.252.
161 Metz, p.40.
162 Coram, p.322.
163 Cowan, p.17.
164 Peter Faber, 'The Evolution of Airpower Theory in the United States', in John Olson (ed), *Asymmetric Warfare* (Royal Norwegian Air Force Academy, Oslo, 2002), p.109.
165 Hammond, p.154.

arguments Boyd developed. It is no coincidence Boyd harped on the intangibles of war, on the fundamental uncertainty of war and strategy and on the alternatives to the attritional style of warfare. On the other hand, considering the dominant strategic and military culture, it is all the more remarkable and equally impressive that someone was able first of all to develop a new, distinctive and coherent military theory in such an environment, and second, to gain the wide influence Boyd achieved with his non-conformist ideas.

Second, contact with the audience provided direct feedback. Coram tells how Boyd found it difficult to finish an intellectual product. As soon as it was finished, he would insist on beginning on changes. These changes made him see another fallacy or another place for elaboration, and the process began all over[166]. As Hammond states, each version of *A Discourse* was different, imperfect. Boyd refined and polished his ideas in response to discussions and his expanding list of literature he devoured[167]. This was an essential element. If Hammond is correct when he notes of *Patterns of Conflict* that this massive set of slides became 'the means by which the philosophy of the [reform] movement was spread', it is also correct to note that the reform effort inspired his work and his insistence on maneuver warfare as an alternative for the alleged flawed attritional war fighting style. He developed his arguments and ideas with the purpose of inducing change. As Burton posits, Boyd's mindset was infuzed with a measure of frustration concerning the sorry state of strategic thinking in the US military establishment: 'Boyd would change that and would force the military to scramble like mad to catch up with him as he produced theory after theory that was unique and revolutionary in the art of war'[168].

A Discourse is thus the result and manifestation of Boyd's own learning process, a process of analysis, synthesis, creation, destruction and recreation, or creative destruction. Like Clausewitz, Fuller and Liddell Hart in their times, Boyd's ideas evolved and matured in a time when the US military was searching for novel ideas to solve concrete strategic and operational problems. He was in no small measure a formative factor of the military *Zeitgeist* and the military *Zeitgeist* in turn was a formative factor of his ideas. It also suggests that an important role of Boyd lay in *rediscovering* and *synthesizing* existing theories and insights and offering them in a very digestible and convincing format to his audience. The chapter has also shed light on Boyd's intellectual predecessors and inspirators, such as Fuller, Liddell Hart and Sun Tzu. This discussion has also already hinted at Boyd's other role; that of *re-conceptualizing* maneuver warfare and, by extension, other schools of strategic thought, with the employment of the OODA loop model. And it is this last aspect that this study will turn next.

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166 Coram, p.309.
167 Hammond, p.17.
168 Burton, p.44.

4. SCIENCE: BOYD'S FOUNTAIN

Knowledge is an unending adventure at the edge of uncertainty.
Jacob Bronowski

Boyd and science

Introduction

The following two chapters discuss the influence of science as a formative factor on the development of Boyd's work, and the consequences of this influence on the interpretation of the meaning of his work. In two chapters a short panorama of the scientific *Zeitgeist* of Boyd lifetime will be presented, in no small measure based on the same books Boyd read during the sixties, seventies, eighties upto the mid-nineties.

Chapter 4 describes the scientific developments that occurred during the early decades of the 20th Century that Boyd incorporated in his work, and which had a tremendous influence beyond physics from which these developments originated. It will show the deep and deliberate philosophical underpinnings of Boyd's work. It continues with a discussion of the emergence of the systems view of the world during the late sixties and early seventies, a view that is readily apparent across Boyd's work.

Chapter 5 will complete the study of the influence of the scientific *Zeitgeist* by taking a look at the development of chaos and complexity theory that took place during the late seventies, eighties and nineties, developments which Boyd closely followed and incorporated in his work (in particular in his last three presentations). Moreover, it finishes with an assessment of the implications of the findings for understanding Boyd.

Hidden fountain

Destruction and Creation is the first part of Boyd's strategic opus. It is the one written work he ever published besides *Aerial Attack Study*. It is the paper that is considered the conceptual heart of his subsequent work as well as his most impressive intellectual achievement. It is considered 'the culmination of a quest to find scientific, mathematical, and logical verification for principles Boyd knew intuitively to be true'[1]. It is also the first indication of the way and extent science influenced his thinking. Far from being a coincidence, the attention Boyd paid to developments in and insights from science was fundamental and essential. It can be argued that:

(a) Boyd's scientific education followed the scientific Zeitgeist, not unconsciously, but deliberately;
(b) Boyd thought the study of war required an interdisciplinary study of science;
(c) His education matured while the scientific Zeitgeist shifted;

[1] Hammond, p.118.

(d) Boyd was aware of this shift;
(e) He made this new paradigm central in his work;
(f) He considered this paradigm as the appropriate way to approach the study of war.

Indeed, it can be considered his hidden fountain. His interest in science came in part from his study in Georgia Tech University and his work on fighter design. EM theory led him to it, as described before. Another factor making him study various fields of science was more of an introvert nature. Since 1972 he had been working on *Destruction and Creation*. He had been pondering for some time before 1972 about thinking processes and how they can be taught to others. He was trying to understand the nature of creativity. His path breaking work on EM theory made him aware that apparently his thought process somehow worked differently than others', how else could such a simple theory as EM theory not have been conceived by someone else before his discovery?

On October 15 1972 he wrote from his base in Thailand to his wife that 'I may be on the trail of a *theory of learning* quite different and - it appear now more powerful than methods or theories currently in use'. Learning for him was synonymous for the process of creativity. Without any premeditated overall design or goal, he read every available book in the base library on philosophy and physics and math and economics and science and Taoism and half a dozen other disciplines, according to Coram[2]. It laid the foundation for what would become the major focus of his life.

His research brought him to formulate the creative and unique synthesis of three insights. Boyd saw the ideas of Gödel, Heisenberg and the Second Law of Thermodynamics, which he had encountered at Georgia Tech, as keys to how to think, how to compete successfully, and how to adapt and survive. Taken together these three notions support the idea that any inward-oriented and continued effort to improve the match-up of a concept with observed reality will only increase the degree of mismatch[3]. These ideas forces one to recognize that uncertainty, imprecision and mismatches are fundamental parts of reality.

Mathematics, the second law of thermodynamics, and quantum mechanics, early interests, form the philosophical cornerstone of *A Discourse*. Although in *A Discourse* this essay comes last, as a basis of thought it came first for Boyd[4]. But starting with this difficult and abstract essay would have turned most people off, so he left it at the end of *A Discourse*. He may have been right, for these concepts are not the materiel that soldiers digest normally, as will become evident below.

The impact of science, in the broad sense of the word, on the development of Boyd's ideas is thus obvious already in the first part of *A Discourse*. From there on, during the latter twenty years of his life, the period in which *A Discourse* was developed, Boyd delved deeper and probed more widely and connected more completely insights from a variety of disciplines to improve his understanding of thinking, strategy, and time. He would call his friends and disciples sometimes in the middle of the night to discuss the latest piece he had read which could be the work of the German philosopher Hegel, Gödel, Piaget, Skinner, Polanyi, a book on quantum physics, history or social science[5]. This impression is reinforced by the list of books read by Boyd on political theory, philosophy, new age, mathematics and science, according to the archive that the US Marine Corps University maintains on Boyd.

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[2] Coram, p.271.
[3] Ibid, p.120.
[4] Hammond, p.119.
[5] Both Hammond, Burton and Corum make frequent references on Boyd's obsessive study and his frequent late night phone calls. See for instance Coram, pp.319-20 and Hammond, pp. 180-86, and Burton, p.44.

The list exceeds 20 pages. Indeed, science played an increasing role in Boyd's thinking on conflict and strategy. His interest in science preceded his interest in history. And interestingly, while his study of military history went from the contemporary to the past, a travel back in time, his study of science progressed in reverse order.

His background in engineering provided the foundations for his progressive study. It was a natural step to delve into mathematics, quantum mechanics, information theory, and related fields such as cybernetics and systems theory in general. Indeed, his knowledge gained as a pilot and aircraft designer about control mechanisms and feedback likewise made a study of cybernetics an easy step. From there he developed a taste for evolution theory and neuro-physiology. These fields grew in prominence from 1930-1970. Cybernetics and Systems Theory where hotly debated areas in the 1960s, the period Boyd was at Georgia Tech and designing fighters. Subsequently, but more often in parallel, he ventured into Evolution Theory, Chaos and Complexity theory, which were popularized in a growing number of very accessible books. In particular during the last decade of his life he read about Chaos Theory and Complexity Theory, areas that were explored in an explosively rising number of books from 1984 onwards. At the time of his death Boyd's reading list only mentions popular scientific works (see table below), including one's he had read long before[6].

John Barrow *The Artful Universe,*
John Barrow *Pi in the Sky*
John Barrow *Theories of Everything*
Richard Brodie *Virus of the Mind*
Fritjof Capra *The Web of Life*
Jack Cohen & Ian Stewart *The Collapse of Chaos*
Peter Coveney & Roger Highfield *Frontiers of Complexity*
Peter Coveney & Roger Highfield *The Arrow of Time*
Richard Dawking, *The Blind Watchmaker*
Richard Dawkins, *The Selfish Gene*
Stephen Gellert, *In the Wake of Chaos*
Murray Gell-Mann, *The Quark and the Jaguar*
John Horgan, *The End of Science*
Konrad Lorenz, *Behind the Mirror*
Marvin Minsky, *Society of the Mind*
Robert Ornstein, *The Evolution of Consciousness*
Roger Penrose, *Shadows of the Mind*
Roger Penrose, *The Emperor's New Mind*
Ilya Prigogine & Isabelle Stenger, *Order out of Chaos*
Stephen Rose, *The Making of Memory*
David Ruelle, *Chance and Chaos*
Mitchell Waldrop, *Complexity*

A common theme of these works is *evolution* and *adaptation*, and these ideas mattered to Boyd. As one noted expert recalled:

> Boyd introduced the language of the New Physics, Chaos Theory, and Complexity Theory[7].

Boyd introduced concepts from the scientific *Zeitgeist* into the military *Zeitgeist*. Relying in large part on books Boyd read, the following detailed description of the scientific *Zeitgeist*, or rather, the sweeping changing taking place in and coloring this *Zeitgeist*, will provide themes, theories, concepts, and models that Boyd employed in his own work, either directly and explicitly, or implicitly.

Shifting foundations

A new sensibility

Boyd's intellectual education occurred in the period of roughly the three decades of 1960-90. This has been an important period for science, philosophy and culture, for in this period a "paradigm shift" occurred in the natural sciences, and by extension, also in the social

[6] This list was provided by Hammond.
[7] Faber, in John Olson (2002), p.58.

sciences and culture. It was a tumultuous period. In the sixties and seventies, a "new sensibility" rose[8]. Other would call it a cultural revolution or the great disruption[9]. In particular the "long 1960s" may be regarded the most important postwar period, the most pivotal.

In the sixties, the student revolts of may 1968, the sexual revolution, the rise of pop-art and pop culture, race and gender issues dominating politics, competed with the landing of the first man on the moon in 1968. In 1973 the oil crisis and the attack by Egypt and Syria on Israel fuelled doubts about the viability of the modern western capitalist industrialized societies. Modernism was becoming suspect with, for instance, the publication of the Club of Rome Report on *The Limits to Growth* in 1969, a report Boyd was aware of[10]. Indeed, Boyd had read the somber opening question 'Is there hope for man' in Robert Heilbroner's book *An Inquiry into The Human Prospect,* while Jeremy Rifkin painted a future characterized by increasing disorder due to the unescapable force of the second law of thermodynamics[11]. Individualism was on the rise, reinforcing the sense that culture in modern society was waning or already absent. The novelist Thomas Wolfe had published *The Me Decades* in 1976 and three years later Christopher Lasch wrote *The Culture of Narcissism.* For Theodore Roszak this meant instead that culture was shifting and showing *The Making of a Counter Culture,* which he published in 1970. He posited that this was a youth revolt and as much as anything, was opposed to the reductionism of science and technology. Everything was called into question: family, urbanism, science, technology, progress. The means of wealth, the meaning of love, the meaning of life, who decides what is knowledge or reason?[12] Not surprisingly, the 1960s and 1970s creative dynamics - how creativity emerges - gained popularity[13].

This came on top of French works by Raymond Aron and Herbert Marcuse who both believed the 1960s to have been a critical decade, since they had revealed science and technology as real threats to freedom, not just in the form of weapons and weapon research, which had tied so many universities to the military, but also because the civil revolution in general had been underpinned by a psychological transformation of the individual who had discovered new ways of freedom and manners to express it. In 1974 Robert Persig published *Zen and the Art of Motorcycle Maintenance* in which he rallies against the "Church of Reason" and moves between Eastern mystics, Zen Buddhism and the classical Greek philosophers, offering an alternative to the rational scientific mindset of modernity. Boyd had read this work too, as he had other authors who are considered part of this wave of authors of the

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[8] Peter Watson, *A Terrible Beauty, The People and Iodeas that Shaped the Modern Mind* (Phoenix Press, London, 2000), chapter 33.

[9] Francis Fukuyama, *The Great Disruption, Human Nature and the Reconstitution of Social Order* (Free Press, New York, 1999).

[10] His list of personal papers includes for instance Donella Meadows, et. al., *The Limits to Growth: A report to the Club of Rome's Report on the Predicament of Mankind* (Signet, New York, 1972); as well as Mihajlo Mesarovic and Eduard Pestel, *Mankind at the turning Point: The Second Report to the Club of Rome* (E.P.Dutton & Co., New York, 1974); and Jan Tinbergen, *Rio: Reshaping the International Order: A Report to the Club of Rome* (Signet, New York, 1977).

[11] Robert Heilbroner, *An Inquiry into The Human Prospect*, (W.W. Norton & Company, New York, 1974), p.13. Heilbroner also touches upon the Rome Report. Jeremy Rifkin's work, *Entropy, A New World View* (The Viking Press, New York, 1980), is another book in this vein and also appears in Boyd list of personal papers.

[12] Watson, pp. 595-596.

[13] And not within the defence community untill the eighties as Roger Beaumont notes, in *War, Chaos and History* (Praeger, Westport, Connecticut, 1994), p.113.

counter-culture. He had read several works by Alan Watts, who taught a Zen Based psychotherapy[14]. This cultural wave cohered in post-modernism.

Scientific waves were equally unsettling. The Big Bang Theory was widely discussed when Steven Weinberg published *The First Three Minutes* in 1977. Genetic engineering became a feasible option after new discoveries from 1972 to 1978 in microbiology which made cloning and sequencing of DNA possible. E.O. Wilson, a Harvard zoologist, made the link between genes, social organization and human nature when he published *Sociobiology: The New Synthesis* in 1975 and argued that social behavior is governed by biology, by genes[15]. One year later, Richard Dawkins advanced the idea in *The Selfish Gene* that we must think of the central unit of evolution and natural selection as the gene. Watson explains this in almost Boydian terms as 'the gene, the replicating unit, is "concerned" to see itself survive and thrive, and once we understand this, everything else falls into place: kinship patterns and behavior in insects, birds, mammals and humans are explained, altruism becomes sensible, as do the relations of non-kin groups (such as race) to one another'[16]. These books were foreshadowed by Jacques Monod's *Chance and Necessity* (1971). Monod felt that ideas, culture, and language are survival devices[17].

Importantly for the study of Boyd, they also sparked a highly publicized resurgence of Darwinian thinking that characterized the last quarter of the century, a process that met with a ferocity that was unusual even by the standards of academic invective. As Steven Pinker notes, E.O. Wilson was doused with a pitcher of ice water at a scientific convention,

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[14]This influence should not be underestimated. *First* of all, Robert Persig's book was a bestseller in Boyd's time and a manifestation of the sense of crisis of the rational (Western) mode of thinking. It is also highly philosophical. The character, Phaedrus (who also fought during the Korean War interestingly), rallies against this "church" for very fundamental reasons for he sees the social crisis of the 'most tumultuous decade of this century' as the result of Western reductionist and analytical mindset which has lost sight of the elements of quality and wholeness. It discusses the impact of Relativity Theory as well as problems of Euclidian mathematics. It contains extensive section of dialogue and critique on Western philosophers from Aristoteles, to Hume, Kant and Hegel upto Henry Poincaré who noted already in the nineteenth century the relevance of the act of observation and selecting facts for observation in the scientific enterprise, thus negating the existence of objectivity. The book that offers the way out for Phaedrus is the ancient Chinese book the *Tao I Ching* of Lao Tzu, a book also on Boyd's list of personal papers. *Second*, as one noted military historian recently noted that 'life, according to Zen teaching, is too variable and unpredictable to be anticipated by fixed doctrine and must be engaged as it comes with flexible judgment rather than conformation with rigid prior instruction. Zen decision-making is about decisiveness and quickness that reflects and individual's authentic sense of reality[…]'. He asserts that the masters of Zen are concerned with the creation of a disciplied yet flexible sensibility that would be capable of quick and sound judgement in spite of incomplete or misleading knowledge and risk of serious consequences in the event of error. See Jon Tetsuro Sumida (1997), pp.xvi, xviii. This relates to the *third* reason: Boyd's inspiration by Sun Tzu. As an aside, it may be a coincidence, still it is interesting to note that the Bantam New Age Book list of publications included in the 1984 edition of *Zen and the Art of Motorcycle Maintenance* mentions some other books Boyd has read (some of which were Bantam publications) such as Heinz Pagels' *The Cosmic Code*, Gary Zukav's *The Dancing Wu Li Masters*, Jeremy Rifkin's *Entropy,* Rudy Rucker's *Inifnity and the Mind,* Gregory Bateson's *Mind and Nature*, Ilya Prigogine's *Order Out of Chaos* and Fritjof Capra's *The Tao of Physics: An Exploration of the Parallels Between Modern Physics and Eastern Mysticism* and *The Turning Point*.

[15] Ibid, p.618.

[16] Ibid.

[17] Monod's book too is on Boyd's list. Interestingly Monod's book includes the idea that living things, as isolated, self-contained energetic systems, seem to operate against entropy, an idea included in Boyd's work.

angry manifestos and denunciations were published by people and organizations abhorred by the unorthodox, and morally dangerous notion that genes have such a determining role in human behavior[18].

Not surprisingly, in the field of the philosophy of science ideas changed too. Indeed, they were in integral part and stimulant of the tumultuous period for they led to a re-evaluation of the nature of knowledge itself. As Derek Gjertsen describes, with the publication in 1962 of Thomas Kuhn's remarkable work, *The Structure of Scientific Revolutions*, at a stroke the issue of scientific change had been placed at the centre of debate for historians and philosophers of science alike, soon to be joined by radical sociologists who quickly saw in within the Kuhnian legacy the seeds of a new and more cogent relativism, from which not even science could remain exempt[19]. One of those radicals, Paul Lyotard - one of the premier post-modernists - concurs, asserting that, 'the status of knowledge is altered as societies enter what is known as the postindustrial age and cultures enter what is known as the postmodern age. This transition has been under way since at least the end of the 1950s'[20].

Boyd was aware of these changes in the scientific *Zeitgeist*, through the literature he read, but also because the intellectual environment of the sixties, seventies and eighties was marked by highly publicized scientific debates, one of which was the debate on the nature of science between Karl Popper, Thomas Kuhn, Imre Lakatos and Paul Feyerabend. In fact, Boyd's entire opus starts with an investigation into the way man develops mental patterns or concepts of meaning, an investigation that is thoroughly and explicitly inspired and influenced by this debate on the nature of knowledge. Boyd's list of personal papers features the following works on this topic that have influenced his thinking while he developed *Destruction and Creation*:

W.I.B. Beveridge, *The Art of Scientific Investigation* (1957)
Werner Heisenberg, *Physics and Philosophy* (1958)
Micheal Polanyi, *Knowing and Being*, (1969)
Thomas Kuhn, *The Structure of Scientific Revolutions* (1970)
James Bryant Conant, *Two Modes of Thought* (1964)
Jean Piaget, *Structuralism* (first English edition 1971)
Fred Hoyle, *The New Face of Science* (1971)

Besides works on mathematics, logic and physics, such as *Gödel's Proof* (1958) by Ernest Nagel and James Newman, and by Gödel themselves, the list also includes well-known works on creative thinking by Edward DeBono. Later this list would grow to include Karl Popper's seminal works *The Logic of Scientific Discovery* (1968) and *Conjecture and Refutations: The Growth of Scientific Knowledge* ((1965) and Michael Polanyi's work *The Tacit Dimension* (1967).

Boyd's OODA concept reflects insights of this debate. In a sense, the OODA loop seems a graphic rendering of the 'normal model' of scientific research developed by Karl Popper. However, it was Polanyi's work and in particular Kuhn's reaction to Popper on the way science advances, how scientists learn and how knowledge grows that perhaps more deeply informed Boyd's ideas. A discussion of Popper, Polanyi and Kuhn is essential for a proper understanding of Boyd's ideas concerning strategic behavior and the function of strategic theories and military doctrines.

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[18] Steven Pinker, *How the Mind Works* (Norton & Company, New York, 1997), pp.43-47.
[19] Derek Gjertsen, *Science and Philosophy, Past and Present*, (Penguin Books, London, 1989), p.6.
[20] Paul Lyotard, *The Postmodern Condition* (University of Minnesota Press, Minneapolis, 11th printing, 1997), p.3.

Popper's Evolutionary Epistemology

Karl Popper advanced the idea that science made progress through falsification. Popper had become disenchanted with the idea that science is special because it can be derived from facts, the more facts the better. He denied the positivist assertion that scientists can *prove* a theory through induction, or repeated empirical tests or observations. One never knows if one's observations have been sufficient; the next observation might contradict all that preceded it[21].

Therefore, according to Popper, a claim to truth by a theory is only possible if it can be shown to be false. The scientist encounters the world - nature - essentially as a stranger, and that what sets the scientific enterprise apart from everything else is that it only entertains knowledge or experience that is capable of falsification. For Popper this is what distinguishes science from religion or metaphysics. Science was regarded as a neatly self-correcting process. It was never finished in the sense that anything is knowable as true for all time. It increased incrementally through constant but piecemeal efforts of falsification so that each new element introduced could be tested to see whether it was an improvement on the earlier arrangement[22].

Falsificationists freely admit that observation is guided by and presupposes theory. They are also happy to abandon any claim implying that theories can be established as true or probably true in the light of observational evidence. Theories are construed as speculative and tentative conjectures or guesses freely created by the human intellect in an attempt to overcome problems encountered by previous theories to give an adequate account of some aspects of the world or universe. Once proposed, speculative theories are to be rigorously and ruthlessly tested by observation and experiment. Theories that fail to stand up to observational and experimental tests must be eliminated and replaced by further speculative conjectures. Science progresses by trial and error, by conjecture and refutations. Only the fittest theories survive[23].

Starting with problems, not facts as the inductivist/positivist assert, the enterprise of science involves the proposal of highly falsifiable even bold and rash speculative hypotheses, followed by deliberate and tenacious attempts to falsify them. Boyd's OODA loop can be construed as such a process of hypothesis testing. Indeed, in the presentation *The Conceptual Spiral* he offers his definition of science as 'a self-correcting process of observation, hypothesis, and test'[24]. The constant discovery of errors in hypothesis lead to renewed efforts to improve our mental models for coping with the environment.

Not surprisingly, and quite relevant for understanding the importance of Popper for Boyd and for Boyd's take on the function of military doctrine and strategic theory, Popper named his theory that knowledge can grow only by conjecture and refutation an *evolutionary epistemology*. In 1961 Popper claimed that growth of our knowledge

> is the result of a process closely resembling what Darwin called 'natural selection'; that is, *the natural selection of hypotheses*: our knowledge consists, at every moment, of those hypothesis which have shown their (comparative) fitness by surviving so far in their struggle for existence; a competitive struggle which eliminates those hypotheses which are unfit[25].

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[21] John Horgan, *The End of Science* (Broadway Books, New York, 1997), p.34.
[22] Watson, p. 380, 488.
[23] Alan Chalmers, *What is this thing called Science?* (3rd Edition, Cambridge, 1999), pp.59-60.
[24] John Boyd, *The Conceptual Spiral*, p.7.
[25] Karl Popper, *Objective Knowledge,* (Oxford University Press, Oxford), 1972.

All theories are being subjected to variation and selection, according to criteria which are themselves subject to variation and selection. The whole process resembles biological evolution. A problem is like an ecological niche, and a theory is like a gene or a species which is being tested for viability in that niche. Variant of theories, like genetic mutations, are continually being created, and less successful variants become extinct when more successful variants take over. "Success" is the ability to survive repeatedly under selective pressures - criticism - brought to bear in that niche, and the criteria for that criticism depend partly on the physical characteristics of the niche and partly on the attributes of other genes and species (i.e. other ideas) that are already present there. As David Deutsch explains, both in science and in biological evolution, evolutionary success depends on the creation and survival of *objective knowledge*. The ability of a theory or gene to survive in a niche is not a haphazard function of its structure but depends on whether enough true and useful information about the niche is implicitly or explicitly encoded there[26].

Here Boyd found reinforcement, and additional insight, in Dawkins' work. Boyd owned no less than two copies of *The Selfish Gene,* in addition to Dawkins other famous books *The Extended Phenotype* and *The Blind Watchmaker*. Dawkins introduced the term "meme" as the cultural replicator. Memes are the vehicle for cultural evolution just as much as the genes are the vehicles for genetic evolution. Memes should be regarded as living structures, not just metaphorically but technically. Ideas replicate like genes and survive, mutate or become ignored and extinct. They are entities that are capable of being transmitted from one brain to another and can be considered a virus of the brain. Popper in particular, according to Dawkins, illuminated the analogy between scientific progress and genetic evolution by natural selection[27].

Interestingly, Dawkins even advances the element of time-based competition, adding another element of similarity between Boyd's theory and evolutionary epistemology. As in computers, in brains time and storage space are precious Dawkins asserts. The computer in which memes live are human brains. Time is possibly even a more important limiting factor than storage space, and it is the subject of heavy competition. The human brain, and the body that it controls, cannot do more than one or a few things at once. If a meme is to dominate the attention of the human brain, it must do so at the expense of "rival" memes. This provides an understanding of Boyd's perception of the role and behavior of strategic theories and military doctrines. They are like memes, they compete with other memes, and survive depending on the contribution they make to the host's survival and on the outcome of the contest with other memes[28].

Polanyi and the tacit dimension

Gjertsen delivered an interesting critique. He points out that theories can be forgotten and revived, several theories can co-exist, and they may survive for social reasons, through propaganda, censorship, and other political tools. Alternatively, they may die out not because they are unfit, but through stupidity, prejudice, and corruption. Fit theories can die and unfit theories survive. Theories can be dismissed in an era and lie dormant for a long while, unlike

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[26] David Deutsch, *The Fabric of Reality* (Penguin Books, London, 1998), p.69. See chapter 3 in particular on the relevance of Popper. For an assessment of the current value of Popper see chapter 13.

[27] Richard Dawkins, *The Selfish Gene* (Oxford University Press, Oxford, paperback edition 1989), p.190. See entire chapter 11 for a full explanation of the idea of meme. An interesting observation at this point may be that the OODA loop itself has proven to be a very powerful meme indeed if the number of citations is any measure of success as Dawkins proposes.

[28] Ibid, p.197.

species. Finally, theories, unlike species who always emerge from ancestries, can sometimes be entirely original, unanticipated, without ancestors. This indicates that the growth of knowledge is determined to a large extent by the social context. That leads to Michael Polanyi and Thomas Kuhn.

Within the OODA loop graphic, in *Destruction and Creation* and in *The Conceptual Spiral*, Boyd explicitly incorporated essential insights from both authors who, to a certain extent, disagreed with Popper. Polanyi had published his magnum opus *Personal Knowledge: Towards a Post-Critical Philosophy* in 1958. Preceding Thomas Kuhn's famous book by four years, Polanyi's book is part of the mid-century shift in philosophy of science towards interest in scientific practice. Several arguments were later refined in *The Tacit Dimension*. The book Boyd read, *Knowing and Being*, is a collection of short essays Polanyi wrote after *Personal Knowledge*. It introduced Boyd to Kant Hegel, Piaget, Nagel and many other social theorist and philosophers. It includes themes from *The Tacit Dimension* and *Personal Knowledge,* which pertain on the practice of science and the way scientific knowledge grows. It addresses the structure of consciousness and even includes the role of DNA as a factor in shaping consciousness, elements Boyd would include in his OODA loop sketch later on. A noteworthy feature too is that the editor states in her lengthy introduction that 'all knowing is orientation'[29].

A first important idea Polanyi advances is that there are two levels of awareness and human beings employ both[30]. It is an idea that is closely related to Boyd's insistence that understanding requires analysis as well as synthesis, a central theme of *Destruction and Creation*. In fact, Boyd points to Polanyi as one of two sources for this idea[31]. Knowing is action oriented and a process. Polanyi regards the process of knowing as fragmentary clues, senso-motoric or from memory, which are integrated under categories. We make sense of reality by categorizing it. This is the lower level of awareness: it observes separate clues.

However, this process of logical disintegration has reduced a comprehensive entity to its relatively meaningless fragments. The higher form of awareness recreates the comprehensive entity of which the disparate clues are a part. As Polanyi asserts, a deliberate act of consciousness has […] not only an identifiable object as its focal point, but also a set of subsidiary roots which function as clues to its objects or as part of it. Indeed, he emphasizes that 'the higher principles which characterize a comprehensive entity cannot be defined in terms of the laws that apply to its parts in themselves', a theme which will reappear later when systems thinking is discussed, to which Polanyi sometimes refers.

This 'integrating power of the mind' is what Polanyi terms *tacit knowing*. And tacit knowing is implicit. It is the patterns of categories that contain theories, methods, feelings, values and skill that can be used in a fashion that the tradition judges valid. This integration of knowledge is a personal skill in itself, it cannot be known by others. This tacit dimension is essential. The knowledge that underlies the explicit knowledge is more fundamental. All knowledge is either tacit or rooted in tacit knowledge. New experiences are always assimilated through the concepts that the individual disposes and which the individual has inherited from other users of the language. Those concepts are tacitly based, and importantly for understanding Boyd's OODA loop, Polanyi asserts that the individual changes, "adapts", the concepts in the light of experiences and reinterprets the language used. When new words

[29] Marjorie Green, 'Introduction', in *Knowing and Being* (1969), p.xi.
[30] See 'The Structure of Consciousness', in *Knowing and Being* (1969), pp.211-224.
[31] Boyd, *Destruction and Creation,* p.3.

or concepts are brought into an older system of language, both affect each other. The system itself enriches what the individual has brought into it[32].

A second relevant element in Polanyi's work is based on the correlate of the former ideas, which is that *knowledge is social*. Subsequently Polanyi criticizes the ideal of objectivity[33]. Instead, Polanyi asserted that much of science stems from guesswork and intuition and that although, in theory, science is continually modifiable, in practice it doesn't work like that. 'The part played by new observations and experiment in the process of discovery is usually over-estimated', he noted. It is not so much new facts that advance science but new interpretations of known facts, or the discovery of new mechanisms or systems that account for known facts. Moreover, advances often have the character of "gestalt", as when people suddenly "see" something that had been meaningless before. His point was that scientists actually behave far more intuitively than they think, and that, rather than being absolutely neutral or disengaged in their research, they start with a conscience, a scientific conscience. This conscience operates in more than one way. It guides the scientist in choosing the path of discovery, but also guides him in accepting what results are "true" and which not, or need further study[34].

Indeed, *intuition*, again a tacit element, plays an underestimated role in the growth of science, Polanyi repeatedly asserts. As he explains, science grows through the discovery of interesting problems: 'problems are the goad and the guide of all intellectual effort, which harass and beguile us into the search for ever-deeper understanding of things. For knowing is always a tension alerted by largely unspecifiable clues on which we rely for attending to it'[35]. All search starts by a process of collecting clues that intrigue the inquiring mind, clues that will largely be like peripheral clues of perception, not noticed or not even notable in themselves. A scientist must have the gift of seeing the problem where others see none, of sensing the direction towards solution where others find no bearings, and eventually revealing a solution that is a surprise to all[36]. Boyd was to incorporate this insight using the term "mismatch" in stead of problem or tension.

Science thus starts with the act of perception. Perception, according to Polanyi, 'is performed by straining our attention towards a problematic centre while relying on hidden clues which are eventually embodied in the appearance of an object recognized by perception[37]. This is also how the pursuit of science proceeds. This is the unaccountable element, which enters into science at its source and vitally participates throughout even in its final result. In science this element has been called intuition. Intuition is a skill, rooted in our natural sensibility to hidden patterns and developed to effectiveness by a process of learning. Great powers of scientific intuition are called originality, for they discover things that are most surprising and make men see the world in a new way'[38]. 'It is customary today to represent the process of scientific inquiry as the setting up of a hypothesis followed by its subsequent testing', Polanyi continues, 'I cannot accept these terms. All true scientific research starts with hitting on a deep and promising problem, and this is half the

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[32] On p.173, Polanyi even includes the notion that 'the experience of our senses is somehow to be accounted for in terms of neural processes within our body', an idea that will resurface later on in the next chapters.

[33] And in the nineties his work has come to be seen by many professional philosophers as part of the shift to a post-modern context for philosophical thought.

[34] Watson, p.472.

[35] Polanyi, p.117.

[36] Ibid.

[37] Ibid.

[38] Ibid, p.118.

discovery'[39]. 'We have here the paradigm of all progress in science: discoveries are made by pursuing unsuspected possibilities suggested by existing knowledge'[40]. These are words Boyd would makes his own, in particular in *The Conceptual Spiral*.

But even the highest degree of intuitive originality can operate only by relying to a considerable extent on the hitherto accepted interpretative framework of science, Polanyi acknowledges[41]. Countering the 'modern man's Cartesian view that he will believe nothing unless it is unassailable by doubt, Polanyi asserts that science can only be pursued and transmitted to succeeding generations within an elaborate system of traditional beliefs and values'[42]. And here the social and consensual character of scientific knowledge comes to the fore, again exerting a tacit influence. In the essay 'The Republic of Science' in the book, Polanyi notes that 'the first thing to make clear is that scientists, freely making their own choice of problems and pursuing them in the light of their own personal judgment, are in fact cooperating as members of a closely knit group'[43]. Each scientist sets himself a problem and pursues it with a view to results already achieved by all other scientists, who had likewise set themselves problems and pursued them with a view to the result achieved by others before.

The practice of science therefore contains an *internal tension*, a theme that resurfaces in Boyd's work. On the one hand, acceptance of the results of research depends on the level of plausibility of the result and the scientific value of the research conducted in terms of the accuracy, its systematic importance, and the intrinsic interest of its subject-matter. These elements translate into a social constraint in the sense that they tend to enforce conformity. On the other hand, the element of originality, also a prime criterion for judging scientific merit, encourages dissent. This internal tension, Polanyi asserts, is essential in guiding and motivating scientific work[44]. The professional standards of science must impose a framework of discipline and at the same time encourage rebellion against it. They must demand that, in order to be taken seriously, an investigation should largely conform to the currently predominant beliefs about the nature of things, while allowing that in order to be original, it may to some extent go against these. Thus the authority of scientific opinion enforces the teachings of science in general, for the very purpose of fostering their subversion in particular points. Scientific opinion imposes an immense range of authoritive pronouncements on the student of science, but at the same time it grants the highest encouragement to dissent from them in some particular[45].

This feature leads to an additional relevant assertion: knowledge grows out of the *network* that scientists form together; which form *consensual chains*. No single scientist has a sound understanding of more than a tiny fraction of the total domain of science. How can an aggregate of such specialists possibly form a joint opinion? How can they exercise jointly the delicate function of imposing a current scientific view about the nature of things, and the current valuation of proposed contributions, even while encouraging an originality which would modify this orthodoxy? Polanyi asserts that a joint opinion of what constitutes reality emerges due to the fact that each scientist can usually judge an area adjoining their own special studies that is broad enough to include some fields on which other scientists have specialized. There is considerable overlap between fields and as scientists are thus linked

[39] Ibid.
[40] Ibid, p.79.
[41] Ibid, p.119.
[42] Ibid, p.68.
[43] Ibid, p.49.
[44] Ibid, p.54.
[45] Ibid, p.66.

through several overlapping networks of specialists, the whole of science will be covered by chains and networks of overlapping neighborhoods. Each link in these chains and networks will establish agreement between valuations made by scientists overlooking the same overlapping fields, and so, from one overlapping neighborhood to the other, agreement will be established on the valuation of scientific merit throughout all the domains of science. This network is the seat of scientific opinion. Scientific opinion is an opinion not held by any single human mind, but one which, split into thousands of fragments, is held by a multitude of individuals, each of whom endorses the others' opinion at second hand, by relying on the consensual chains which link him to all the others through a sequence of overlapping neighborhoods[46].

Interestingly, Polanyi extends the practices of the 'Republic of Science' to apply also to society if one strives for an open and free society, thus transferring the principles governing science, and the growth of knowledge to the wider social realm and into the dynamic of organizational survival. *The Republic of Science,* Polanyi continues*, shows us an association of independent initiatives, combined towards an indeterminate achievement. It is disciplined and motivated by serving a traditional authority, but this authority is dynamic; its continued existence depends on its constant self-renewal through the originality of its followers*[47]. It is a society of explorers which strives towards an unknown future, which it believes to be accessible and worth achieving. The scientists strive towards a hidden reality, for the sake of intellectual satisfaction. And as they satisfy themselves, they enlighten all men and are thus helping society to fulfill its obligation towards intellectual self-improvement.

He had noted that such an attitude was deliberately destroyed in the Soviet Union. Stalinism was a closed system, he asserts, and this would have disastrous effects on societal cohesion throughout the communist world the moment people came to realize this[48]. In an essay on *The Message of the Hungarian Revolution,* he notes how the political realm had subverted the scientific realm, and subsequently, Polanyi asserts, 'Stalin's regime virtually ceased to exist when its basic conceptions of intellectual and moral reality lost their hold on thought'[49].

A free society, on the other hand, may be seen to be bent in its entirety on exploring self-improvement. This suggest, he notes, a generalization of the principles governing the Republic of Science. It appears that a society bent on discovery must advance by supporting independent initiatives, co-coordinating themselves mutually to each other. Such adjustments may include rivalries and opposing responses which, in society as a whole, will be far more frequent than they are within science. Even so, all these independent initiatives must accept for their guidance a traditional authority, enforcing its own self-renewal by cultivating originality among its followers. In his view of a free society, both its liberties and its servitudes are determined by its striving for self-improvement, which in its turn is determined by the intimations of truths yet to be revealed calling on men to reveal them.

For Boyd reading this at the time he became more and more engaged in the Military Reform Movement, and with his experience with organizational interests blocking promising aircraft research and development while willfully promoting dysfunctional designs, these words must have sound very convincing. And it is not surprising so see several of these themes resurface in his essay, but also in the presentations *Organic Design for Command and Control* and *The Strategic Game of ? and ?*. Boyd would stress the importance of the tacit dimension, an organizational culture marked by trust and open communications, a tolerance

[46] Ibid, pp.55-56.
[47] Ibid, p.70.
[48] Ibid, p.31.
[49] Ibid, p.36.

for failure and an encouragement for innovation and experimentation and a comfort with conflicting views and dissent, as long as the entities would be bound by a common overarching goal, a shared view or belief.

Paradigms and revolutions

Thomas Kuhn developed another alternative view of scientific progress, the occurrence of revolutions in science, one that includes Polanyi's sensitivity for the social aspect of the activities of scientists as well as the essential unfinished nature of science. Kuhn noted that falsification was to some extend a flawed concept[50]. If everyone was constantly questioning the fundamentals of a discipline, as characterized in Popper's method of "conjectures and refutations", it is unlikely to make significant progress simply because principles do not remain unchallenged long enough for esoteric work to be done. Moreover, an embarrassing historical fact for falsificationists is that if their methodology had been strictly adhered to be scientists then those theories generally regarded as being among the best examples of scientific theories, such as Niels Bohr's theory of the atom or the Copernican revolution, would have been rejected in their infancy[51].

He advanced the idea that a better way to explain the work of scientists and describe how science advances was through shifts in paradigms. He defined a paradigm as 'a constellation of achievements - concepts, values, techniques, etc. - shared by a scientific community and used by that community to define legitimate problems and solutions[52]. It also refers to a set of fundamental assumptions on the basis of which theories and models are developed[53]. It embodies a particular conceptual framework through which the world is viewed and in which it is described, and a particular set of experimental and theoretical techniques for matching the paradigm with nature. However, there is no a priori reason to expect any one paradigm is perfect or even the best available. There are no inductive procedures for arriving at perfectly adequate paradigms[54].

A paradigm defines what is construed as "normal science" by a scientific community. Scientists are educated and trained to conduct scientific research using tools,

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[50] And Imre Lakatos as well. Lakatos will not be discussed here as available sources do not indicate specifically he read any of his material. Moreover, Lakatos attempts to rescue Popper while allowing for the existence of a kind of paradigm, which he terms 'research program', but avoiding the relativist implications of Kuhn's theory. See for instance Chalmers, p.130-36. For a general overview of recent history of the philosophy of science see for instance Peter Machamer, 'A Brief Historical Introduction to the Philosophy of Science'; John Worrall, 'Philosophy of Science: Classical Debates, Standard Problems, Future Prospects'; and Jim Woodward, 'Explanation', all in Peter Machamer and Michael Silberstein, *The Blackwell Guide to the Philosophy of Science* (Blackwell Publishers, Oxford, 2002). For more technical and more polemic studies see for instance Adam Morton, 'The Theory of Knowledge: Saving Epistemology from the Epistemologists' and Noretta Koertge, 'New Age Philosophies of Science: Constructivism, Feminism and Postmodernism', all in Peter Clark and Katherina Hawley, *Philosophy of Science Today* (Clarendon Press, Oxford, 2000). For a reconstruction and assessment of Kuhn's growing influence, and of the misinterpretations of his work, see for instance Steve Fuller, 'Being There with Thomas Kuhn: A Parable for Postmodern Times', *History and Theory*, October 1992, Vol.31, Issue 3, pp.241-275. In this article the influence of Polanyi is also addressed. For a concise critique of Kuhn see Deutsch (1998), in particular chapter 13.

[51] Chalmers, p.91.

[52] Capra, *The Web of Life, A New Scientific Understanding of Living Systems* (Anchor Books, New York , 1997), p.5.

[53] John Steinbrunner, *The Cybernetic Theory of Decision* (Princeton University Press, 1974), p.10.

[54] Chalmers, p.118.

concepts, fundamental laws and theoretical assumptions, to such an extend even that most of the "rules of the scientific game" have become internalized. In the words of Polanyi, they have become "tacit" or implicit, (a term Boyd would also use within context of the OODA loop), and exert a controlling influence on what is observed, which problems to focus on and how reality is explained. They will articulate and develop the paradigm in their attempt to account for and accommodate the behavior of some relevant aspects of the real world as revealed through the results of experimentation[55].

In studying seminal scientific developments - the works of Kepler, Copernicus, and Galileo in astronomy; of Lavoisier and Dalton in chemistry; of Newton in physics - Kuhn noted the impact of these achievements resulted from the fact that they changed the basic working assumptions of their respective fields. Astronomers working before Kepler, Copernicus and Galileo assumed that the sun and other planets moved about the earth and all research and argument among astronomers rested on that proposition. The change to a sun centered system, with the earth in motion was in itself an esoteric change in the working assumptions of the astronomers. The change provided a new basis for all subsequent theory and research in the field. The remarkable feature of the episode is that an apparently esoteric change could have such a profound effect and far reaching consequences. Not only was a new basis laid for all subsequent theory and research in astronomy, but cascading consequences occurred far beyond the limits of astronomy.

Another remarkable feature of such conceptual changes is the fact that their effects transcend the scientific community or the discipline in which the shift occurred. Newtonian physics and modern chemistry were logical descendents of the change in astronomer's assumptions. But beyond that the religious and philosophical basis of society was forced to adjust, and the practical life of nearly every human being has been pervasively affected. The intellectual shifts effected by Copernican and others somehow struck at the very core of human organization[56].

Such changes of paradigms according to Kuhn, occur in discontinuous, revolutionary breaks called "paradigm shifts" and thus science progresses not via a neat gradual accumulation of knowledge[57]. In Kuhn's view the transformation of a paradigm appears as a crisis[58]. Such a revolution is defined by the appearance of new conceptual schemes. This does not happen in an instant but is a social process. Before a paradigm shift, scientist practicing normal science within the reigning paradigm encounter anomalies. Initially, these are not considered to undermine the basic assumptions of the paradigm. However, over time the number of anomalies produced by research within a paradigm accumulate and manifest a persistent character.

The potential of a new paradigm brings to the fore aspects which previously were not seen or perceived, or even suppressed in "normal" science. The basic assumptions of the reigning paradigm are actually questioned by the member of the scientific community. They challenge the legitimacy of their methods. Thus the community diversifies. Different points of view, cultural experiences and philosophical convictions are now expressed and often play a decisive role in discovery of a new paradigm.

The emergence of the new paradigm further increases the vehemence of the debate. The rival paradigms are put to the test until the academic world determines the victor, which becomes the new "norm science". Hence there is a shift in the problems noticed and

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[55] Ibid, pp.108, 112.
[56] Steinbrunner, p.10.
[57] Capra (1997), p.5.
[58] Ilya Prigogine and Isabella Stengers, *Order Out Of Chaos, Man's New Dialogue With Nature* (Flamingo, London, 1984), p.308.

investigated and a change of the rules of scientific practice[59]. In this fashion Kuhn argues, Ptolemaic astronomy was replaced by the new paradigm of Copernicus. Euclidian geometry and Newtonian physics are paradigms in other fields[60]. A scientific revolution corresponds to the abandonment of one paradigm and the adoption of a new one, not by an individual scientist only but by the relevant scientific community as a whole. While Popper looked at scientific progress within a paradigm, Kuhn thus looked at scientific progress as a succession of paradigms.

These paradigms are "incommensurable". Different paradigms have no common standard for comparison. Each paradigm will regard the world as being made up of different kinds of things. Rival paradigms will regard different kinds of questions as legitimate or meaningful. Indeed, Kuhn argues that there is a sense in which proponents of rival paradigms are "living in different worlds". And because of the fundamental different set of standards and metaphysical principles, there will be no purely logical argument that demonstrates the superiority of one paradigm over another and that thereby compels a rational scientist to make the change[61].

Kuhn does not dismiss the value of normal science. Periods of normal science provide the opportunity for scientists to develop the esoteric details of a theory thereby improving the match between the paradigm and nature to an ever-greater degree. However, as there is no way to tell in advance which theory will hold up to scrutiny, science should contain within it a means of breaking out of one paradigm into a better one. And this is the function of revolutions. Chalmers explains Kuhn in terms that could have taken directly from Boyd's presentations *Destruction and Creation* and *The Conceptual Spiral* when he asserts that according to Kuhn all paradigms will be inadequate to some extent as far as their match with nature is concerned. When the *mismatch* becomes serious, that is, when a crisis develops, the revolutionary step of replacing the entire paradigm with another becomes essential for the effective progress of science[62].

Thus, progress - as improved understanding of real world phenomena - depends on the Popperian notion of problem (also a mismatch) solving within a paradigm as on the Kuhnian emphasis on discovering of mismatches between a paradigm and reality. John Horgan adds to the idea that Boyd incorporated Kuhnian insights by noting first that Kuhn held that 'a revolution is a destructive as well as a creative act', and, second, that:

> Kuhn described himself as a "post-Darwinian Kantian". Kant too believed that without some sort of *a priori* paradigm the mind cannot impose order on sensory experience. But whereas Kant and Darwin each thought that we are all born with more or less the same innate paradigm, Kuhn argued that our paradigms keep changing as our culture changes[63].

In Boyd's work these notions are already apparent in *Destruction and Creation*. Directly referring to Kuhn's 1970 edition of *The Structure of Scientific Revolutions* Boyd includes a rendering of the Popperian dynamics of science within a paradigm:

> the effort is turned inward towards fine tuning the ideas and interactions in order to improve generality and produce a more precise match of the conceptual pattern with reality. Toward

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[59] Ludwig von Bertalanffy, *General Systems Theory* (George Brazilier, New York, 1969), p.18.
[60] Steinbrunner, p.11.
[61] Chalmers, pp.115, 121.
[62] Ibid, p.118, emphasis mine to highlight the connection with Boyd's use of wording.
[63] Horgan, pp.41, 42. Incidentally, this book was also on Boyd's reading list at the time of his death in 1997.

> this end, the concept - and its internal workings - is tested and compared against observed phenomena over and over again in many different and subtle ways.

But at some point, Boyd asserts following Kuhn, 'anomalies, ambiguities, uncertainties, or apparent inconsistencies may emerge'[64]. In subsequent presentations he refers often to the idea that a paradigm, a closed system of logic cannot be falsified from within. One needs to look across various systems to ascertain the nature of reality and one needs to evolve one's orientation patterns. Indeed, in several sections in *The Conceptual Spiral* Boyd manifests a "Polanyiist/Kuhnian" inspiration:

> Novelty is produced by a mental/physical feedback process of analyses and synthesis that permit us to interact with the world so that we can comprehend, cope with, and shape that world as well as be shaped by it[65].
>
> The presence and production of mismatches are what sustain and nourish the enterprise of science, engineering and technology, hence keep it alive and ongoing[66].
>
> The practice of science/engineering and the pursuit of technology permit us to continually rematch our mental/physical orientation with that of the changing world so that we can continue to thrive and grow in it.
>
> The enterprise of science, engineering, and technology affects us personally as individuals, as groups, or as societies by changing our orientation to match with a changing world that we, in fact help change[67].
>
> Very simply, review of "Destruction and Creation", this presentation, and our own experiences reveal that the various theories, systems, processes, etc., that we employ to make sense of that world contain features that generate mismatches that, in turn, keep such a world uncertain, ever-changing, and unpredictable[68].

Strategic activities thus are similar to the Kuhnian scientific endeavor. Indeed, Boyd asserts, *The Conceptual Spiral* also represents 'A *Paradigm* for Survival and Growth'. And,

> Since survival and growth are directly connected with the uncertain, everchanging, unpredictable world of winning and losing we will exploit this whirling (conceptual) spiral of orientation, mismatches, analysis/synthesis, reorientation, mismatches, analysis/synthesis…so that we can comprehend, cope with, and shape, as well as be shaped by that world and the novelty that arises out of it[69].

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[64] Boyd, *Destruction and Creation*, p.7.
[65] Boyd, *The Conceptual Spiral*, p.22. All underlining in original.
[66] Ibid, p.23.
[67] Ibid, p.24.
[68] Ibid, p.31. Although it is likely that Boyd followed Kuhn in this idea of creative destruction, it can not be ruled out that Boyd was also influence by Joseph Schumpeter, whose work *Capitalism, Socialism and Democracy* Boyd had read. Schumpeter is credited with the idea of the merits of creative destruction as an engine for economic growth.
[69] Ibid, pp.37-38. Italics are mine.

Beyond Newton

In the past four decades such a Kuhnian scientific paradigm shift has occurred, according to various authors, or at least a novel conceptual framework has evolved to complement the reigning one in important ways, and Boyd was intimately aware of these views. This shift was highly visible in a much discussed and bestselling work such Douglas Hofstadter's *Gödel, Escher, Bach* (1979), an influential book Boyd was familiar with, but Polanyi and Heisenberg also explicitly alluded to the end of the Newtonian paradigm[70], as well as a host of other authors featuring on the bibliography of *Patterns of Conflict,* who were among the first to discuss the contemporary scientific changes in popular scientific works, such as Fritjof Capra's *The Tao of Physics* (1976), Richard Dawkins' *The Selfish Gene* (1976), E.O. Wilson's *On Human Nature* (1978) and Ilya Prigogine's widely acclaimed book *Order out of Chaos* (1984). Together with other bestselling works like Capra's *The Turning Point: Science, Society and the Rising Culture* (1982), Stephen Hawking's *A Brief History of Time* (1988), Dawkins' *The Blind Watchmaker*, Stephen Jay Gould with a whole list of bestselling studies on paleontology and evolution theory, James Gleick's *Chaos* (1987) and Mitchell Waldrop's *Complexity, The Emerging Science at the Edge of Order and Chaos*, these books marked the popular acceptance of science[71].

The shift can be described as a movement away from a scientific worldview entirely based on what are often and variously labeled Cartesian, Newtonian, Linear, Analytical, Objectivistic, Reductionist, Deterministic or Mechanical concepts, towards a focus on change, diversity, evolution, unpredictability, complexity, uncertainty, non-equilibrium and non-linearity.

The Newtonian paradigm rests firmly upon linear principles, whereas the recent emerging paradigm stresses non-determinism and non-linearity. Linear systems played an important role in the development of science and engineering, as their behaviors are easily modeled, analyzed, and simulated. A linear system has two defining mathematical characteristics. First, it displays proportionality. If some input X to the system gives an output of Y, then multiplying the input by a constant factor A yields an output of AY. The second characteristic of linear systems is superposition or additivity which means as much as that the whole is equal to the sum of its parts. That is, if inputs X1 and X2 give outputs Y1 and Y2 respectively, then an input equal to X1 + X2 gives an output of Y1 + Y2. Systems that do not display these characteristics are called nonlinear.

Importantly, linear systems of equations can be solved analytically or numerically. Given a set of linear equations and initial conditions, we can calculate the future values of the variables. Consequently, if we can describe a system by a linear mathematical model, we can determine its future states exactly from its given initial state. A large body of mathematics has grown up around linear systems and techniques for their solution.

Reductionism is an important consequence of the Newtonian paradigm. Reductionism is a methodology for solving problems. The analyst breaks the problem into its constituent pieces, solves each piece separately, then sums the results from the pieces to obtain the overall solution to the problem. This is a natural consequence of superposition. It also leads to the principle of replication which means that the same action or experiment

[70] Not only is it on the list of personal papers, other authors such as Paul Davies frequently referred to Hofstädter.
[71] Watson, pp.740, 757.

under the same conditions will come out the same way, that results are repeatable and therefore independently verifiable. Finally cause and effect are demonstrable. This can happen in a number of ways: observed, inferred, extrapolated, etc. Therefore the nature of linear systems is that if you know a little about their behavior, you know a lot. You can extrapolate, change scales and make projections with confidence. A consequence of the Newtonian paradigm is the view of systems as closed entities, isolated from their environments. Outside events do not influence such a system; the only dynamics are those arising from its internal workings. The analyst thus has an inward focus.

This leads to the deterministic character of the Newtonian view. Newton's equations of motion are the basis of classical mechanics. They were considered to be fixed laws according to which material points move, and were thus thought to account for all changes observed in the physical world. The "cosmic machine", once in motion, was seen as being completely causal and determinate. All that happened had a definite cause and gave rise to a definite effect, and the future of any part could - in principle - be predicted with absolute certainty if its state at any time was known in detail. This view was not only applied to solid matter but also to fluids and gases. The first law of thermodynamics, which sprang from the application of Newtonian mechanics to the study of thermal phenomena (treating liquids and gases as complicated mechanical systems), states that total energy in a process is always conserved.

Thus, it was also believed that the world could be described objectively, i.e. without ever mentioning the human observer[72]. Laplace hypothesized that a sufficiently intelligent being (or "demon") could grasp any future event from an adequate comprehension of the present. The perceiving subject is a neutral observer and the object a pure datum of perception, each separated from the other by a chasm of non-participation. Defined as a "mirror of nature", the mind was thought capable of representing the world through objective knowledge that was stable, certain, and accurate[73].

The Newtonian natural science proved itself in practice, with its theories producing impressive results and its success had a dramatic impact on the social sciences emerging in the 18th and 19th centuries. Social scientists and historians began searching for laws that that controlled the social and psychological world in the same way that laws controlled the natural world. Thus from the 17th to the 20th centuries, a new modern paradigm emerged, organized around the logic of determinism, and rooted in the objectifying, mechanistic, abstract, and atemporal mode of thought stemming from the natural sciences. Scientism became a modern faith, promoting the belief that the scientific method alone provided the royal road to truth, that there was one legitimate logic and one reliable methodology, and that eventually all sciences and fields of intellectual endeavor could be unified within the same nomological and reductionist framework[74].

However, the assumptions of classical physics upon which we have confidently erected our entire way of organizing life turn out to be largely fallacious, Rifkin told Boyd[75]. There is not a crisis of the sort Kuhn described. The recent history of science is characterized by a series of problems that are the consequences of deliberate and lucid questions asked by scientists who knew that the questions had both scientific and

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[72] Capra, 1975, pp.56-57. I deliberately refer directly to this book as it is one read by Boyd in the early stages of his research. The issue of determinism is also discussed at length in Prigogine and Coveney.
[73] Steven Best and Douglas Kellner, *The Postmodern Turn* (The Guilford Press, New York, 1997), p.203.
[74] Ibid, p.202.
[75] Rifkin (1980), p.224.

philosophical aspects, Prigogine and Gell-Mann note[76]. Thus the limitations of the Newtonian paradigm have been deliberately addressed as a new paradigm developed that was able to explain phenomena that could be not addressed within the classic paradigm. And this does not mean that theorists are suggesting that the traditional underlying assumptions are wrong. Boyd's understanding about the nature of science and is almost literally reflected in observations by Capra (shared by others), who note that instead,

> modern science has come to realize that all scientific theories are approximations to the true nature of reality; and that each theory is valid for a certain range of phenomenon. Beyond this range it no longer gives a satisfactory description of nature, and new theories have to be found to replace the old one, or, rather, to extend it by improving the approximations[77].

The end of certainty

The new paradigm developed from changes of concepts and ideas that occurred in physics during the first three decades of the 20th century. And these changes feature prominently in Boyd's work: relativity theory, quantum mechanics and the uncertainty principle. The first blow to the Laplacian school dominating science was delivered by thermodynamics. The Second Law of Thermodynamics, which Boyd alludes to in *Destruction and Creation* and *A New Conception for Air-to-Air Combat,* deals with dissipation of energy[78]. This law also features prominently in Chaos and Complexity theory. While the total energy involved in a process is always constant, the amount of useful energy is diminishing, dissipating into heat, friction, and so on. The broader philosophical significance was that it introduced into physics the idea of irreversible processes, of an "arrow of time".

According to the Second Law, there is a certain trend in physical phenomena. Mechanical energy is dissipated into heat and cannot be completely recovered, as when hot and cold water are brought together. What such processes have in common is that they proceed in a certain direction - from order to disorder. Any isolated physical system will proceed spontaneously in the direction of ever increasing disorder. This unidirectional process was described in a new quantity called "entropy". Entropy is a quantity that measures a degree of evolution of a physical system.

Entropy in an isolated physical system will keep increasing and because this evolution is accompanied by increasing disorder, entropy can also be seen as a measure of disorder. This process will continue until an equilibrium has been reached called "heat death". Then all activity has ceased, all material evenly distributed and at the same temperature. According to classical physics the universe as a whole evolves toward such a state of maximum entropy; it is running down and will eventually grind to a halt[79], which was the message of Rifkin's book Boyd read and a prospect Boyd included as a warning for members of closed strategic entities.

Darwinism also forced scientists to abandon the Cartesian conception of the world as a machine. Instead the universe had to be pictured as an evolving and ever changing

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[76]Prigogine and Stengers (1984), p. 309; Murray Gell-Mann, *The Quark and the Jaguar, Adventures in the Simple and the Complex*, (Freeman & Company, New York, 1994), p.136.

[77] Capra (1982), p.101.

[78] At Georgia Tech Boyd had studied James B. Jones and George A. Hawkins; *Engineering Thermodynamics* (1960), but later works, such as Rifkin's, take the concept far beyond the realm of engineering.

[79] Fritjof Capra, *The Turning Point* (Bantam Books, New York, 1982), pp.72-74. See for a more detailed account in particular Coveney and Highfield (1990).

system in which complex structures developed from simpler forms. Whereas in biology evolution meant a movement toward increasing order and complexity, in physics (thermodynamics) it came to mean just the opposite - a movement toward increasing disorder. This grim picture of cosmic evolution is in sharp contrast to the ideas of biologists and the emergence of evolution in physics thus brought to light a limitation of the Newtonian theory. The mechanistic conception of the universe as a system of billiard balls in random motion is far too simplistic to deal with the evolution of life[80]. Relativity theory and atomic physics shattered all the principal concepts of the Newtonian world view: the notion of absolute space and time, the elementary solid particles, the strictly causal nature of physical phenomena, and the ideal of an objective description of nature[81]. The philosophical implication of the theory was that time can change and depends on the circumstances, and the position of the observer is essential for the measurement of time, a theme that was to become one of the characteristics of the new physics of the first three decades of the 20th Century. The universe is experienced as a dynamic inseparable whole, which always includes the observer in an essential way, as Capra noted[82].

Quantum theory delivered the third blow to the Newtonian worldview. Where relativity theory is valid on the very large cosmological scale and replaces Newtonian physics, in the realm of elementary particles, atoms, and molecules, quantum theory replaces classical physics[83]. Ever since Newton physicists had believed that all physical phenomena could be reduced to the properties of hard and solid material particles. Quantum theory forces them to accept the fact that the solid material objects of classical physics dissolve at the subatomic level into wavelike patterns of probabilities. There is wave-particle duality[84]. These patterns, moreover, do not represent probabilities of things, but rather probabilities of interconnections. The subatomic particles have no meaning as isolated entities but can be understood only as interconnections, or correlations, among various processes of observation and measurement. In other words, subatomic particles are not things but interconnections among things. Shifting the attention from macroscopic objects to atoms and subatomic particles, nature does not show us any isolated building blocks, but rather appears as a complex web of relationships among the various parts of a unified whole. These relationships are expressed in quantum theory in probabilities, which are determined by the dynamics of the whole system. Whereas in classical mechanics the properties and behavior of the parts determine those of the whole, the situation is reversed in quantum mechanics. It is the whole that determines the parts.

The duality feature also led Werner Heisenberg in 1927 to formulate his famous "uncertainty (or indeterminacy) principle", which Boyd incorporated in *Destruction and Creation* and *A New Conception for Air-to-Air Combat,* and referred to in most other presentations. Heisenberg noted that it is possible to determine the coordinate of a subatomic particle, but the moment we do so, the momentum of the particle will acquire an arbitrary value, and vise versa. We can measure coordinates or movements, but not both. It meant that the more precisely we know the measured value of one quantity, the greater the

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[80] Capra (1982), p.72-74.

[81] Fritjof Capra, *The Tao of Physics* (Shambala, Boston, Mass.,1975), pp.61-62.

[82] Ibid, p.81 (note that this work was on Boyd's early reading lists).

[83] Peter Coveney & Roger Highfield, *The Arrow of Time* (Flamingo, London, 1991), p.107.

[84] Ibid, p.114. This book gives a very detailed yet accessible account of developments in physics in the past century. For quantum mechanics, and a concise discussion of Heisenberg's uncertainty principle, see chapter 4. Likewise, Prigogine and Stengers give a historical overview of the scientific developments of the past century leading up to complexity theory in the 1980's. They focus more on the second law of thermodynamics.

uncertainty in another "conjugate" quantity[85]. Quantum mechanics obliged us to speak less absolutely about the location of an object. This was a fundamental observation with far reaching consequences for again, as with relativity theory, it meant that the act of observation heavily shaped reality. No single theoretical language articulating the variables to which a well-defined value can be attributed can exhaust the physical content of a system. Various possible languages and points of view about the system may be complementary. They all deal with the same reality, but it is impossible to reduce them to one single description. The irreducible plurality of perspectives on the same reality expresses the impossibility of a divine point of view from which the whole of reality is visible.

It implied that reality studied by physics is a mental construct. Heisenberg noted that 'what we observe is not nature itself, but nature exposed to our method of questioning'[86]. For Prigogine the real lesson to be learned from the principle of complementarity consists in emphasizing the wealth of reality, which overflows any single language, and single logical structure. Each language can only express a part of reality[87]. For Boyd it implied another variation of the same theme of uncertainty along with Kuhn's thesis of the workings of paradigms. Inspired among other works, by Heisenberg's own book *Physics and Philosophy,* Boyd literally includes Heisenberg's indeterminacy principle as formulated above, and adds to this that the uncertainties involved in observing phenomena 'hide or mask phenomena behavior'. Under these circumstances,

> the uncertainty values represent the inability to determine the character or nature (consistency) of a system within itself[88].

Boyd also came across another source of uncertainty. As Jean Piaget asserted in the book Boyd read for his essay, 'In 1931 Kurt Gödel made a discovery which created a tremendous stir, because it undermined the then prevailing formalism, according to which mathematics was reducible to logic and logic could be exhaustively formalized. Gödel established definitely that the formalist program cannot be executed'[89]. Gödel thus added another theory that describes limits to knowledge, one Boyd also includes in *Destruction and Creation* and *A New Conception for Air-to-Air Combat.* He tells no less firmly than Heisenberg's uncertainty principle that there are things we cannot know. Gödel stated that within any consistent formal system, there will be a sentence that can neither be proved true nor proved false. In addition, he states that the consistency of a formal system of arithmetic cannot be proved within that system. Thus he established there are limits to math and logic. It was a form of mathematical uncertainty principle[90].

Destruction and Creation includes two typed pages devoted to Gödel. According to Boyd, Gödel showed that 'any consistent system is incomplete' and that 'even though such a system is consistent its consistency cannot be demonstrated within the system'. Boyd also noted that Gödel showed

> that a consistency proof of arithmetic can be found by appealing to systems outside that arithmetic. Thus Gödel's proof indirectly shows that in order to determine the consistency of

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[85] Ibid, p.125.
[86] Cited in Capra (1996), p.40.
[87] Prigogine and Stengers (1985), pp.222-225.
[88] Boyd, *Destruction and Creation*, p.10.
[89] Jean Piaget, *Structuralism*, (London, Routledge and Kegan Paul, 1971), pp.32-33.
[90] Watson, pp.270-272.

> any new system we must construct or uncover another system beyond it. Over and over this cycle must be repeated to determine the consistency of more and more elaborate systems[91].

Boyd not only referred to original works of these authors. Additionally, several authors whose books Boyd had read describe these fundamental changes and point at the similarities of the philosophical and epistemological implications[92]. Capra wrote in 1975 that 'the classical mechanistic world view had to be abandoned at the beginning of this [20th] century when quantum theory and relativity theory forced us to adopt a much more subtle, holistic, and "organic" view of nature'[93]. As Paul Davies noted in a popular book included in Boyd's list of personal papers, in the 1920s a revolution occurred in fundamental physics that shook the scientific community and focused attention as never before on the relation between observer and the external world. It forms a pillar in what has become known as the new physics, and provides the most convincing scientific evidence yet that consciousness plays an essential role in the nature of physical reality. And by the 1970s this idea, according to Davies, had finally percolated through to the layman[94]. Gell-Mann too, another "father" of the new sciences, recently pointed to the intellectual foundations laid by Gödel and Heisenberg[95], while Uri Merry stated that the old paradigm is breaking down 'under the combined onslaught of the findings of quantum theory; Heisenberg's uncertainty principle; Gödel's theorem; the discoveries of chaos, complexity, self-organization, evolution, autopoeisis in living systems, and other breakthroughs in science'[96]. In hindsight Boyd thus was on solid grounds to base his work on the emerging worldview.

Although Rifkin mentions Heisenberg and the Second Law in one chapter arguing that 'the static view of the worl has been replaced by the view that everything in the world is always in the process of becoming'[97], few contemporaries however made the direct connection between thermodynamics, Heisenberg and Gödel. In light of the fact he read Monod[98], Capra, Davies, Rifkin, Prigogine, Heisenberg and Gödel, and because he had become intimately familiar with thermodynamics in Georgia Tech, it may not seem such a remarkable conceptual leap. It was however a genuine creative original act, most certainly in the realm of military thought[99].

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[91] Boyd, *Destruction and Creation*, pp.8-9.

[92] And besides the already mentioned early works of Capra, etc., that are listed in the bibliographies of his first papers, his personal papers reveal an astounding number of books on the history of science. Early works that describe the stunning advances in physics in the first halve of the 20th century include for instance George Gamow *Thirty Years That Shook Physics, The Story of Quantum Physics* (1966), Werner Heisenberg's *Physics and Philosophy: The Revolution in Modern Science* (1962).

[93] Fritjof Capra, *The Tao of Physics* (3nd edition, 1991), p. 54. The first edition of 1975 already included this passage.

[94] Paul Davies, *God and the New Physics* (Penguin Books, 1990), pp.100-101. This book was first published in 1983. Interestingly, Davies notes how 'many modern writers are finding close parallels between the concept used in the quantum theory and those of oriental mysticism, such as Zen'.

[95] Gell-Mann's chapters 3 and 11, deal with information and quantum mechanics respectively.

[96] Uri Merry, *Coping with Uncertainty, Insights from the New Sciences of Chaos, Self-organization and Complexity* (Westport, Connecticut, 1995), p.100.

[97] Rifkin (1980), p.227.

[98] Monod held that living things as isolated self-contained energetic systems, seem to operate against entropy, and that different life forms will battle against each other until a greater disorder takes over again.

[99] Paul Davies had included the three in his 1983 book *God and the New Physics*. Prigogine included, besides Heisenberg and Gödel, explicitly the Second Law of Thermodynamics, however, this was in his seminal work published in 1984[99].

The link between thermodynamics and Heisenberg/Gödel however may well have been provided through his reading of cybernetics and systems theory in which the concept of open and closed systems is an essential theme. Indeed, the seed of this insight may have been sown when Boyd read Jean Piaget's work *Structuralism* in preparation of *Destruction and Creation*, to which he frequently explicitly refers in this essay[100]. *Structuralism* is a remarkable book, and Structuralism a highly influential movement. The book contains a broad overview of disciplines that dealt with structures. Translated from French, it not only dealt with Gödel (although Gödel features very prominently indeed), but also includes explanations of the work of systems theoretician Ludwig von Bertalanffy, the linguist Noam Chomsky, the sociologists Talcott Parsons and Michel Foucault, anthropologist Claude Levy-Strauss, Charles Darwin, Thomas Kuhn, Karl Popper, Ernest Nagel, and a host of others. According to Piaget, they all explain their subject in terms of systems or structures and in terms of processes of transformations that sustain these structures or systems. Indeed, Piaget shows, structure *is* a system of transformations, indeed, a structure is a systematic whole of self-regulating transformations[101]. The quintessence is that *there is no structure apart from construction*[102]. Alternatively, he may have been alerted by Polanyi, who, as noted before, pointed Boyd at the insight that *'the higher principles which characterize a comprehensive entity cannot be defined in terms of the laws that apply to its parts in themselves'*[103]. In any case, these books capture the nexus between the epistemological issues discussed above and the next element of Boyd' s scientific *Zeitgeist*: the systems view of the world[104].

The emerging systems view of the world

Wholes, not parts

The new complementary paradigm that emerged carries various labels. The contours are described by various authors in various ways, depending in part on the moment of publication and their own discipline. Yet several similarities appear throughout. Capra noted in 1982 that

> Out of the revolutionary changes in our concept of reality that were brought about by modern physics, a consistent world view is now emerging. In contrast to the mechanistic Cartesian view of the world, the world view emerging from modern physics can be characterized by words like organic, holistic, and ecological. It might also be called a *systems view*, in the sense of *general systems theory*. The universe is no longer seen as a machine, made up of a multitude of objects, but has to be pictured as one indivisible dynamic whole whose parts are essentially interrelated[105].

Later he labeled it as the "holistic worldview", and "deep ecology"[106]. The essence of new paradigm is alternatively captured in words such as the "Organismic Revolution"[107], the

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[100] Jean Piaget, *Structuralism* (Routledge and Kegan Paul, London, 1971).
[101] Ibid, p.44.
[102] Ibid, p.140.
[103] Polanyi (1969), p.217. This comes from the same section in which he introduces Piaget.
[104] Another study on structuralism Boyd had read, Howard Gardner's *The Quest for Mind, Piaget, Levi-Strauss and the Structuralism Movement* (University of Chicago Press, Chicago, 1972) actually regards structuralism as the 'worldview' that took hold during the sixties.
[105] Capra, (1982), pp.77-78.
[106] Fritjof Capra, *The Web of Life, A New Understanding of Living System* (New York, 1996, p. 6).
[107] Ludwig von Bertalanffy, *General Systems Theory* (2nd edition, New York, 1968), p.186.

"Evolutionary Paradigm"[108]and "Prigoginianism"[109]. Capra notes that this paradigm shift transcends beyond the boundaries of the physical sciences: 'today, twenty-five years after Kuhn's analysis, we recognize the paradigm shift in physics is an integral part of a much larger cultural transformation'[110]. Watson asserts that we are now in an era of 'universal Darwinism'[111], an important statement in light of the fact that Boyd already in his first presentation of *A Discourse* states that:

> In addressing any questions about conflict, survival, and conquest one is naturally led to the Theory of Evolution by Natural Selection […][112]

One of the key figures in this process and one whose work Boyd had read, Ilya Prigogine contends that there is a 'radical change in our vision of nature towards the multiple, the temporal and the complex'[113], and 'this development clearly reflects both the internal logic of science and the cultural and social context of our time'[114]. Already Heisenberg recognized the shift from the parts to the whole as a central aspect of the conceptual revolution occurring in the 1920s[115]. At the same time in biology organismic biologists took up the problem of biological form and explored the concept of organization. This involved a shift away from function to organization and implicitly also from mechanistic to systemic thinking. Organization was determined by configuration, relationships which formed patterns as a configuration of ordered relationships. What these early systems thinkers recognized very clearly is the existence of different levels of complexity with different kinds laws operating at each level. The term "organized complexity" was introduced as the subject of study. At each level of complexity the observed phenomena exhibit properties that do not exist at the lower level. The new science of ecology in the 1930s added to the movement. Ecologists study "communities" of organisms, or super-organisms, which for all intent and purposes act as an entity. Ecology also introduced the concept of "network" to describe the fact that organisms and communities of organisms are integral wholes whose essential properties arise from the interaction and interdependence of their parts.

A similar shift was occurring in psychology towards Gestalt Psychology (Gestalt is the German word for organic whole). The word "system" was coined to denote both living organisms and social systems and from that moment on a system had come to mean an integrated whole whose essential properties arise from the relationships between its parts, and systems thinking the understanding of a phenomenon within the context of a larger whole[116]. According to systems view, the essential properties of an organism, or living system, are properties of the whole, which none of the parts have. They arise from the interactions and relationships among the parts. Systemic properties are properties of a patterns. These properties are destroyed when the system is dissected, either physically or theoretically, into isolated elements.

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[108] Prigogine and Stengers, p. xxix.
[109]Uri Merry, *Coping With Uncertainty, Insights from the New Sciences of Chaos, Self-Organization, and Complexity* (Praeger, Westport, Connecticut, 1995), p.100.
[110] Capra (1996), p.5.
[111] Watson, p.757.
[112] Boyd, *Patterns of Conflict*, p.11.
[113] Prigogine and Stengers, p.xxvii.
[114] Ibid, p.309.
[115] Capra (1996), p.31. A similar discussion can be read in Piaget's *Structuralism*.
[116] Capra (1996), pp.29-35.

As Ludwig Bertalanffy noted, the great shock of 20th century science has been that systems cannot be understood by analysis for the application of the analytical procedure depends on two conditions. First, the interaction between parts is non-existent or very weak, second, the relationships describing behavior of part is linear. These conditions are not fulfilled in the entities called systems, i.e. consisting of parts "in interaction"[117]. The properties of the parts are not intrinsic properties but can only be understood within the context of the larger whole. Instead of focusing on the parts, systems thinking concentrated on basic principles of organization. Analysis means taking something apart to understand it; systems thinking means putting it into the context of the larger whole. As McDermott and O'Connor assert in their overview of systems thinking:

> breaking a whole into its parts is analysis. You gain *knowledge* by analysis. Building parts into wholes is synthesis. You gain *understanding* through synthesis. When you take a system apart and analyze it, it loses its properties. To understand systems you need to look at them as wholes[118].

Capra notes that 'what is destroyed when a living organism is dissected is its pattern. The components are still there, but the configuration of relationships among them - the patterns - is destroyed'[119].

Not surprisingly Boyd recommends both analysis and synthesis to comprehend the world, and an opponent's system. One of the early works Boyd had read for *Destruction and Creation* actually centered on this dichotomy. In *Two Modes of Thought* James Bryant Conant, one time President of Harvard and under whose auspices Thomas Kuhn wrote *The Structure of Scientific Revolutions*, discussed the benefits and dangers of the theoretical-deductive and empirical-inductive approach respectively. He asserts that 'the great scientists can and have used both modes of thought', without a combination science does not progress[120]. Indeed, he continues, the reconciliation of both types is essential for the continuation of a free society in an age of science and technology[121].

Already in *Destruction and Creation* Boyd devotes a considerable section towards this systems-theoretical theme. He notes how deduction, analysis and differentiation are related and can be referred to as unstructuring or destruction, hence *destructive deduction*. But applying this to a "comprehensive whole" will result in parts but also in loss of order and meaning. He contrasts this approach with induction, synthesis and integration, which can be labeled as creative or *constructive induction*. Both however are required:

> the crucial step that permits creative induction is the separation of the particulars from their previous domains by destructive deduction. Without this unstructuring the creation of a new structure cannot proceed - since the bits and pieces are still tied together as meaning within unchallenged domains or concepts[122].

Elsewhere, in order to make a point in his discourse on the essence of strategy, he notes that:

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[117] Bertalanffy, p.19.
[118] Boyd, *Strategic Game of ? & ?*, p.10.
[119] Capra (1996), p.81.
[120] James Bryant Conant, *Two Modes of Thought* (Trident Press, New York, 1964), p.31. This short book includes several examples of scientific breakthroughs in the 19th Century. Darwin is included in this survey.
[121] Ibid, p.91.
[122] *Destruction and Creation*; pp.5-6.

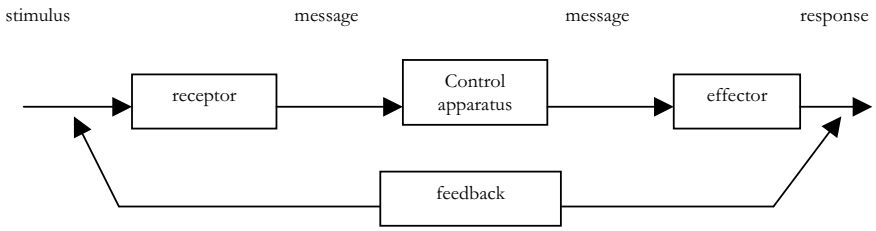
> We will use this scheme of pulling things apart (analysis) and putting them back again (synthesis) in new combinations to find how apparently unrelated ideas and actions can be related to one another[123].

Indeed, this mode of thinking, which is in line with the ideas of Polanyi, became a key insight Boyd wanted to get across as an essential element of proper strategic thinking. *The Conceptual Spiral* revolves around this theme.

Cybernetics

Cybernetics was the next important stepping stone in the development in systems thinking, another important theory for understanding Boyd for it introduces the element of *feedback*[124]. In 1948 Norbert Wiener published a book called *Cybernetics,* meaning steersman. He described it as the science of communication and control in animal and machine. As stated, cybernetics focuses on how systems function, regardless of what the system is – living, mechanical or social. Wiener proposed that the same general principles that controlled the thermostat may also be seen in economic systems, market regulation and political decision-making systems. Cybernetics encapsulated the multi-disciplinary insights from meetings of, a.o., biologists, anthropologists, mathematicians, engineers and evolutionary theorists in the 1940s. This group included also Gregory Bateson, who made wide ranging contributions to, a.o., psychiatry, and John von Neumann, one of the founders of computer science.

It became a powerful intellectual movement. The practitioners were mathematicians, neuroscientists, social scientists and engineers. Their intention from the beginning was to create an exact science of the mind. Their investigations led them to the concepts of feedback, *self-regulation*, and later to self-organization, concepts that Boyd incorporated in his work. Figures 2 depict two simple feedback loops, which immediately show the parallels with the OODA loop[125].



123 *The Strategic Game of ? and ?*, p.10.

124 In the bibliography of *Destruction and Creation* along with work on Kuhn etc, he lists also Maxwell Maltz, *Psycho-Cybernetics* (1971). The personal papers include U.S. Anderson; *Success-Cybernetics: the Practical Application of Human-Cybernetics* (1970), F.H. George; *Cybernetics* (1971) and Y. Sabarina; *Cybernetics Within Us* (1969), and Marvin Karlins and Lewis Andrews; *Biofeedback: Turning on the Power of Your Mind* (1973) and Norbert Wiener's *The Human Use of Human Beings: Cybernetics and Society* (1967).

125 After Bertalanffy, p.43 and Capra (1996), p.59.

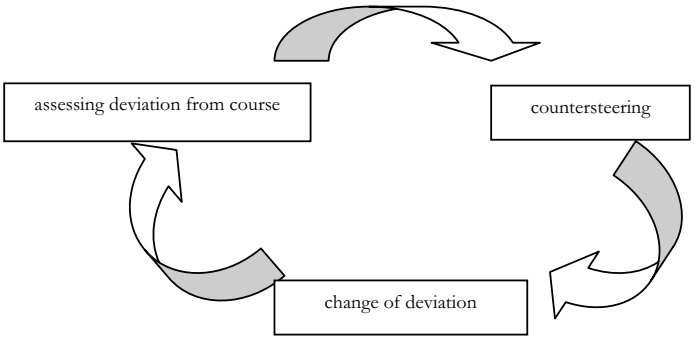


Figure 2: examples of simple feedback loops

Self-regulation of systems by feedback, defined by Wiener as a method of controlling a system by reinserting into it the results of past performance, became an engineering principle in particular in cars, aircraft, missiles and air defense systems[126]. A feedback loop is a circular arrangement of causally connected elements, in which an initial cause propagates around the links of the loop, so that each element has an effect on the next, until the last "feeds back" into the first element of the cycle. The consequence is that the first link ("input") is affected by the last ("output"), which results in self-regulation of the entire system. Feedback is the control of a machine on the basis of its actual performance rather than its expected performance. In a broader sense feedback has come to mean the conveying of information about the outcome of any process or activity to its source.

The cyberneticists distinguished between this type of "*negative*" or "*balancing*" feedback, which dampens the effects of change and leads to less of the action that is creating it, and "*positive*" or "*reinforcing*" feedback, in which changes return to the system and amplify a change in the same direction[127]. It was recognized as the essential mechanism of *homeostasis*, the self-regulation that allows living organisms to maintain themselves in a state of dynamic balance.

From the beginning cybernetic theorists were aware that feedback is an important concept for modeling not only living organisms but also social systems. Like an individual, a social system is an organization that is bound together by a system of communication and it has a dynamics in which circular processes of a feedback nature play an important role. They recognized the similarity between the concept of feedback, the interplay of thesis and antithesis in the dialectic of Hegel and Marx and or instance the economic theory of Adam Smith that argues for the self-regulation of markets. All of these ideas implied circular patterns of causality that can be represented by feedback loops. It was the major achievement of cybernetics and informed investigations in other fields, such as biology and psychiatry.

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[126] Joseph O'Connor & Ian McDermott, *The Art of Systems Thinking*, (Thorsons, San Fransisco, 1997), p.236.
[127] Capra (1996), pp. 56-64.

General Systems Theory

Systems thinking matured with the integration of several scientific fields, including cybernetics, into *General Systems Theory* in the 1960s, which was also the title of the seminal work by Ludwig von Bertalanffy, one which Boyd had read. Coming from the organismic school of biologists, Bertalanffy was perhaps one of the first to paint the first coherent picture of the developing paradigm and definitely the one who established systems thinking as a major scientific movement. He is commonly credited with the first formulation of a comprehensive theoretical framework describing the principles of organization of living systems[128]. He advocated a science of wholeness. He also was convinced that understanding systems behavior required a profoundly interdisciplinary approach[129].

Bertalanffy objected to the dominant position of physics within modern science and emphasized the crucial difference between physical and biological systems. To make his point, he pinpointed a dilemma that had puzzled scientists since the nineteenth century, when the novel idea of evolution entered into scientific thinking. Whereas Newtonian mechanics was a science of forces and trajectories, evolutionary thinking – thinking in terms of change, growth, and development – required a new science of complexity. The first formulation of this new science was classical thermodynamics with its celebrated Second Law of dissipating energy, as described above, operating in closed systems. The contradicting view with biology was solved by Bertalanffy. He took the first crucial step in recognizing that living systems are *open systems* that cannot be described by classical thermodynamics[130].

He was influenced by process-thinking that was developed in the 1930s in various fields. Systems thinking is always process thinking. Every structure is seen as a manifestation of an underlying process. In biology for instance the concept of *homeostasis* was coined to describe the self-regulating mechanisms that allows organisms to maintain themselves in a state of dynamic balance with their variables fluctuating between tolerance limits. This was an internally oriented regulating system. Bertalanffy extended this notion to external interactions between a system and its environment. Subsequently von Bertalanffy called living systems "open" because they need to feed on a continual flux of matter and energy from their environment to stay alive. As Bertalanffy describes it:

> We express this by saying that living systems are basically open systems. An open system is defined as a system in exchange of matter with its environment, presenting import and export, building up and breaking down of its material components…Closed systems are systems which are considered to be isolated from their environment[131].

Unlike closed systems, which settle into a state of thermal equilibrium, *open systems maintain themselves far from equilibrium* in this "steady state" characterized by continual flow and change. This ability depends on the availability of a *requisite variety*. This principle was advanced by the cyberneticist W. Ross Ashby. It states that the internal regulatory mechanisms of a system must be as diverse as the environment with which it is trying to deal. The greater the number of sets and elements comprising the system, the greater the variety a system has, and importantly, the greater the number of states a system can achieve. Variety is an extremely valuable commodity for a system to possess because a system is "constrained" if it does not have sufficient elements and arrangements of elements to deal with variety imposed upon

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[128] Ibid, p.43.
[129] Bartallanffy, p.94.
[130] Ibid, p.39.
[131] Ibid, p.141.

the system by the environment or other systems. Ashby noted that 'the severity of constraint is shown by the reduction it causes in the number of arrangements a system can take to counteract opposing elements' and 'that when a constraint exists, a system can be taken advantage of because it is predictable'[132]. Thus only by incorporating required variety into internal controls can a system deal with the variety and challenge posed by its environment. Any system that insulates itself from diversity in the environment tends to atrophy and lose its complexity and distinctive nature, an insights Boyd was to adopt.

The basis of the open-system model is the dynamic interaction of its components (and not the feedback cycle as in cybernetics). In cybernetics the goal and function of feedback is the maintenance of a desired value. The theory of open systems is thermodynamics but in open systems order can increase and entropy can decrease. In contrast, in closed feedback mechanisms entropy increases (which is information of the measure of order), therefore information never increases. Information can be transformed into noise but not vice versa. An open system can "actively" tend toward a state of higher organization, i.e., it may pass from a lower to a higher state of order. Notably, according to Bertalanffy, a feedback mechanism in open systems can reactively reach a state of higher organization owing to "learning", i.e., information fed into the system[133]. These insights were later on refined and mathematically under girded by Ilya Prigogine and form the basis for chaos and complexity theory[134].

Systems everywhere

The structure of the brain

Cybernetics and systems thinking had a large impact on cognitive science, biology and psychology, psychiatry, the concept of mind and organization theory. B.F. Skinner based his model of "stimulus-response" on it which forms the heart of the behaviorist school of psychology. Skinner asserted that in order to understand human behavior we must take into account what the environment does to an organism before and after it responds. Behavior is shaped and maintained by its consequences. In the 1960s and 1970s his theories enjoyed a vogue and in many clinics "behavior therapy" was adopted. Although criticized for an alleged under appreciation of the influence of experience and thought, (and free will) behaviorists are generally credited with discovering much what we know about learning, conditioning and the proper use of reward and punishment[135].

In Skinner's work *Beyond Freedom and Dignity*, which Boyd studied for his first essay, Skinner extends this idea to the problem of equality and freedom. Skinner saw human nature as the product of evolution and as an adaptation to the environment. The environment exerts a confining influence, a measure of control, on man. For Skinner, freedom is merely the state in which man does not feel the control that is exerted over him. Freedom is moreover the lack of averse stimuli in the environment. Manipulating and shaping the environment to effectuate a decrease in averse stimuli thus becomes the obvious method for people to enhance freedom[136]. While difficult to assign direct linkage, the echo of Skinner

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132 W.Ross Ashby, *An Introduction to Cybernetics*, John Wiley & Sons, New York, 1956, pp.127-131.

133 Bertalanffy, p.150. In popular system thinking, this feature is enclosed in the notion of feedforward, actions which are the result of expectation and anticipation. See O'Connor & McDermott, pp.48-52.

134 Capra, (1996), pp.46-50.

135 Ibid, p.13, and Watson, pp.495-96.

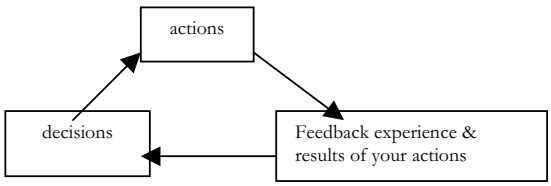
136 Watson, p.551.

cannot be ignored in Boyd's often repeated statement concerning the strategic goal of an organism:

> to diminish adversary's freedom-of-action while improving our freedom-of -action so that our adversary cannot cope while we can cope with events/efforts as they unfold[137].

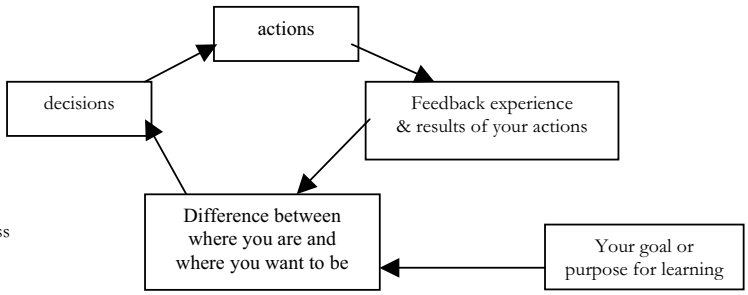
Wiener, von Neumann and others such as Alan Turing and Marvin Minksy, applied cybernetics as a model for the brain. They developed the "computational theory of mind", one of the great ideas in intellectual history, according to Pinker. This fueled the cognitive view in psychology. The central idea is that much human behavior can be understood in terms of the mental processing of information through mental modules, and patterns of connections and patterns of activity among the neurons of the brain[138]. The idea was that the mind is like a program, and the brain is the hardware on which the program runs. The mind resembled a computer to the extent that cognition, the process of knowing, can be defined as information processing, a feature included in Boyd's OODA loop[139]. It led to functionalism, i.e. a focus on the functional organization of matter and on the input-output operations of the mind. The computer model of mental activity became the prevalent view of cognitive sciences and dominated all brain research for the next thirty years. The cybernetic loop was also employed to explain learning, a subject Boyd was keenly interested in. Learning is defined as a process in which one changes due to experience[140]. This process is generally represented as a simplified single reinforcing cybernetic loop as shown below[141].

Figure 5: model of a reinforcing loop



The fact that a system is goal-oriented is incorporated in the balancing loop shown below[142].

Figure 6: model of
double loop learning process



137 Boyd, *Patterns of Conflict*, p.128.
138 Dennis Coon, *Essential of Psychology* (seventh edition, Brookes/Cole, Pacific Grove, Ca, 1997), p.17.
139 Machamer, p.10.; and Rick Grush, 'Cognitive Science', in Machamer and Silberstein (2002), Chapter 13.
140 O'Connor & McDermott, p.118, and Coon, p.279. See also Gareth Morgan, *Images of Organizations* (Beverly Hills, Ca, 1986), chapter 4, in particular pp.84-97, which deal with single and double loop learning.
141O'Connor, p.119.
142 Ibid, p.120.

A slightly more complex model from a 1970s study also illustrates this school of thought:

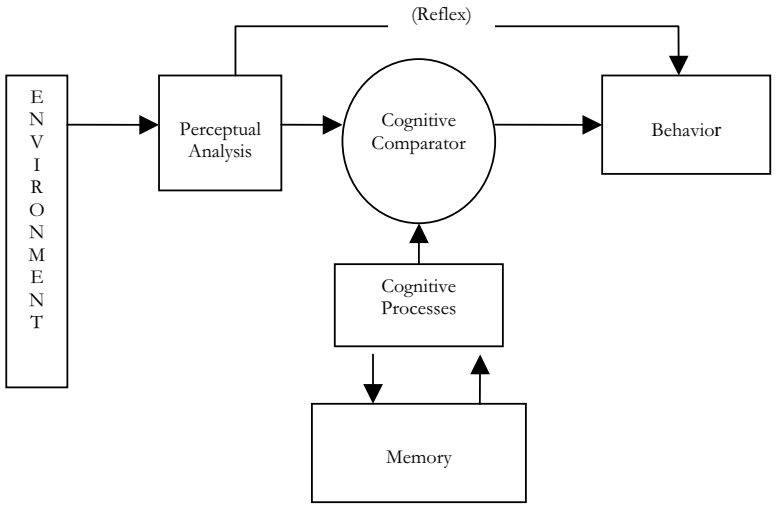


Figure 3. Cognitive Behavior Model.
Source: Adapted from Peter H. Lindsay and Donald A. Norman, *Human Information Processing* (NY: Academic Press, 1977), 689. Adopted from Plehn.

The cognitive revolution

Boyd delved deeply into the literature mapping this cognitive revolution that started at the end of the 1950s and took off fully in the 1960s en 1970s, showing the influence and relevance of cybernetics for understanding human thought processes[143]. Indeed, Boyd's model may in part be retraced to cyberneticists such as Gregory Bateson. Bateson was heavily influenced by Wiener. Bateson developed a model of mind based upon systems-theoretical principles. His list of the criteria of mind includes the following[144]:

1. A mind is an aggregate of interacting parts or components
2. The interaction between parts of mind is triggered by difference (or change), which is related to negentopy and entropy rather than to energy (or in other words, information consists of differences that make a difference);
3. Mental process requires circular (or more complex) chains of determination (and Bateson includes cybernetic drawing of a steam engine regulated by a governor);
4. In mental process, the effects of difference are to be regarded as transforms (i.e. coded version) of events which preceded them.

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[143] One very readable account Boyd studied was for instance Howard Gardner, *The Mind's New Science, A History of the Cognitive Revolution* (Basic Books, New York, 1985). Other works he read that are considered part of the cognitive revolution include John von Neumann, *The Computer and the Brain* (1958), Norbert Wiener, *The Human Use of Human Beings*,*Cybernetics and Society* (1967) and Gilbert Ryle, *The Concept of Mind* (1966) .

[144] Gregory Bateson, *Mind and Nature, A Necessary Unity* (Hampton Press, Cresskill, New Jersey, 2002), pp. 85-86.

Interestingly, Boyd resembles Bateson in arguing for a thoroughly interdisciplinary approach. Like Boyd, Bateson's interest was in addressing the very way we think about issues. He was after the very principles of organization that informed the thinking not only of organisms but of our culture as a whole[145]. And like Boyd, Bateson made the connection between evolution theory and mental processes, asserting that 'if you want to understand mental process, look at biological evolution and conversely if you want to understand biological evolution, go look at mental process'[146].

In similar vein, and very relevant for understanding Boyd's comprehensive OODA loop graphic, from Monod Boyd learned that the prime functions of the nervous system could be defined in the following way[147]:

1. To control and coordinate neuromotor activity, notably in accord with sensory inputs.
2. To contain, in the form of genetically determined elements of circuitry, more or less complex programs of action, and to set them in motion in response to particular stimuli.
3. To analyze, sift, and integrate sensory inputs so as to obtain a representation of the outside world geared to specific performances [of an organism].
4. To register events which are significant in light of those specific performances.
5. To group them into classes according to their analogies.
6. To enrich, refine, and diversify the innate programs by incorporating these experiences into them.
7. To imagine – represent and simulate – external events and programs of action for the organism itself.

Monod asserts that we observe and respond through a genetically determined program which is the result of 'experience accumulated by the entire ancestry of the species over the course of its evolution' (what Boyd would term culture), which in turn shapes action and current experience after analysis of the effect of the action[148]. Here one can recognize the elements of genetics, culture, experience and new information Boyd includes in his graphic of the OODA loop.

Boyd's model, in line with Monod's description, also reflects the criticism against purely cybernetic models. Research from the 1970s onwards in cognitive sciences have made it clear that human intelligence is utterly different from a machine. Gardner told Boyd that the cognitive revolution deliberately de-emphasized culture, emotions, context and history[149]. As Grush observed, the cognitive revolution that occurred during the sixties and seventies in essence was the realization that any adequate theory of human and animal mentality would need to posit representational states between sensory stimulus and behavioral response - at least for a great many domains of behavior. The cognitive revolution brought about a renewed legitimacy of talk and theorizing about some types of mental or cognitive states, specifically, content-bearing states such as beliefs, desires, or more generally states which were about things, or carried information about things, and over which operations such as inference could be performed so as to solve problems and plan. Functionalism too received criticism for the same reason. Genuine understanding is not just a matter of our mental

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145 Alfonso Montuori, 'Editors Introduction', in Gregory Bateson, *Mind and Nature, A Necessary Unity* (Hampton Press, Cresskill, New Jersey, 2002), p.xvii..
146 Sergio Manghi, 'Foreword', op cit., p.xi.
147 Monod, p.149.
148 Ibid, p.154.
149 Gardner (1985), p.41.

implementation of the right program. The mind is not just a functional organization of matter[150].

The human nervous system interacts with the environment by continually modulating its structure, and emotions and experience play a large role in human intelligence, human memory and decisions (this will be further addressed in the next chapter). Moreover, conceptualizing the brain as an information processing devise is flawed for the human mind thinks with ideas, not with information. Ideas create information, they are the integrating patterns that derive not from information but from experience. As Paul Davies suggested to Boyd, 'the essential ingredient of the mind is information. It is the pattern inside the brain, not the brain itself, that makes us what we are'[151]. Moreover, in the computer model of cognition, knowledge is seen as context and value free, based on abstract data. But all meaningful knowledge is contextual knowledge, and much of it is tacit and experiential. As Boyd was aware, the psychologist Jean Piaget and later neo-Darwinists Monod, Dawkins and Wilson all talked about mental structures. Dawkins and Wilson advanced the idea that genetics and culture (in that order) play a substantial role[152]. Thus, the cognitive revolution made common currency of the view that complex behavior is, in large part at least, controlled by inner representational states[153]. As Piaget stated, 'all learning and remembering depend upon antecedent structures'[154]. This does not invalidate cybernetics, merely the unwarranted metaphor of the mind as a computer[155].

In systems thinking, and in Boyd's model, these insights are partly incorporated by introducing the concept of *generative learning* - or *double loop learning* - and the notions of *mental models*, or *cognitive maps*. A cognitive map is an internal image or other mental representation of spatial relationships (or other kinds of knowledge), which allows one to choose alternative paths towards one's goals. Mental models consist of general ideas that shape one's thoughts and actions and lead one to expect certain results. They are theories in use, based mostly on observation and experience. They form belief systems. They give meaning to events. We interpret our experience in light of them. They are formed through socialization, culture and experience, elements Boyd would include in his OODA model as well[156].

In generative learning we allow our mental models to be influenced, perhaps changed, by the feedback. It provides one with a wider number of choices, new strategies and decision rules to apply. It leads to questioning one's assumptions and seeing a situation in a different way[157]. When a person becomes exposed to a new perception or an experience,

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[150] Rick Grush, 'Cognitive Science', in Machamer and Silberstein, pp.273-277. This revolution was brought about by (among others) Noam Chomsky who's work was explicitly directed against Skinner's behaviorist theory of language. Chomsky provied powerful arguments to the effect that no purely stimulus-driven mechanism could possibly learn the structure of natural language, and that rather, language learning seemd to require at least some innate cognitive representational structures which circunscribed possible grammars that were then selected from by exposure to linguistic data. Rat brain research (which Boyd read about) furthermore suggested the presence of cognitive maps.

[151] Davies (1983), p.98.

[152] In *Structuralism,* Piaget advanced the idea that there are "mental structures" that exist midway between genes and behavior. Mental structures built up as the organism develops and encounters the world. Structures are theoretic, deductive, a process. Interestingly, Piaget was influenced by , a.o., Ludwig von Bertalanffy. See Watson, pp.629-630.

[153] Grush, p.275.

[154] Piaget (1971), p.51.

[155] Capra, 1996, pp.51-68.

[156] O'Connor & McDermott, pp.63-65. In the next chapter the concept of schema(ta) will be discussed in the context of complexity theory. Schemata can be considered similar to mental modules.

[157] Ibid, p.124.

which challenges existing schemas, a process of re-organization and adaptation occurs, leading to new schemas. This is referred to as 'cognitive growth'. Learners construct new cognitive structures through a process of 'assimilation', which refers to the integration of new knowledge into existing structures, and 'accommodation', which encompasses the adjustment of the existing structure to integrate new knowledge. The result of this process is to place the learner's cognitive structure on to a higher level of thinking. Another model is called the experiential learning model, which sees learning as an ongoing process whereby knowledge is created through the transformation of experience and a reflective process. In 1975 James March and Johan Olson advanced this model of experiential learning[158]:

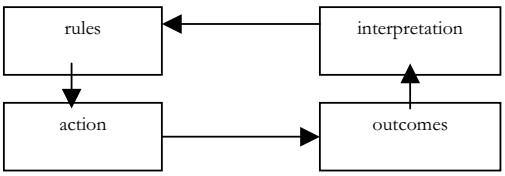

Figure 6: basic model of experiential learning

A later model is interesting because it involves the element of application and testing, a feature Boyd refers to in *The Conceptual Spiral* when talking about the nature of science and engineering[159]:

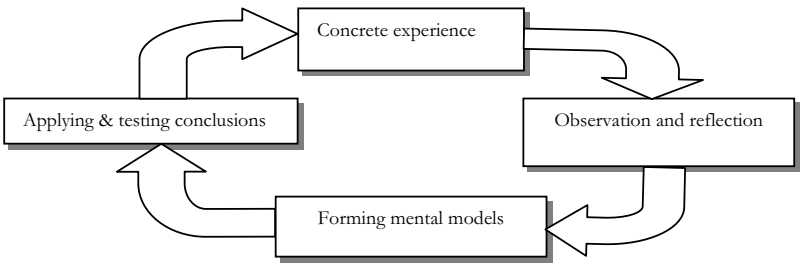

Figure 7: refined model of experiential learning

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[158] James G. March and Johan P.Olson, 'The Uncertainty of the Past: Organizational Learning Under Ambiguity', *European Journal of Political Research*, 3 (1975): 147-71.

[159] Edward Borodzicz and Kees van Haperen, 'Individual and Group Learning in Crisis Simulations', in *Journal of Contingencies and Crisis Management*, Vol. 10, No.3, September 2002, p.141. The authors have copied the model from D. Kolb, *Experiential Learning: Experience as the Source of Learning and Development*, which was published in 1984. Later studies and concepts such as Recognition Primed Decisionmaking explore the influence of training and experience in similar loop models, affirming Boyd's model (see for instance (see Gary Klein, 'Strategies of Decision Making', *Military Review*, May 1989; and *Sources of Power, How People Make Decisions*, (MIT Press, Cambridge, Ma, 1999)). Interestingly though, Boyd's reading list does not list any of the well known works on crisis decision making theory emerging from political science during the seventies and eighties, such as Graham Allison's landmark study *Essence of Decision* (1971), Robert Jervis' *Perception and Misperception in International Politics* (1976) and Irvin Janis' *Groupthink* (1982). For a recent compilation of insights concerning decision making under adversarial conditions see for instance Yaacov Y.I. Vertzberger, *Risk Taking and Decisionmaking*, Stanford University Press, 1998.

The model below shows this process in a slightly other format [160].

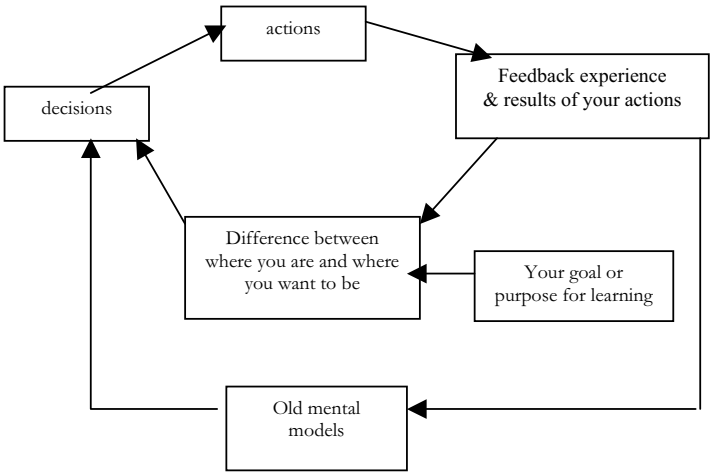

Figure 8: aggegrate model

Creativity

Systems thinking recognizes the limits mental models can and will put on one's viewpoints. It recognizes that the world is always richer than any perspective we have of it. Therefore *the more perspectives we can gain the better*. Piaget had informed Boyd that 'a fundamental trait of science today is the multiplicity of their interactions, which tend to form a system closed upon itself with many cross-linkings', words Boyd would almost literally include in his own work[161]. An additional relevant point of systems thinking is the awareness that this *requires a certain level of curiosity*, i.e., a *deliberate and continuous search for novelty and new insights*. This process, according to systems theory, is what generates new, varied, enriched and improved mental models. As McDermott and O'Connor state,

> creativity and different sorts of intelligence all involve taking different viewpoints, and therefore getting different sorts of feedback[162].

Peter Senge referred to this as *creative tension* and regarded it as a necessity for organizational as well as for individual learning; 'the gap is the source of creativity', words that sound very much like Boyd's own and echo those of Polanyi[163].

Boyd interest in the nature of creativity, and cognitive processes in general surfaces in his investigations as well as his theory. While he studied Quantum theory, Gödel, systems theory, etc, he also read works by Edward deBono such as *New Think: The Use of Lateral Thinking in the Generation of New Ideas* (1971) and *Lateral Thinking: Creativity Step by Step* (1973), Henri Bergson's *The Creative Mind* (1975), J. Bronowski; *The Origins of Knowledge and Imagination*

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[160] O'Connor & McDermott, p.124.
[161] Piaget (1971), p.133.
[162] O'Connor & McDermott, pp.140-141.
[163] Peter Senge, *The Fifth Discipline, The Art and Practice of The Learning Organization* (Doubleday, London, 1992), p.150. This book is a highly popular systems-theory based work on organizational learning.

(1978) and P.E. Vernon; *Creativity* (1970). *Destruction and Creation* actually includes the notion that 'creativity is related to induction, synthesis and integration'[164]. According to Coon, creative thinking for solving problems involves what Boyd actually proposed: inductive, deductive, logical, illogical modes of thinking. In addition to that, Coon asserts that fluency (the total number of suggestions you are able to make), flexibility (the number of times you shift from one class of possible uses to another) and originality (how novel or unusual your suggestions are). Stages of creative thought include:

orientation:	defining the problem and important dimensions);
preparation:	creative thinkers saturate themselves with as much information pertaining to the problem as possible;
incubation:	setting aside the problem and allowing it to 'cook' in the background;
illumination:	the stage of incubation is often ended by a rapid insight or series of insights;
verification:	the final step is to test and critically evaluate the solution obtained during the stage of illumination. If the solution proves faulty, the thinker reverts to the stage of incubation.

An overview of characteristics of creative persons furthermore show not only what Boyd practiced in reality (and indeed describing his character rather accurately), but also his normative view concerning strategic thinking[165].

Thinking abilities	**Personality characteristics**	**Thinking styles**
Use metaphors in thinking	Willing to take intellectual risk	Challenges assumptions
Flexible decision maker	Curiosity and inquisitiveness	Looks for novelty and gaps in knowledge
Uses broad categories	Openness to new experiences	Draws new ideas out of existing
Uses mental images	Tolerates ambiguity	knowledge
Can cope with novely	Broad range of interests	
Can break mental sets	Playful with ideas	
Finds order in chaos	Intuitive	

Organizational learning

From the 1960s onwards systems thinking became a popular concept also outside of the scientific community. In the 1950s and 1960s it had a strong influence on engineering and management. System-oriented management became a catchword in the 1970s with words such as "system-oriented management", "system dynamics" and "management cybernetics" featuring in the titles. Boyd for instance studied several works on systems thinking such as F.E. Emery; *Systems Thinking* (1976), John Gall; *Systemantics: How Systems Work and especially How They Fail* (1977), Marvin Kasner and Lewis Andrews; *Biofeedback: Turning on the Power of Your Mind* (1973), C.T. Landes, *Control and Dynamic Systems: Advances in Theory and Applications* (1973). The cybernetic and systems view was applied in the reports to the Club of Rome[166].

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[164] *Destruction and Creation,* p.5.

[165] Coon, pp.386-389.

[166] And in international relations theory by the mid-1960s, in stead of the familiar billiard ball model, a very different image of the international system was being advanced, depicting international relations in terms of cobwebs being constantly spun across the globe on many different levels, a metaphor supported by a pluralist approach. See for instance Barry Buzan, Richard Little, *International Systems in*

The process of learning, and the previous insights were taken up in management studies. The metaphor of the organization as an organism and as a learning brain proved fruitful correctives for the prevalent view of the organization as a machine, which had dominated management theory up till the 1960s. Both metaphors were based on open systems theory[167]. This spawned two related schools of thought in management literature: the Cognitive School of strategic management and the Learning School, both of which can in turn be considered part of the Organic School of management theory. The idea that organizations are more like organisms guided the attention toward the more general issues of survival, organization-environment relations and organizational effectiveness, and away from goals, structures and efficiency, which were key themes in the machine metaphor. It also induced a focus on information flows. In the process, organization theory became a kind of biology in which the distinctions and relations among molecules, cells, complex organisms, species, and ecology are paralleled in those between individuals, groups, organizations, populations (species) of organizations and their social ecology.

The organic school of management emphasizes the environment in which the organizations exist. Morgan asserts that the open systems view suggests that we should always organize with the environment in mind. This has important implications for organizational practice, stressing the importance of being able to scan and sense changes in task and contextual environments, of being able to bridge and manage critical boundaries and areas of interdependence, and of being able to develop appropriate strategic responses. The dynamic of organizational learning resembles the process described by Boyd. Even in the simplified form as depicted in the introduction, the OODA loop is obviously a very close copy of graphic renderings of organizational learning processes shown above. Included in Boyd's notion of Orientation is the idea of institutional memory in the form of doctrine, practices, values, and shared experiences, that guide action and that inform newcomers in the organization. Other traits too betray the 'organizational learning' character of the OODA loop. The OODA loop model includes double feedback loops that allow an individual or organization to monitor the continued relevance of its goals, its repertoire of responses and the adequacy of the lens of its institutional memory. The following overview gives an impression of definitions of organizational learning in which both the cybernetic as well as the evolution-theoretical elements are evident[168].

- Organizational learning means the process of improving actions through better knowledge and understanding;
- Organizational learning is defined as increasing an organization's capacity to take effective action;
- An entity learns if, through its processing of information, the range of potential behaviors is increased
- Organizational learning is a process of detecting and correcting error;
- Organizational learning is defined as the process by which knowledge about action-outcome relationships between the organization and the environment is developed;
- Organizations are seen as learning by encoding inferences from history into routines that guide behavior;
- Organizational learning occurs through shared insights, knowledge, and mental models [and] builds on past knowledge and experience – that is, on memory.

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World History (Oxford University Press, Oxford, 2000), p.27. See also J.W. Burton, *Systems, States, Diplomacy and Rules* (Cambridge University Press, Cambridge, 1968) for one of the earliest applications, in particular chapter 1.

[167] See Morgan (1986), p.44. Chapters 3, 4 and 8 are based on evolution theory, systems theory and complexity theory and provide an early synthesis of these developments and apply the to organization theory.

[168] This is adopted David A. Garwin, *Learning in Action* (Harvard Business School Press, Boston, Ma., 2000), p.10. Garwin quotes seven different studies.

Drawing together these tenets, Garwin offers the definition that 'a learning organization is an organization skilled at creating, acquiring, interpreting, transferring, and retaining knowledge, and at purposefully modifying its behavior to reflect new knowledge and insights'[169]. Boyd's views on the required organizational features of an organization in constant or at least potential conflict and operating in uncertainty are close to the 'Learning School' of strategic management. Mintzberg, et al, note that the organizational capacity to learn is essential for professional-type organizations, that operate in highly complex environments, where the knowledge required to create strategy is widely diffused, or that face truly novel situations, and/or that operate in dynamic and unpredictable environments[170]. Adaptability and flexibility, for which learning is essential, is the defining parameter for corporate success, i.e., long-term survival[171]. In a very Boydian passage, Warren Bennis notes that

> if we view organizations as adaptive, problem-solving, organic structures, then inferences about effectiveness have to be made, not from static measures of output, but on the basis of the processes through which the organization approaches problems. The measure for health is flexibility, the freedom to learn through experience, the freedom to change with changing internal and external circumstances[172].

In *Organic Design for Command and Control* Boyd argues for a permissive and loosely structured organization, and again his view is in accordance with organization theory developed in the seventies and eighties. Chris Argyris and Donald Schon for instance suggested in 1978 that a loosely structured organization, unfettered by rigid internal hierarchies and overspecialization, would be more amenable to a free internal debate that would facilitate organizational learning and so facilitate change[173]. Others agree, noting that this and the features listed in the table on page 116 are both characteristic as well as the determining parameters for the organizational learning capability[174]: Several authors have since then identified specific facilitators for learning and tools an organization can implement[175]. Facilitators for learning include a broad base of contributors and data sources; a process for sharing diverse perspectives and points of view and a willingness to embrace contradictory and unexpected findings; quick feedback; and forums for brainstorming in which new ideas are generated and creative thinking should be stimulated. When organizations interpret acquired information, they should adopt a dialectic mode in which various views are debated and tested. When information is transformed into action, new approaches must be tried, even when they result in some mistakes and failures[176].

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169 Ibid, p.11. Interestingly Garwin, pp.20-28, distinguishes three stages of learning that resemble three elements of the OODA loop: acquiring information, interpreting information and applying information.
170 Mintzberg, *Strategy Safari,* p.229.
171 Garwin, p.9
172 Cited in Garwin, p.9.
173 Chris Argyris and Donald Schon, *Organizational Learning: A Theory of Action Perspective* (Addison-Wesley, Reading, Mass), 1978, pp. 38-39, 143, 145.
174 Adapted from J.Edward Russo & Paul J.H. Schoemaker, *Winning Decisions* (Doubleday, New York, 2002), pp.227-28.
175 Garwin, p.42.
176 Ibid,pp.28-43.

Positive indicators	Negative indicators
Operating characteristics	
Anticipatory	Reactive
Long-term focus	Short term focus
Change=opportunity	Change=threat
Adapts to change	Static organization
Culture	
Simple structure	complex & bureaucratic
Participative management style	directive/autocratic
Strong networking	lack of sharing/disconnected functions
Open flow of information	information used as power base
External scanning encouraged	insular/lacking external contacts
Encourage questioning and review	closed mind-set/tunnel vision
Innovation/experimentation encouraged	non-risk-taking
Failures used as learning opportunities	failure punished

Boyd's view on the optimum military organization in both peace time and war mirrors these insights. In particular *Organic Design* and *The Conceptual Spiral* bear the markings of this school of thought.

Boyd and the first stage of the paradigm shift

A new view

Thus a systems approach, or systems thinking, slowly developed, which is distinctly contextual. This emergence of systems thinking, growing out of progress in biology in the first halve of the 20th Century, was a profound revolution in the history of Western scientific thought as both Bertalanffy and Capra assert, one which complements the revolution in physics and was stimulated by it. Bertalanffy remarks that 'in one way or another we are forced to deal with complexities, with "wholes" or "systems" in all fields of knowledge. This implies a basic re-orientation of scientific thinking'[177]. Capra remarks that during the second half of the century, the network concept has been the key to the recent advances in the scientific understanding not only of ecosystems, but of the very nature of life[178]. To summarize the early contours of the paradigm shift Capra's list of characteristics suffices. Already in 1975 he laid out several criteria of the 'new-paradigm thinking in science' and he has expanded and restated them in different forms and different editions. Considering the fact that this book was included in the briefing Boyd developed after the essay, Capra's views are important.

The *first* criterion, according to Capra, concerns the relationship between the part and the whole […] the properties of the parts certainly contribute to our understanding of the whole, at the same time the properties of the parts can only be fully understood through the dynamics of the whole. The *second* criterion of new-paradigm thinking in science concerns a shift from thinking in terms of structure to thinking in terms of process. Process is primary and every structure is a manifestation of an underlying process. The *third* criterion is the shift from objective science to epistemic science. Whereas in the old paradigm scientific

[177] Von Bertalanffy, p.5. He actually employed the Kuhnian term paradigm to describe the relevance of system theory, see p.18.
[178] Capra, (1996), p.35.

descriptions were believed to be objective, that is independent of the human observer and the process of knowledge., in the new paradigm epistemology - the understanding of the process of knowledge – has to be included explicitly in the description of natural phenomena. The *fourth* criterion is a shift towards networks as the metaphor for knowledge. Things exist by virtue of their mutually consistent relationships. There is no hierarchy of fundamental laws or principles as the widely held metaphor of knowledge as a building suggests. The *last* criterion involves the shift from truth to approximate description. The Cartesian paradigm was based on a belief in the certainty of scientific knowledge. In stead, the paradigm shift described by Capra advances the idea that all scientific concepts and theories are limited and approximate[179]. Or as Piaget had suggested to Boyd

> Rather than envisaging human knowledge as a pyramid or building of some sort, we should think of it as a spiral the radius of whose turns increases as the spiral rises[180].

Boyd and the systems view of life

Historically, systems theoretical developments and its applications to actual problems were in full swing starting in the early 1950s and continuing well into the 1970s. It was the time Boyd attended Georgia Tech, immersed himself in fighter design and theories of learning. Clearly, Boyd was profoundly influenced by these insights. In his strategic theory this becomes evident not only through his bibliographies, but also in various sections in different presentations, as already alluded above. First of all, Boyd adopted the key insight that living systems are essentially open systems and need to be if they aspire to exist and grow. He often employs the terms 'organic whole'. In *Patterns of Conflict* for instance, when he summarizes the 'theme for vitality and growth', he states that the aim is to:

> improve fitness as an organic whole to shape and expand influence or power over the course of events in the world[181].

In fact, this fundamental scientific insight informed Boyd's thoughts concerning the essence of strategy, which he expressed in systems theoretical terms. In his presentation *The Strategic Game of ? & ?*, in which he distills the abstract essence of strategy, he includes as what he termed an 'essential element' the idea that:

> Living systems are open systems; closed systems are non-living systems. Point: if we don't communicate with outside world - to gain information for knowledge and understanding as well as matter and energy for sustenance - we die out to become non-discerning and uninteresting part of that world[182].

Indeed, when we do not maintain communication with the outside world, Boyd asserts, both Gödel and the Second Law will "kick in":

> One cannot determine the character or nature of a system within itself.
>
> Moreover, attempts to do so lead to confusion and disorder[183].

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[179] Capra, *The Tao of* Physics (3d edition, Shambala, Boston, 1991), pp. 328-33.
[180] Piaget (1971), p.34.
[181] Boyd, *Patterns of Conflict*, p.144.
[182] Boyd, *Strategic Game of ? & ?*, p.28.
[183] Boyd, *Organic Design*, p.20. See also *Strategic Game of ? & ?* , p.41.

In *Patterns of Conflict* he also employs the Second Law by stating that one of the key elements of victory consists of:

> Diminish own friction (or entropy) and magnify adversary friction (or entropy)[184].

Boyd thus regarded the Second Law as another "producer" of uncertainty on a par with the principles described by Gödel and Heisenberg. In *Destruction and Creation* he asserts that

> Confusion and disorder are also related to the notion of Entropy and the Second Law of Thermodynamics…Accordingly, whenever we attempt to do work or take action inside such a system - a concept and its match-up with reality - we should anticipate an increase in entropy hence an increase in confusion and disorder. Naturally, this means we cannot determine the character or nature (consistency) of such a system within itself, since the system is moving irreversible toward a higher, yet unknown, state of confusion and disorder[185].

Strategy, creativity, doctrines and mental modules

A second obvious parallel between systems theory and Boyd's work is in the importance Boyd attaches to creativity, the availability of a multitude of mental modules and the necessity to constantly improve existing mental modules. Devising strategy as an act of creativity and the ideas armed forces operate on -doctrine - or in Boyd's word, orientation patterns, are like mental modules. Boyd's entire starting point of *Destruction and Creation* is a search for way we form - create- mental models or "mental concepts", as Boyd labels them. His investigation begins with the question 'how do we generate or create the mental concepts to support [this] decision making?'[186]. Elsewhere Boyd employs the term Orientation as an equivalent of mental models. In 1987, Boyd elaborated on the element of Orientation of the OODA loop by asserting that

> Orientation, seen as a result, represents images, views, or impressions of the world shaped by genetic heritage, cultural traditions, previous experiences, and unfolding circumstances[187].

In *Destruction and Creation* he advances the notion that for creating relevant mental concepts, we need to heed the warnings of Polanyi, Kuhn, Gödel, Heisenberg and the dynamics of the Second Law. The following examples, again from Boyd's presentation *Organic Design for Command and Control* also reflect this concept:

> Orientation is the Schwerpunkt. It shapes the way we interact with the environment - hence orientation shapes the way we observe, the way we decide, the way we act.
>
> Orientation shapes the character of present observation-orientation-decision-action loops - while these present loops shape the character of future orientation.

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184 Boyd, *Patterns of Conflict*, p.184. Note how Boyd uses the Clausewitzian term concept of friction not in the mechanical sense, as Clausewitz did, but in the thermodynamical sense, indicating that for Boyd friction refers to disorder.
185 Ibid, pp.12-13.
186 *Destruction and Creation*, p.3.
187 *Organic Design for Command and Control*, p.13.

These insights implied, for Boyd, that:

> We need to create mental images, views, or impressions, hence patterns that match with activity of world.

Systems theory enters strategy when Boyd next advances the idea that:

> We need to deny adversary the possibility of uncovering or discerning patterns that match our activity, or other aspects of reality in the world[188].

The systems theoretical principle of the necessity of applying a multitude of perspectives comes to the fore when Boyd asserts in *Organic Design*:

> Orientation is an interactive process of many sided implicit cross-referencing projections, empathies, correlations and rejections […][189].

> expose individuals, with different skills and abilities, against a variety of situations - whereby each individual can observe and orient himself simultaneously to the others and to the variety of changing situations[190].

In *The Strategic Game of ? & ?*, which he finished one month after completing *Organic Design*, he includes several statements referring to this theme, exemplifying the fact that indeed this issue is of an essential nature for Boyd:

> To discern what is going on we must interact in a variety of ways with our environment.

> We must be able to examine the world from a number of perspectives so that we can generate mental images or impressions that correspond to that world[191].

> We can't just look at our own personal experiences or use the same mental recipes over and over again; we've got to look at other disciplines and activities and relate or connect them to what we know from our experiences and the strategic world we live in[192].

When he discusses the ways to maintain interaction with the ever changing world so as to ensure one's ability to adapt, he asserts further that this is accomplished:

> By an instinctive see-saw of analysis and synthesis across a variety of domains, or across competing/independent channels of information, in order to spontaneously generate new mental images or impressions that match up with an unfolding world of uncertainty and change[193].

Conclusion

Scientific debates and insights thus directly informed Boyd's thinking, and awareness of the works Boyd studied and the themes he was interested in help explain his work. As science

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188 Ibid, p.16. underlining in original.
189 Ibid, p.15.
190 Ibid, p.18.
191 *Strategic Game of ? & ?,* p.10.
192 Ibid, p.45.
193 Ibid, p.58.

progressed and developed a new language to address and explain the dynamics of living systems, so Boyd actively developed his mental concepts accordingly. The epistemological debates he read about informed him about the pervasiveness of uncertainty and about the ways science progresses. Reading Conant, Polanyi, Kuhn, Popper and others brought him the themes of analysis and synthesis, the central role of the observer and the influence of existing theories and paradigms on the act of observation. Cybernetics and systems-theory, including the cognitive revolution informed him about the concepts of entropy, feed-back, interdependency, adaptation, and about the role of experience and genetics and their role in shaping mental modules. His study of a wide range of scientific topics suggested a multispectral, multidisciplinary and holistic approach and offered him a new frame of reference and a new lexicon for understanding war and strategy. Already in the end of the 1970s and the early 1980s systems theory was expanded with new concepts which would cohere later into chaos theory and complexity theory - a development Boyd followed from its beginning to the end of his life - which will be described in the next chapter.

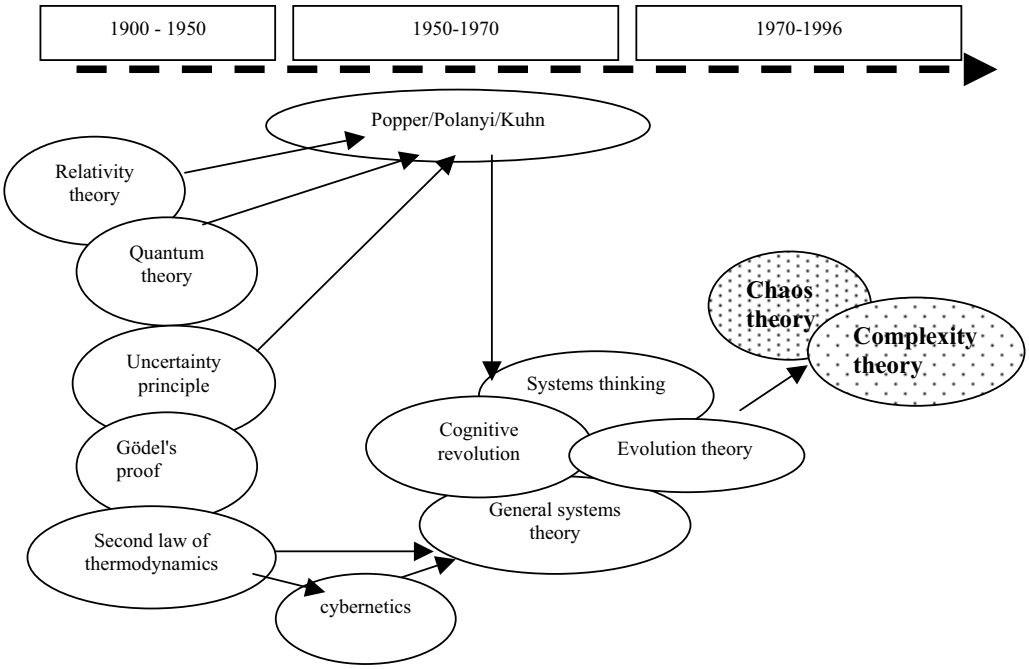
5. COMPLETING THE SHIFT

Physicists, mathematicians, biologists, and astronomers have created an alternative set of ideas. Simple systems give rise to complex behavior. Complex systems give rise to simple behavior. And most importantly, the laws of complexity hold universally, caring not at all for the details of a system's constituent atoms[1].

James Gleick

Riding the wave

Thus far, I have advanced the argument that Boyd's ideas were influenced by the following insights/debates/concepts (the arrows indicate how these ideas were related among themselves):



The next influence, and flowing logically from these previous scientific developments, would come from studies on the behavior of so called *Complex Adaptive Systems*, or *CAS*. Boyd found further inspiration and confirmation from Chaos and Complexity Theory and by implication the neo-Darwinist works. Boyd was interested in any field of knowledge that could illuminate aspects of processes involved in growth, evolution, change and survival, and all of these works discussed above in one form or other deal with aspects of change, growth,

[1] James Gleick, *Chaos: Making a New Science,* (New York, Viking Penguin, 1987), p.304.

advances in knowledge, adaptation, i.e., evolution. Neo-Darwinist perspective dominated the popular scientific literature from the late seventies onward. And the processes of cognition played an increasing role in these fields. As Jeremy Rifkin noted in 1987,

> the old Darwinian view of "survival of the fittest" is now being cast aside in some quarters in favor of a new view of "survival of the best informed".

According to standard Neo-Darwinian orthodoxy, each species up the evolutionary line is better able to utilize scarce resources more efficiently. The emergent theory characterizes each species up the evolutionary chain as better adept at processing greater stores of information in shorter time spans[2]. Already Boyd's first presentation carries the marks of this perspective. Boyd's ideas about war and strategy are pregnant with Darwinian notions. This starts with the opening remarks in the essay *Destruction and Creation*, where he notes that

> studies of human behavior reveal that the actions we undertake as individuals are closely related to survival.

Hence Boyd's statement that the goal of an individual is:

> to improve our capacity for independent action.

In the opening slides of *Patterns of Conflict* this surfaces again when he discusses human nature. The goal, again, is to survive, and to survive on one's own terms, or improve one's capacity for independent action. Due to forced competition for limited resources to satisfy these desires, one is probably compelled to

> diminish adversary's capacity for independent action, or deny him the opportunity to survive on his own terms, or make it impossible to survive at all.
>
> Life is conflict, survival and conquest.

And he actually notes explicitly that in studying war:

> one is naturally led to the Theory of Evolution by Natural Selection and The Conduct of War.

Also in *Organic Design for Command and Control*, again he refers to Darwin stating that

> we observe from Darwin that the environment selects [and] the ability or inability to interact and adapt to exigencies of environment select in or out[3].

This was not a coincidence. Various works discussed in the previous chapters had referred to this theme. Now this perspective was gaining profile among popular scientific books. Major works Boyd had read on "complex systems" dealt with evolution of chemical, biological and social systems. And it was this concentration on the dynamics of complex systems, which show *emergent properties* and operate not, as in cybernetics, in equilibrium, but in stead *far from*

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[2] Jeremy Rifkin, *Time Wars, The Primary Conflict in Human History,* (Henry Holt & Co, New York, 1987) p.185.
[3] *Organic Design for Command and Control*, p.20.

equilibrium and evolve constantly, that marks the new paradigm, which should be considered when reading Boyd.

An early and influential work on chaos and complexity theory, following not long after Capra's *The Tao of Physics* was authored by Eric Jantsch, titled *The Self-organizing Universe* (1980). He states that 'the central aspects of the emerging paradigm of self-organization are: *primo*, a specific macroscopic dynamics of process systems; *secundo*, continuous exchange and thereby co-evolution with the environment, and *tertio*, self-transcendence, the evolution of evolutionary processes'[4]. This second stage in the shift in paradigm has had an obvious and demonstrable influence on Boyd. Boyd was not only very aware how science "works", develops and grows through his reading of the works of Conant, Heisenberg, Gödel, Kuhn and other books on the philosophy of science. Boyd was also conscious of the changes in science occurring around him during the three decades he developed his ideas on war and strategy. He devoured popular scientific studies describing the scientific developments during his own time. For instance the list of sources used for *Patterns of Conflict* shows he read Hoyle's work *The New Face of Science*, as noted before the immensely influential book *Order out of Chaos* by Nobel laureate Ilya Prigogine and Isabelle Stengers and Fritjof Capra's *The Tao of Physics*, as well as various other works on entropy, the science of the mind and evolution (including as already stated Richard Dawkin's *The Selfish Gene*). The list of personal papers includes moreover annotated early works that described this development, such as

John Briggs and F.David Peat; *Looking Glass Universe: The Emerging Science of Wholeness* (1984)
Ernst Mayr; *The Growth of Biological Thought* (1982)
Heinz Pagels; *The Cosmic Code: Quantum Physics as the Language of Nature* (1982)
Heinz Pagels; *The Dreams of Reason: The Computer and the Rise of the Sciences of Complexity* (1988)
Nick Herbert; *Quantum Reality: Beyond the New Physics* (1987)
James Gleick; *Chaos: Making a New Science* (1987)
Jeremy Rifkin; *Entropy: A New World View* (1980)
Alexander Woodcock and Monte Davis; *Catastrophe Theory* (1980)
Fred Alan Wolf; *Star Wave, Mind, Consciousness and Quantum Physics* (1984)
Gary Zukav; *The Dancing Wu Li Masters: An Overview of the New Physics* (1979)

The works he was reading and re-reading at the time of his death are almost exclusively concerned with the 'new sciences' as they are sometimes referred to. In several of these books, of which several have become bestsellers, the shift in paradigm, the contours of which Bertalanffy already discerned, is laid out in full. They give accessible accounts of scientific developments in various disciplines, ranging from artificial intelligence, quantum physics, cosmology, biology, neurophysiology and genetics.

Common to these books is that they lay out the inadequacy of the deterministic, mechanistic, reductionist Newtonian view of the world. Most of them refer to Einstein, Heisenberg, Gödel, Bertalanffy and Prigogine and describe in detail the concepts and discoveries concisely described above. In addition, all of them build upon the system theoretical view and refine the understanding of dynamical systems. They describe new concepts to explain systems behavior. Combined, they form a new 'world view of descriptors'. In this chapter a number of key concepts that feature prominently in these books and that combined form the emerging 'worldview', will be described. For an initial impression of what the emerging worldview entails, the list of keywords below is included[5].

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[4] Erich Jantsch, *The Self-Organizing Universe, Scientific and Human Implications of the Emerging Paradigm of Evolution*, Pergamon Press, Oxford, 1980, p.9.

[5] Adapted from Eric B. Dent, 'Complexity Science: A Worldview Shift', *Emergence*, Vol. 1, issue 4 (1999), p.8

Traditional	Emerging
Reductionism	holism
Linear causality	mutual causality
Objective reality	perspective reality
Determinism	indeterminism
Survival of the fittest	adaptive self-organization
Focus on discrete entities	focus on relationships between entities
Linear relationships	non-linear relationships
Newtonian physics perspectives	quantum physics perspectives
World is predictable	world is novel and probabilistic
Modern	post-modern
Focus on hierarchy	focus on heterarchy (within levels)
Prediction	understanding
Based on 19th Century physics	based on biology
Equilibrium/stability/deterministic dynamics	structure/pattern/self-organization/life cycles
Focus on averages	focus on variation

Towards Chaos Theory

Dissipative structures

The concept of self-organization was one of the primary ideas which propelled further research into system dynamics. Self-organization has emerged as *the* central concept in the systems view of life, and like the concepts of feedback and self-regulation, it is closely linked to networks. Early models of self-organization developed by cyberneticists asserted that structural changes take place within a given "variety pool" of structures, and the survival chances of the system depend on the richness, or "requisite variety" of that pool, as noted above. There is no creativity, no development, no evolution. The later models include the creation of novel structures and modes of behavior in the processes of development, learning and evolution. And this process was characterized by two features[6]:

- self-organization occurs when the open system is operating *far-from- equilibrium;*
- *non-linear interconnectedness* of the system's components.

Chaos and complexity theory of the past two decades emerged from research in the 1960s and 1970s and in particular on advances in made by Prigogine. In 1967 Ilya Prigogine presented his theory of dissipative structures for which he was awarded the Nobel prize in 1977. He discovered that classical thermodynamics lead to the concept of "equilibrium structures" such as crystals[7]. Here the dissipation of energy in heat was always associated with waste. Prigogine's concept of a *dissipative structure* introduced a radical change in this view by showing that in open systems dissipation becomes a source of order. This idea emphasizes the close association between structure and order on the one side and dissipation

[6] Capra (1996), p.85.
[7] Capra (1996), pp.86-89. See also Prigogine's book *Order out of Chaos* which describes in detail this discovery. In particular chapter V.

of energy on the other. In certain chemical reactions he noted that as the system moved farther away from equilibrium (that is from a state with uniform temperature throughout the liquid), it reaches a critical point of instability, at which certain ordered patterns in the fluid emerged such as hexagonal patterns. This was a spectacular example of spontaneous self-organization. He had found that when systems are driven far-from-equilibrium entirely new things can happen.

This non-equilibrium is maintained by the continual flow of heat through the system. These dissipative structures not only maintain themselves in a stable state far- from-equilibrium, but may even evolve. When the flow of energy and matter through them increases, they may go through new instabilities and transform themselves into new structures of increased complexity. He discovered that while dissipative structures receive their energy outside, the instabilities and jumps to new forms of organization are the result of fluctuations amplified by positive feedback loops. Thus amplifying "runaway" feedback, which had always been regarded as destructive in cybernetics, appears as a source of new order and complexity in the *theory of dissipative structures*. As Prigogine noted in 1984, 'nonequilibrium is the source of order, nonequilibrium brings order out of chaos'[8]. This concept goes much further than that of an open system (as developed by Bertalanffy) as it also includes the idea of points of instability at which new structures and forms of order emerge. Prigogine's theory implied a radical re-conceptualization of many fundamental ideas associated with structure - a shift of perception from stability to instability, from order to disorder, from equilibrium to non-equilibrium, from begin to becoming[9].

Although Prigogine himself warns against direct application of the model of dissipative structures in fields and phenomena beyond chemical nonequilibrium reactions, he asserted already in 1984 these insights would have implications far beyond chemistry. Indeed, he repeated in 1996,

> it brings in a unified element. It brings in the element of bifurcation, it brings in the historical dimension, it brings in the idea of evolutionary patterns which indeed you find on all levels. And in this sense it is a unifying element of our view of the future[10].

Interestingly in his presentation *Strategic Game* Boyd included a telling section out of Prigogine's book *Order out of Chaos* in which Prigogine marks the inadequacy of equilibrium thermodynamics to explain nature and in which he makes the cautious jump to social systems[11]:

> Equilibrium thermodynamics provides a satisfactory explanation for a vast number of physicochemical phenomena. Yet it may be asked whether the concept of equilibrium structures encompassing the different structures we encounter in nature. Obviously the answer is no.
>
> Equilibrium structures can be seen as the result of statistical compensation for the activity of microscopic elements (molecules, atoms). By definition they are inert at the global level…Once they have been formed they may be isolated and maintained indefinitely without further interaction with their environment. When we examine a biological cell or a city, however, the situation is quite different: not only are these systems open, but also they

[8] Prigogine and Stengers (1984), p.287.
[9] Capra (1996), p.180.
[10] Horgan, pp.218-19.
[11] Boyd, *Strategic Game*, p.18. On page 19 Boyd included a section from *Looking Glass Universe* by John Briggs and David Peat which once more desribes Prigogine's concept of dissipative structures.

> exist only because they are open. They feed on the flux of matter and energy coming to them from the outside world. We can isolate a crystal, but cities and cells die when cut off from their environment. They form an integral part of the world from which they can draw sustenance, and they cannot be separated from the fluxes that they incessantly transform.

The non-linearity of nature

It was obvious that this was not a linear process but highly non-linear. Far-from-equilibrium, the system's flow processes are interlinked through multiple feedback loops and the corresponding mathematical equations are non-linear. The farther a dissipative structure is from equilibrium, the greater its complexity and the higher is the degree of non-linearity in the mathematical equations describing it[12].

Out of these development, chaos theory emerged in the eighties as a popular concept which focuses on thoroughly unstable regions and on non-linearity of systems behavior. It reflects the recognition that non-linear phenomena dominate much more of the inanimate world than we had thought, and that they are an essential aspect of the network patterns of living systems. It absorbs many of the former systems theoretical insights into a theory of cause and effect, albeit a radically different one from Newtonian cause and effect relationships. In the Newtonian paradigm the discovery of non-linear relationships would be immediately 'linearized', in other words, replaced by linear approximations. The equations of classical science deal with small oscillations, shallow waves, small changes in temperature etc. In the world of linear equations we thought we knew that systems described by simple equations behaved in simple ways, while those described by complicated equations behaved in complicated ways. In the non-linear world, simple deterministic equations may produce an unsuspected richness and variety of behavior. On the other hand, complex and seemingly chaotic behavior can give rise to ordered structures, to subtle and beautiful patterns.

Chaos theory describes the specific range of irregular behaviors in a system that moves or change[13]. The thrust of chaos theory is that small inputs in a closed system may produce large, unpredictable consequences, and that these systems may jump from ordered states to chaotic states based on those small inputs. This feature is the consequence of the frequent occurrence of self-reinforcing feedback processes. In that chaos operates in a closed system, it does not, as is commonly thought, describe a non-deterministic phenomenon. In fact, the whole point to chaos theory is that the fate of the system is determined by small factors which become magnified over time. It is the fact that these factors are too many, and too small to know, that cause the system to be unpredictable. The behavior of chaotic systems is not merely random but shows a deeper level of patterned order. Advances in computer technology as well as new mathematical techniques appearing in the 1970s and 1980s enabled scientists to make these underlying patterns visible in distinct shape.

The philosophical thrust of chaos theory is that uncertainty can be caused by small changes which, even if these changes are anticipated, results in an unpredictable system. This does not mean that the behavior of the system is totally unpredictable. Long term trends can be distilled with a certain level of probability, the range of change can to some extend be estimated. However, the *Sensitivity to Initial Conditions* (SIC) of many systems does force one to shift from a quantitive towards a qualitative analysis[14]. Long term predictions however are

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[12] Horgan, p.182.
[13] Glenn E. James, *Chaos Theory: The Essentials for Military Applications* (Naval War College Press, Newport R.I., 1995), p.3.
[14] Capra (1996), p.123.

meaningless. Interestingly for understanding Boyd, this condition of SIC offers yet another dimension of fundamental uncertainty. As Gell-Mann notes,

> chaos gives rise to effective indeterminacy at the classical level over and above the indeterminacy in principle of quantum mechanics[15].

For many purposes it is useful to regard chaos as a mechanism that can amplify to macroscopic levels the indeterminacy inherent in quantum mechanics[16].

Phase space, stable basins and forks in the road

With new methods offered by computers non-linear equations describing this behavior could be solved but these solutions are of a very distinct kind[17]. Near equilibrium one finds repetitive phenomena and universal laws. As we move away from equilibrium, we move from the universal to unique, toward richness and variety. The result of these non-linear equations will not be a formula describing the behavior of the system under investigation. In stead the result will be an idea of the "*phase space*" of a system, which describes the range of positions a system can occupy.

The problem with chaotic systems is that, unlike a clock's pendulum (which will slowly return to a stand still), they never pass through the same point, i.e. the system never repeats itself so that each cycle of a pendulum (to continue the example) covers a new region of phase space. It will not be possible to predict which point in phase space the system will pass through at a certain time but it will be possible to map the phase space, for in spite the seemingly erratic motion, the points in phase space are not randomly distributed. Together they form a complex, highly organized pattern (aptly named "*attractor*") which computers are able to visualize. These are sometimes also referred to as basins because they better connotate a system settling into something. Interestingly, a chaotic system may have fifty variables, but its motion may be restricted to a strange attractor of three dimension. Thus spaces of stability are known as attractors, and if the system is understood well enough, the attractor space can be predicted albeit only over the short term.

When energy is added to the system, the system moves further away from equilibrium and moves to the edges of the phase space. In the absence of significant perturbations, a dissipative system will usually follow a 'normal' linear trajectory. There will be the usual boundary testing, but in the absence of any sustained increase in environmental energy, the system will return to its original point of reference. At some point such movement may be due to internal micro-fluctuations or due to external perturbations from the environment. This may give rise to a self-amplifying cycle. At the boundary zone, far-from-equilibrium, systems may *bifurcate*. The bifurcation point is a crisis point of a system. At these bifurcation points, where the variables of parameters fluctuate constantly, the system first fluctuates between two or more new points, and as the oscillations continue it will abandon the original path and 'chooses' between two possible new trajectories on the basis of very small differences in the values of the controlling parameter(s) at the point of change. Figure 9 depicts a bifurcation diagram for chemical reactions far-from-equilibrium[18].

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[15] Gell-Mann, p.26.
[16] Ibid, p.27.
[17] This description is based primarily on Prigogine and Stengers (1984), Chapter V.
[18] Adapted from Peter Coveney & Roger Highfield, *The Arrow of Time*, Flamingo, London, (1991), p.166 (a book also on Boyd's personal papers).

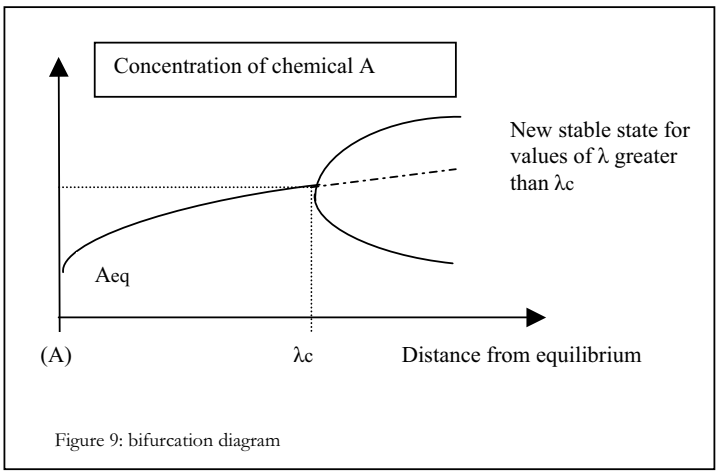

Figure 9: bifurcation diagram

Change is the result of perturbation beyond a boundary. This perturbation may be very small, but due to the non-linearity of complex systems, the outcome can be a radical regime change. It signifies to the transition of a system from the dynamic regime of one set of attractors, generally more stable and simpler ones, to the dynamic regime of a set of more complex and chaotic attractors. Alternatively, the system may find a new area of stability. Dissipative (or, one might prefer, chaotic) structures thus evolve. They make a transformation from the apparently chaotic to increasingly ordered state on the other side of the bifurcation point. Dissipative structures thus manifest the process of self-organizing. They arise spontaneously and may evolve towards greater complexity and a higher degree of the system's order. However, the move into the chaotic regime, to the bifurcation point, may also lead to a fatal perturbation that causes the system to disintegrate. Thus bifurcation also denotes a critical state in which the system either evolves or becomes extinct[19]. This obviously has implications for strategic theory.

Which path it will take will depend on the system's history, and on various external conditions and can never be predicted. The existence of bifurcations at which the system may take several different paths therefore implied also that indeterminacy is another characteristic of Prigogine's theory, thus adding another 'producer' of fundamental uncertainty of dissipative systems to the indeterminacy due to non-linearity caused by the SIC property[20]. It means, in the words of Nicolis, that 'we therefore give up the idea of obtaining exact results of a global character and limit our attention to the local behavior of the solutions in the vicinity of the bifurcation point'[21]. Indeed, the recognition of indeterminacy as a key characteristic of natural phenomena is part of a profound re-conceptualization of science.

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[19] Jong Heon Byeon, 'Non-Equilibrium Thermodynamic Approach to the Change in Political Systems', *Systems Research and Behavioral Science*, 16, (1999), pp. 286-90. This paper includes a good concise introduction into far-from-equilibrium dynamics. See for instance also Kenyon B. Green, 'Field Theoretic Framework for the Interpretation of the Evolution, Instability, Structural Change, and Management of Complex Systems', in L. Douglas Kiel and Euel Eliot (ed), *Chaos Theory in the Social Sciences* (University of Michigan Press, Ann Arbor, 1997).

[20] Capra (1996), p.183.

[21] G. Nicolis, *Introduction to Non-linear Science* (Cambridge University Press, Cambridge, 1995), p.96.

From chemistry to life: autopoiesis

Subsequently a multitude of such processes were discovered in physical and biological systems. In biochemical systems, such as enzymes, when exposed to energy flows, different catalytic reactions were found to combine to form complex networks that sometimes contain closed loops. Such catalytic cycles tend to interlock to form closed loops in which the enzymes produced in one cycle act as catalysts in the subsequent cycle. These 'hypercycles' turn out to be not only remarkable stable, but also capable of self-replicating and of correcting replication errors, which meant that they can conserve and transmit complex information. One of the most striking lifelike properties of hypercycles is that they can evolve by passing through instabilities and creating successively higher levels of organization that are characterized by increasing diversity and richness of components and structures. Thus a Darwinian process of selection and retention may be at play even at the molecular level[22]. Jantsch noted that the far-from- equilibrium transition to a new dynamic system state renews the capacity for entropy production - a process that he viewed as life in a broad sense[23].

This step from non-living to living systems was made by Humberto Maturana and his former student Francisco Varela during the early 1970s. Maturana's central insight was that the nervous system operates as a closed network of interactions, in which every change of the interactive relations between certain components always results in a change of the interactive relations of the same or of other components. He hypothesized that the circular organization of the nervous system is the basic organization of all living systems. Living systems are organized in a closed causal circular process that allows for evolutionary change in the way the circularity is maintained, but not for the loss of the circularity itself. This also implied that the components that specify the circular organization must also be produced and maintained by it.

They coined the term *autopoietic system*. An autopoietic system is a network of production processes in which the function of each component is to participate in the production or transformation of other components in the network. In this way, the network continually 'makes itself'. The product of the system's operation is its own organization. This is the *self-generating* property. The second property consists in the fact that this production includes the creation of a *boundary* - for instance the membrane of a cell - that specifies the domain of the network's operations and defines the system as a unit[24]. Autopoietic systems are *self-bounded*, and the boundary is an integral part of the network. The final property is *self-perpetuating,* which denotes the fact that all components are continually replaced by the system's processes of transformation.

Autopoietic systems are *organizationally closed* in the sense that its order and behavior are not imposed by the environment but are established by the system itself. In other words, living systems are autonomous. This does not mean they are isolated from their environment. On the contrary, they interact with the environment through a continual exchange of energy and matter. Here the dissipative feature of open systems is applicable. Living systems are *structurally open* for matter and energy, which flow continually through the system, but the system maintains a stable form, and it does so autonomously through self-organization[25].

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[22] Capra (1996), p.95.
[23] Jantsch (1980), p.42.
[24] Capra (1996), p.98.
[25] Capra, (1996), p.267.

It preserves the web-like pattern of organization but undergoes continual structural changes. It does this through a developmental process of *structural coupling* with the environment. New connections in the autopoietic network are created either through environmental influences or as a result of the system's internal dynamics. Structural coupling refers to recurrent interactions with the environment each of which triggers structural changes in the system. For instance, an organism's nervous system changes its connectivity with every sense perception[26]. However, in keeping with the autonomous character of autopoietic systems, the environment only triggers the structural changes, it does not specify or direct them. Not all disturbances cause structural changes. It is the living system that specifies which perturbations from the environment trigger them[27]. There are many disturbances that do not cause structural changes because they are "foreign" to the system. In this way each living system builds up its own distinctive world according to its own distinctive structure. As it keeps interacting with its environment, a living organism will undergo a sequence of structural changes, and over time it will form its own, individual pathway of structural coupling.

At any point on this pathway, the structure of the organism is a record of previous structural changes and thus of previous interactions, i.e. history. It is path-dependent. And as each structural change affects the organism's future behavior the behavior of it is influenced by its structure. The implication is that the structural changes in the system constitute acts of cognition. The organism's structure conditions the course of its interactions and restricts the structural changes that the interactions may trigger in it[28]. For example, when a living system reaches a bifurcation point, as described by Prigogine, its history of structural coupling will determine the new pathways that become available, but which pathway the system will take remains unpredictable.

Already by 1986 the concept had been picked up by other disciplines such as organization theory[29]. Noting the similarity with Prigogine's ideas, Morgan suggests that the theory of autopoiesis thus encourages us to understand the transformation or evolution of living systems as a result of internally generated change. These changes may stem from random modifications introduced through processes of re-preproduction, or through the combination of chance interactions and connections that give rise to the development of new system relations. Random variations provides the seed of possibility that allows the emergence and evolution of new system identities. Random changes can trigger interactions that reverberate throughout the system, the final consequences being determined by whether or not the current identity of the system will dampen the effects of the new disturbance through compensatory changes elsewhere, or whether a new configuration of relations will be allowed to emerge. Thus rather than suggesting that the system adapts to an environment or that the environment selects the system configuration that survives, autopoiesis places principal emphasis on the way the total system of interactions shapes its own future. In providing this kind of explanation, autopoiesis presents and alternative to classical Darwinian theory[30].

And that was the very assertion of Stuart Kauffman, who incorporated these ideas in his concept of the self-organization of living systems in his influential *The Origins of Order*. Akin to simple chemical reactions which undergo dramatic transitions when they reach a certain level of complexity, he saw molecules beginning spontaneously to combine to form

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[26] Ibid, (1996), pp.218-19.
[27] Ibid, p.266.
[28] Ibid, pp.220.
[29] See for instance Morgan, chapter 8.
[30] Morgan (1986), pp.235-40, in particular pp.239-40.

larger molecules of greater complexity and catalytic capability. In stead of chance governing evolution, he asserted that this process of self-organization or autocatalysis led to life. Extending this hypothesis, he asserted that complex arrays of interacting genes subject to random mutations do not evolve randomly, instead, they tend to converge toward a relatively small number of patterns, or attractors. This ordering principle may have played a larger role than natural selection in guiding the evolution of life, particularly as life grew in complexity[31].

Autopoiesis and cognition

The notion of structural coupling inspired the second conclusion Maturana drew from the circular closure of the nervous system which amounted to a radically new understanding of cognition (and one Boyd was aware of). Maturana, influenced in the 1960s by cybernetics, postulated that the nervous system is not only self-organizing but also constantly self-referring. This implied that perception cannot be viewed as the representation of an external reality but must be understood as the continual creation of new relationships within the neural network. Perception, and more generally, cognition do not *represent* an external reality, but rather *specify* one through the nervous system's process of circular organization. Thus Maturana hypothesized that the process of circular organization itself (with or without a nervous system) is identical to the process of cognition. From that he drew the conclusion that living systems are cognitive systems, and living as a process is a process of cognition. In all cognitive processes perception and action are inseparable, and since the structural changes and associated actions that are triggered in an organism depend on the organisms structure, cognition can also be viewed as "embodied action".

The living system is a multiply interconnected network whose components are constantly changing. There is great fluidity in this network, which allows the system to respond to disturbances from the environment. The range of interactions a living system can have with its environment is defined as its "cognitive domain" and as the complexity of a living organism increases, so does its cognitive domain[32]. The new conception of cognition is thus much broader than that of thinking. It involves perception, emotion and action - the entire process of life. In the human realm, according to Capra, it includes language, conceptual thinking and all the other attributes of human consciousness[33].

The link between Maturana's ideas, which he developed in the 1970s, with Boyd's OODA loop and the central role Boyd attached to it is obvious, as is the link with Polanyi's notion of tacit knowing. Structural coupling for instance is evident in Boyd's assertions that[34]:

> Orientation is the schwerpunkt. It shapes the way we interact with the environment[…].
>
> In this sense

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[31] See Stuart Kauffman, *The Origins of Order, Self-Organization and Selection in Evolution*, (Oxford University Press, Oxford, 1993). This is a highly technical book. Chapter 1 is a very accessible introduction however. See also Horgan, p.132. Kauffman later published a layman's version of his book . See *At Home in the Universe, The Search for the Laws of Complexity*, (Penguin Books, London, 1995).
[32] Capra (1996), pp.265-70.
[33] Ibid, pp.172-73.
[34] Boyd, *Organic Design*, p.16. Mind the title of this presentation which once more indicates Boyd's frame of reference.

> Orientation shapes the character of present observations-orientation-decision-action loops -- while these present loops shape the character of future orientation.

It becomes even more evident when more recent research on cognition is added. Evolutionary psychology, which emerged in the mid-eighties, brings together two scientific revolutions. One is the cognitive revolution which explains the mechanics of thought and emotions in terms of information and computation discussed in the previous chapter. The other is the revolution in evolutionary biology of the 1960s and 1970s, which explains the complex adaptive design of living things. The combination explains how a mind is possible, what kind of mind we have as well as why we have the kind of mind we have. This is captured in Pinker's concise rendering of the structure of mind. According to Pinker, the mind is a system of organs of computation, designed by natural selection to solve the kinds of problems our ancestors faced in their foraging way of life (an echo of Monod's). The mind is what the brain does; specifically, the brain processes information, and thinking is a kind of computation. The mind is organized into modules or mental organs, each with a specialized design that makes it an expert in one arena of interaction with the world[35].

While not aware of Pinker's synthesis of three decades of research, Boyd did follow developments in this field closely[36]. In fact, Boyd explicitly included three sections from studies of the mind in his briefing *The Strategic Game of ? and ?*[37]. In two of these sections, Maturana's concept of structural coupling clearly comes to the fore[38]:

> […] a neuron's fibers can change significantly in a few days or weeks, presumably in response to changing demands on the nervous system. …research has shown neurons continually rewire their own circuitry, sprouting new fibers that reach out to make contact with new groups of other neurons and withdrawing old fibers from previous contacts…This rewiring process may account for how the brain improves one's abilities such as becoming proficient in a sport or learning the play a musical instrument. Some scientists have suggested that the brain may use this method to store facts.[…]
>
> […]the complexity of the human brain is dependent upon a vast number of synapses (connections) between brain cells….these synaptic connections are established or fall by the wayside according to how frequent they're used. Those synapses which are in frequent use tend to endure ('are stabilized') while others are eliminated…In other words,…interaction with the environment"…[exert]…"tremendous influence on the way the human brain works and how it has evolved.

Some pages later Boyd combined dissipative structures, autopoiesis, Gödel, Heisenberg and the Second Law of Thermodynamics to take the audience slowly towards the essence of strategy. He notes that[39]:

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[35] Pinker, p.21, 23. See also Jerry Fodor's positive but also critical review of Pinker's book in 'The Trouble with Psychological Darwinism' in *London Review of Books*, Vol.20,. no.2, 22 January 1998. Fodor takes issue with the overly Darwinistic and Dawkinsian elements in Pinker's work.

[36] Dawkins and Wilson have already been mentioned as sources. Additionally, his list of personal paper includes for instance annotated versions of John von Neumann, *The Computer and the Brain* (1958); Richard Restak, *The Brain, The Last Frontier* (1979); Gregory Bateson, *Mind and Nature: A Necessary Unity* (1980); Howard Gardner, *The Mind's New Science: A History of the Cognitive Revolution* (1985); Marvin Minsky, *The Society of Mind* (1986); and Roger Penrose, *The Emperor's New Mind* (1989).

[37] See Strategic Game, p.16-17.

[38] Ibid, both on p.16.

[39] Ibid, p.28.

Physical as well as electrical and chemical connections in the brain are shaped by interacting with the environment. Point: without these interactions we do not have the mental wherewithal to deal or cope with that environment.

Gödel's Incompleteness Theorems, Heisenberg's Uncertainty Principle, and the Second Law of Thermodynamics, all taken together, show that we cannot determine the character or nature of a system within itself. Moreover, attempts to do so lead to confusion and disorder -- mental as well as physical. Point: We need an external environment, or outside world, to define ourselves and maintain organic integrity, otherwise we experience dissolution/disintegration--i.e., we come unglued.

Living systems are open systems; closed systems are non-living systems. Point: If we don't communicate with the outside world -- to gain information for knowledge and understanding as well as matter and energy for sustenance -- we die out to become a non-discerning and uninteresting part of that world.

Beyond open en chaotic systems: complexity theory

Complex Adaptive Systems

These concepts return in Complexity Theory. Complexity Theory and Chaos Theory are now mostly mentioned interchangeably. Indeed, the term chaoplexity has been coined. It is not so much an organized rigorous theory than a collection of ideas that have in common the notion that within dynamic patterns there may be underlying simplicity. It includes and builds upon the notions laid out above. In 1987 the publication of James Gleick's *Chaos: Making a New Science* introduced this new area of intellectual activity[40]. In the late 1980s and early 1990s chaos suddenly blossomed as one of the most popular forms of mathematics. A new research outfit was founded, the Santa-Fe Institute, which focused on chaotic and complex systems. Mitchell Waldrop's account of the emergence (!) of this field of research and the institute became a bestseller[41]. It marked the neo-Darwinian era which clearly Boyd derived inspiration from. Boyd's work includes several references that support the idea that adaptability and evolution are key themes in his work.

Briefly stated, Complexity Theory examines emergent order in large, interactive, adaptive networks such as neural networks or ecosystems. These *Complex Adaptive Systems* (CAS) co-evolve with the environment through self-organizing behavior of agents navigating "the fitness landscapes". The theory includes such ideas as phase change, fitness landscapes, self-organization, emergence, attractors, symmetry and symmetry breaking, chaos and, the edge of chaos[42]. In the brief introduction of Walrop, complexity theory deals with behavior at "the edge of chaos" where spontaneous organization, life and consciousness can occur, and it thus incorporates insights of chaos theory. Yet it transcends it because complex systems somehow acquired the ability to bring order and chaos into a special balance (i.e., the edge of chaos), they never quite lock into place, yet never quite dissolve into turbulence

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[40] Watson, p.747. Watson refers to James Gleick, *Chaos, Making a New Science* (Penguin Books, New York, 1987).

[41] See Mitchell Waldrop, *Complexity: The Emerging Science at the Edge of Order and Chaos* (Viking, London , 1993).

[42] Michael Lissack, 'Complexity: the Science, its Vocabulary, and its Relation to Organizations', *Emergence,* Vol. 1, Issue 1, (1999), p.112.

either. The edge of chaos is where life has enough stability to sustain itself and enough creativity to deserve the name of life, it is where new ideas and innovative genotypes are forever nibbling away at the edges of the status quo[43].

Complexity theory has become the ultimate interdisciplinary science. Subjects such as psychology, evolutionary biology, ecology, linguistics, and archeology all bear on complex adaptive systems[44]. It has become the 'overarching framework for theorists and researchers in economics, biology, physics, and other fields using mathematics and computer simulation, emphasizing holistic synthesis instead of atomistic analysis and focusing on dynamic process instead of static content, in their efforts to deal with 'messy' nonlinear processes – discontinuities', as Sandole asserts[45].

Complex Adaptive Systems, or Complex Systems for short, are quite different from most systems that have been studies scientifically. A remarkable finding of chaos and complexity theory is that different non linear systems have inherently identical structures. Whether it refers to biological evolution, the behavior of organisms in ecological systems, the operation of the mammalian immune system, learning and thinking in animals, the behavior of investors in financial markets, the systems feature common processes[46]. It teaches modesty too for it points to fundamental limits in our ability to understand, control, and manage the world, and the need for us to accept unpredictability and change[47].

Several other brief observations can be made about the make up and about the behavior of complex systems. John Holland, one of the early influential authors on complex systems who features prominently in Mitchell Waldrop's popular account of the emergence of complexity theory, lists the following similarities among brains, ecologies, developing embryos, ant colonies, political parties, scientific communities, etc.[48]:

- They are systems that are networks of "agents" acting in parallel. In a brain the agents are nerve cells, in ecologies the agents are species, in an economy the agents are firms and individuals or even nations;
- Each agent finds itself in an environment produced by its interactions with the other agents in the system;
- It is constantly acting and reacting to what the other agents are doing;
- And because of that essentially nothing is fixed in its environment;
- The control of complex systems is highly dispersed. There is not, for example, a master neuron in the brain.
- Organization within these systems is created by both competition and cooperation with other systems.
- A complex adaptive system has many levels of organization, with agents a any one level serving as the "building blocks" for agents at a higher level. Cells will form a tissue, a collection of tissues will form an organ, organisms will form an ecosystem;
- Complex adaptive systems typically also have many niches, each one of which can be exploited by an agent adapted to fill that niche;
- There are intercommunicating layers within the hierarchy. Agents exchange information in given levels of the hierarchy, and different levels pass information between themselves as well.

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[43] Waldrop, pp.11-13.

[44] Gell-Mann, p.117. Note the similarity with Boyd's view on the fields one needs to take into consideration when dealing with strategy.

[45] Dennis Sandole, *Capturing the Complexity of Conflict* (Pinter Books, London, 1999), p.194.

[46] Gell-Mann, p.17, Waldrop citing Holland, p.145.

[47] Richard Pascale, 'Surfing the Edge of Chaos', *Sloan Management Review*, spring 1999, p.85

[48] Mitchell Waldrop, pp.145-147.

- Correspondingly, the complex system has a number of disparate time and space scales.
- Complex systems are constantly revising and rearranging their building blocks as they gain experience.
- Complex adaptive systems anticipate the future.
- They exhibit coherence under change, via conditional action and anticipation[49]. For this they employ internal models of the world (as in systems theory).
- They are characterized by rich patterns of tight, moderate and loosely coupled linkages. Chains of interdependency branch in complicated patterns among actors. This protects the system against environmental shock by providing multiple paths for action. If one pattern of interdependency in a network is disrupted, the dynamic performed by that subsystem can usually be rerouted to other areas of the network. This makes it difficult to damage or destroy the complex system, for complex interaction leads to amazing resilience[50].
- Complex systems indeed are robust (or fit). They resist perturbation or invasion by other systems.
- Importantly, all operate in accordance with the second law of thermodynamics, exhibiting entropy and winding down over time unless replenished with energy[51].

Emergent order and self-organization

Complex adaptive systems exhibits emergence: the interactions of agents may lead to emerging global properties that are strikingly different from the behaviors of individual agents. These properties cannot be predicted from prior knowledge of the agents. The global properties in turn affect the environment that each agent "sees", influencing the agents' behaviors. A synergistic feedback loop is thus created—interactions between agents determine emerging global properties which in turn influence the agents. A key ramification of emergence is that reductionism does not apply to complex systems. Since emergent behaviors do not arise from simple superpositions of inputs and outputs, reductionism cannot be used to analyze the behaviors of complex systems.

A second fundamental behavior of complex systems is adaptive self-organization. Massively disordered systems can spontaneously 'crystallize' a very high degree of order. Self-organization arises as the system reacts and adapts to its externally imposed environment. Such order occurs in a wide variety of systems, including for example convective fluids, chemical reactions, certain animal species, and societies. A third important behavior of complex systems is evolution at the edge of chaos. They are never stable, always unfolding, always in transition, never in equilibrium. There is no optimum in system fitness. Dynamic systems can occupy a "universe" composed of three regions[52].

- The first is an ordered, stable region. Perturbations to the systems tend to die out rapidly, creating only local damage or changes to the system. Information does not flow readily between the agents.
- In the second region, chaotic behavior is the rule. Disturbances propagate rapidly throughout the system, often leading to destructive effects.

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[49] Holland, p.4.
[50] Russ Marion and Josh Bacon, 'Organizational Extinction and Complex Systems', *Emergence*, Vol. 1, issue 4, (2000), p.76.
[51] Gell-Mann, p.235.
[52] See Waldrop, pp.225-235.

- The final region is the boundary between the stable and chaotic zones. Known as the complex region or the "edge of chaos", it is a phase transition zone between the stable and chaotic regions.

Systems poised in this boundary zone are optimized to evolve, adapt, and process information about their environments. As complex systems evolve, they appear to move toward this boundary between stability and chaos, and become increasingly more complex. Deep in the ordered regime perturbations cannot propagate through the system. Deep in the chaotic regime the system would be too sensitive to small perturbations to maintain its organization[53]. Thus complex behavior is on the border between predictability and non-predictability. Complex systems are somewhat more stable and less active than are the dynamics of chaotic markets or seasonal fluctuations in the size of insect populations. Complex systems possess characteristics of both stable and chaotic systems. One the one hand they exhibit sufficiently stable behavior to allow retention of information, to transfer information across different systems and across time, and to reproduce themselves; on the other hand, they are sufficiently chaotic to permit the creative use of information and to allow change.

Schemata

A key behavior of complex systems is their ability to process information and use of schema's[54]. This is similar to the idea of mental modules of systems theory (and the connection between schema's and Boyd's work does not have to be addressed at length again). The systems sense their environments and collect information about surrounding conditions. They then respond to this information via a set of internal models that guide their actions. In the data stream a system identifies particular regularities and compresses them in a concise schema's or internal models (in psychology schema's refer to a pattern used by the mind to grasp an aspect of reality). This schema is used to sift through data in subsequent stages, to describe the environment and make predictions of events. The descriptions can be more or less accurate, the predictions can be more or less predictable and the prescriptions can lead to more or less favorable outcomes. All these consequences are then fed back to exert 'selection pressures' on the competition among various schemata (here we see the familiar doctrine process surface, doctrines can be seen as internal models for military organizations).

There are two kinds of internal models, or schemata; tacit and overt. A tacit internal model simply prescribes a current action, under an implicit prediction of some desired future state (a notion Boyd included in his command and control philosophy). An overt internal model is used as a basis for explicit, but internal, exploration of alternatives, a process often called lookahead[55]. A schema thus has several functions: a description of an observed system, a prediction of events, or a prescription for behavior of the complex adaptive system itself. Whether Complex Systems adapt to change depends in part on their capability to processing information, to form and select adequate models and to anticipate. Thus variants of the model are subject to selection and progressive adaptation[56].

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[53] Capra, (1996) citing Stuart Kauffman, p.204.

[54] See John Holland, *Hidden Order, How Adaptation Builds Complexity* (Perseus Books, Reading, Massechussetts, 1995), pp.31-34 and Gell-Mann, pp.17-25.

[55] Holland, p.33.

[56] Gell-Mann interestingly makes the comparison between schemata and scientific theories, noting how Popper's falsification principle acts as a selection mechanism. However, he also notes that science

Gell-Mann also addresses *maladaptive schemata*. In a section which offers direct associations with Boyd's work he notes that one of the most common reasons for the existence of maladaptive schemata is that they were once adaptive but under conditions that no longer prevail. The environment of the complex adaptive system has changed at a faster rate than the evolutionary process can accommodate. Moreover, the mechanisms for varying and selecting schemata may lag behind[57]. Compare this with Boyd when he asserts in the more recently developed presentation *The Conceptual Spiral* that

> People using theories or systems evolved from a variety of information will find it increasingly difficult and ultimately impossible to interact with and comprehend phenomena or systems that move increasingly beyond and away from that variety -- that is, they will become more and more isolated from that which they are trying to observe or deal with, unless they exploit the new variety to modify their theories/systems or create new theories/systems[58].

Gell-Mann offers the following graphic illustration of the way a complex adaptive system works through the functioning of schemata, one which has obvious (and most likely not accidental) close parallels with Boyd's OODA loop graphic and Boyd's view on the function of doctrine, shared experience, culture and other factors included in his notion of orientation pattern[59]. It is another variant of the double loop learning graphic included in the previous chapter:

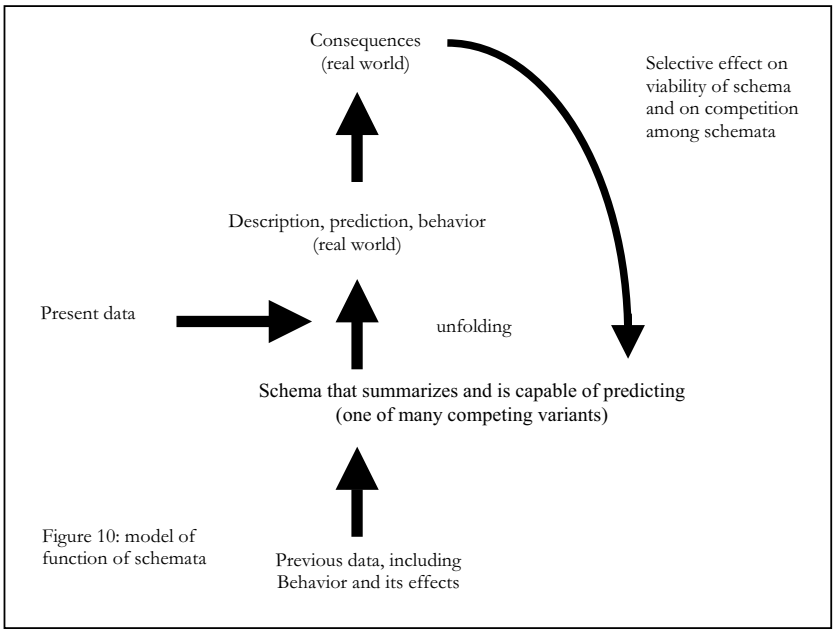

Figure 10: model of function of schemata

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does not progress this neatly and that theories are selected for other reasons as well, referring to Kuhn. See in particular chapter 7.

[57] Gell-Mann, pp.303-04.

[58] Boyd, *The Conceptual Spiral*, p.14.

[59] Gell-Mann, p.25. In fact, similar to Boyd, Gell-Mann includes language, traditions, customs, laws and myths, all of which can be regarded as "cultural DNA". All encapsulate the shared experience of many generations and comprise the schmata for the society which itself functions as a complex adaptive system. See p.292.

Levels of adaptation

This naturally leads to the key theme of adaptation and evolution. At the individual level adaptation takes place on at least four different levels[60].

- *Direct adaptation* takes place as a result of the operation of a schema that is dominant at a particular time (as in a thermostat or cybernetic device). None of the behavior requires any change in the prevailing schema;
- The next level involves *changes in the schema*, competition among various schemata, and the promotion or demotion depending on the action of selection pressures in the real world[61];
- The third level of adaptation is the Darwinian *survival of the fittest*. A society may simply cease to exist as a consequence of the failure of its schemata to cope with events.
- The fourth level is directed evolution which is caused by selection pressures exerted by individual human beings.

The first three modes of adaptation are characterized by increasing flexibility and decreasing reversibility. Successive modes of adaptation restore as much as possible the flexibility that the organism has lost under environmental stress. The flexibility of an individual will depend on how many of its variables are kept fluctuating within their tolerance limits; the more fluctuations, the greater the stability of the organism. For populations of organisms the criterion corresponding to flexibility is variability. Maximum genetic variation within a population provides the maximum number of possibilities for evolutionary adaptation[62]. The three levels of adaptation take place, generally speaking, on different time scales. An existing dominant schema can be translated into action right away; within days or months. A revolution in the hierarchy of schemata is generally associated with a longer time scale, although the culminating events may come swiftly. Extinctions of societies usually take place at still longer intervals of time. Obviously, the question whether adaptation is successful at any one level is in large part a function of the measure of stability of the environment and the rate of change in relation to the rate of adaptation an organism is capable of, a theme close to Boyd's heart.

Boyd actually already included this notion of different hierarchies and time-horizons in *Patterns of Conflict*. The pattern of success in war consists of a combination of adaptive efforts and activities to disrupt the adaptability of the opponent at the tactical, the grand tactical, the strategic and grand strategic level. And although conceptually the activities at the different levels are similar, Boyd recognized that in practice adaptation at each level required a specific type of action and involved a specific time horizon. At the highest level Boyd mentions the *national goal* and *grand strategy*. The national goal is formulated in purely Complexity Theoretical terms:

> Improve our fitness, as an organic whole, to shape and cope with an ever-changing environment[63].

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[60] Gell-Mann, pp.292-94.

[61] This is similar to changing military doctrine. Gell-Mann actually includes a military illustration here: if the strategy to reatreat to a fortress fails to deal with a series of enemy attacks, the next invasion may provoke the sending of an expeditionary force to the enemy's heartland. See p.293.

[62] Capra (1982), pp.273-74. Capra also discusses Gell-Mann's first three modes of adaptation.

[63] Boyd, *Patterns of Conflict*, p.141.

This requires a grand strategy that creates the favorable conditions. At this level this implies, according to Boyd, that

> For success over the long haul […] one needs some unifying vision that can be used to attract the uncommitted as well as pump-up friendly resolve and drive and drain-away or subvert adversary resolve and drive.[…]what is needed is a vision rooted in human nature so noble, so attractive that it not only attracts the uncommitted and magnifies the spirit and strength of its adherent, but also undermines the dedication and determination of any competitors or adversaries[64].

This unifying vision is

> A grand ideal, overarching theme, or noble philosophy that represents a coherent paradigm within which individuals as well as societies can shape and adapt to unfolding circumstances - yet offers a way to expose flaws of competing or adversary systems[65].

Thus at the grand strategic level Boyd addresses the societal level and here he does not talk of rapid OODA looping but of an attractive and agreeable ideology which fosters internal unity and offers a "moral high ground" which is conducive to creating alliances. It favors cooperation or at least does not unnecessarily arouse animosity. It must act as:

> a catalyst or beacon around which to evolve those qualities that permit a collective entity or organic whole to improve its stature in the scheme of things[66].

One level lower, he formulates his view of the general *strategic aim* in purely neo-Darwinian terms as:

> Diminish adversary's capacity while improving our capacity to adapt as an organic whole, so that our adversary cannot cope while we can cope with events/efforts as they unfold.

Strategy is geared more specifically towards the military organization. As at the grand-strategic level, it is not the temporal dimension which is the prime focus, but the set of factors (or in Boyd's words "connections") that glue the enemy system together at the strategic level. Boyd's view on strategy makes it comparable to level two adaptation mentioned above in which the emphasis lies on schemata, for the *strategy* should:

> Penetrate adversary's moral-mental-physical being to dissolve his moral fiber, disorient his mental images, disrupt his operations, and overload his system, as well as subvert, shatter, seize or otherwise subdue those moral-mental-physical bastions, connections, or activities that he depends upon[…][67].

At the *Grand-Tactical level* Boyd shifts his attention towards the enemy command system and the connections between units that hold them together so they operate coherently at the operational level. Together with the *tactical level* it can be compared with direct adaptation, in which time pressure is more prominently a factor than in the form two levels. The pattern for success at the grand tactical level is to:

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[64] Ibid, p.143.
[65] Ibid, p.144.
[66] Ibid, p.143.
[67] Ibid, p.141.

> Operate inside adversary's OODA loops […] to create tangles of threatening and/or non-threatening events/efforts as well as repeatedly generate mismatches between those events/efforts adversary observes, or imagines and those he must react to, to survive;
>
> thereby
>
> Enmesh adversary in an amorphous, menacing, and unpredictable world of uncertainty, doubt, mistrust, confusion, disorder, fear, panic, chaos […];
>
> thereby
>
> maneuver adversary beyond his moral-mental-physical capacity to adapt or endure so that he can neither divine our intentions nor focus his efforts to cope with the unfolding strategic design […].[68]

At the *tactical level* units should:

> OODA more inconspicuously, more quickly, and with more irregularity as basis to keep or gain initiative as well as shape and shift main effort: to repeatedly and unexpectedly penetrate vulnerabilities and weaknesses exposed by that effort […][69].

Eco-systems and fitness landscapes

Evolution and adaptation however should not be addressed solely at the individual level. Capra noted in 1982 that one of the key insights of research in the seventies and eighties has been that 'the tendency to associate, establish links, live inside one another and cooperate is an essential characteristic of living organisms'. Larger networks of organisms form ecosystems, together with various inanimate components linked to the animals, plants, and microorganisms through an intricate web of relations involving the exchange of matter and energy in continual cycles. Like individual organisms, ecosystems are self-organizing and self-regulating systems in which particular populations of organisms undergo periodic fluctuations.

At the collective level, adaptation and evolution is due to several other possible mechanisms[70]. *Symbiosis* is one, *offensive-defensive competition* is another. Whereas the classical Darwinist view focused on competition, struggle and destruction, more recent detailed study of ecosystems has shown that most relationships between living organisms are essentially cooperative ones, characterized by coexistence and interdependence. Although there is competition, it takes place within a wider context of cooperation, so that the larger system is kept in balance[71].

In both forms of co-existence, species develop schemata of other species. An ecological community consists of a great many species all evolving models of other species' habits and how to cope with them. Although competition among schemata is a characteristic of complex adaptive systems, the systems themselves may indulge in a mixture of competition and cooperation in their interactions with one another. It is often beneficial for complex adaptive systems to join together to form a collective entity that also functions as a

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[68] Ibid.
[69] Ibid.
[70] Based primarily on Gell-Mann, chapter 16.
[71] Capra, (1982), pp.278-79.

complex adaptive system. In fact, as Gell-Mann observes, the most fascinating increases in complexity are those that involve a transition from a level of organization to a higher one, typically through the formation of a composite structure.

Ecological communities made up of many complex individuals, belonging to a large number of species, are not likely to reach or even closely approach an ultimate steady state. Each species evolves in the presence of constantly changing congeries of other species. Such changes offer *niches* organisms can fill in. In both economics and ecology, the advent of a new business or a new organism (or of a new type of behavior) will alter the "fitness landscape" for the other members of the community. Fitness is a biological concept which describes the relative success of a species in relation to other in its environment and can be seen as a measure of how well an agent is adapted to its niche in the landscape. Competition can be said to occur on a fitness landscape. That landscape is not fixed but changes in response to the effects of the actions of all other actors. Indeed, always exploring, seeking out opportunities, experimenting with novelty, the complex adaptive system tries out increases in complexity and occasionally discovers solutions that open up the possibility of whole new structures, including new kinds of complex adaptive systems. This is emergent order through self-organization.

This process does not always proceed at a more or less uniform rate. In stead it often exhibits the phenomenon of 'punctuated equilibrium' in which species stay relatively unchanged for long periods of time and the undergo comparatively rapid change over a brief period[72]. This can be caused by sudden changes (relative to the "normal" rate of species adaptive capabilities) in the environment. Just as the addition of a single grain of sand to a large sand pile can trigger avalanches down its side, so can a change in the fitness of one species cause a sudden change in the fitness of all the other species in the ecosystem, which can culminate in an avalanche of extinction[73]. Alternatively it can be due to the accumulation of fairly small genetic changes which can radically alter the phenotype. Such changes can initiate a series of linked events, in which some organisms become more successful, others die out, the whole community is altered, and new ecological niches open up[74]. Such upheaval can then provoke changes in neighboring communities. Systems can feature such a *self-organized criticality*[75]. Kauffman noted that 'the edge of chaos also corresponds to a poised self-organized critical state with respect to co-evolutionary avalanches'[76]. Furthermore he notes that:

> networks on the boundary between order and chaos may have the flexibility to adapt rapidly and successfully through the accumulation of useful variations. In such poised systems, mutations have small consequences because of the systems' homeostatic nature. A few mutations, however, cause larger cascades of change. Poised systems will typically adapt to a changing environment gradually, but if necessary, they can occasionally change rapidly'[77].

Elsewhere he notes that

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[72] Capra (1996), p.226.
[73] Horgan, p.134.
[74] Gell-Mann, pp.239, 257.
[75] This concept was developed by Per Bak and Kan Chen in 'Self-Organized Criticality', *Scientific American*, January 1991, pp.46-53.
[76] Kauffman (1993), p.263. See further Waldrop, pp.307-18 for a historical and journalistic account of Kauffman's investigations.
[77] Stuart Kauffman, 'Antichaos and Adaptation', *Scientific American*, August 1991, cited in Capra (1996), p.205.

> Organisms which are internally constructed such that they are in the solid regime but near the edge of chaos appear to be best able to performs complex tasks and to adapt. Coevolving systems whose members have tuned the structure of their fitness landscape and couplings to other members such that the entire ecosystem is poised at the edge of chaos appear to sustain the highest fitness[78].

There are several key elements determining the strength of an ecosystem which can also be found in Boyd's work, in particular in his arguments concerning command and control. Boydian elements such as variety, harmony, trust, flexibility, the OODA loop, shared experience, organization in semi-autonomous units mirror the descriptors of an ecosystem:

- interdependence,
- feedback (and cyclical flow of resources),
- cooperation,
- partnership,
- flexibility
- and diversity.

The flexibility of an ecosystem is a consequence of its multiple feedback loops, which tend to bring the system back into balance whenever there is a deviation from the norm, due to changing environmental conditions. Disturbances are ever-present because things in the environment change all the time. The net-result is continual fluctuation. All the variables we can observe in an ecosystem - population densities, available nutrients, weather patterns, and so forth - always fluctuate. An ecosystem is an ever-fluctuating network. The more variables are kept fluctuating, the more dynamic is the system; the greater is its flexibility; and the greater is its ability to adapt to changing conditions. Lack of flexibility manifests itself as stress in the system. This will occur when one or more variables of the system are pushed to their extreme values, which induces increased rigidity throughout the system.

The role of diversity is closely connected with the network's structure. A diverse ecosystem will also be resilient, because it contains many species with overlapping ecological functions that can partially replace one another. A diverse community will be able to survive and reorganize itself because a damaged link in the network can at least partially be compensated for by other links. In other words, the more complex the network is, the more complex its pattern of interconnections, the more resilient it will be. Repeating earlier observations from systems theory, diversity means many different relationships, many different approaches to the same problem[79].

Perpetual novelty

Indeed, change, novelty and mismatches are what keeps the evolutionary process going. If the discovery of uncertainty was the start of the paradigm shift, the discovery of the essence of perpetual novelty may be considered one of the key themes of the Prigoginian era. Bateson had already introduced the element of difference as the key to which we respond. And instead of chance and random mutations driving evolution, as classical Darwinist theory asserts, it is the capacity to learn, to propagate successful traits and schemata, and to recombine in novel relationships that leads to the emergence of adaptation and evolution. As

[78] Kauffman (1993), pp.279-80.
[79] Capra (1996), pp.301-03.

Prigogine observes, 'nature is indeed related to the creation of unpredictable novelty'[80]. Holland asserts, Complex Adaptive Systems are characterized by *perpetual novelty*[81]. Capra is even bolder when he asserts that

> the driving force of evolution is to be found not in chance events of random mutations, but in life's inherent tendency to create novelty, in the spontaneous emergence of increasing complexity and order[82].

Boyd would make this - the reveling in novelty, combined with the pervasive presence of uncertainty - key themes. If uncertainty is indeed pervasive, it is imperative for organizations to create the ability to operate comfortably in this condition, in fact, they need to embrace it and turn the capacity to their advantage by introducing uncertainty and novelty into the environment themselves. Already *Destruction and Creation*, and in particular his last major presentation - *The Conceptual Spiral* - revolve around this very theme. Indeed, the major works Boyd studied early on, such as those of Popper, Polanyi, Kuhn, and Piaget are pregnant with this theme. Moreover, the bibliography attached to *Patterns of Conflict* include many books on the role of uncertainty, surprise and the value of deception[83]. In *The Conceptual Spiral*, Boyd lists nine "producers" of uncertainty; features that are contained within the theories, systems, processes, etc. that we employ to make sense of the world:

- Uncertainty associated with the unconfinement, undecidability, incompleteness theorems of mathematics and logic.
- Numerical imprecision associated with using the rational and irrational numbers in the calculation and measurement processes.
- Quantum uncertainty associated with Planck's Constant and Heisenberg's Uncertainty Principle.
- Entropy increase associated with the Second Law of Thermodynamics.
- Irregular and erratic behavior associated with far from equilibrium open nonlinear processes or systems with feedback
- Incomprehensibility associated with the inability to completely screen, filter, or otherwise consider the spaghetti-like influences from a plethora of ever-changing, erratic, or unknown outside events.
- Mutations associated with environmental pressure, replication errors, or unknown influences in molecular and evolutionary biology.
- Ambiguity associated with natural languages as they are used and interact with one another.
- Novelty generated by the thinking and actions of unique individuals and their many-sided interactions with each other[84].

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[80] Ilya Progogine, *The End of Certainty* (The Free Press, New York, 1996), p.73.
[81] Holland in Waldrop, p.147.
[82] Capra (1996), pp.228-29.
[83] For instance: Richard K. Betts, *Surprise Attack* (1982), Anthony Cave Brown, *Bodyguard of Lies* (1975); Charles Cruickshank, *Deception in World War II* (1979); Donald Daniel and Katherine Herbig, *Strategic Military Deception* (1982); Michael Handel, 'The Yom Kippur War and the Inevitability of Surprise', *International Studies Quarterly* (September 1977); David Kahn, *The Codebreakers* (1967); R.V. Jones, *Intelligence and Deception* (1979); Ronald Lewin, *Ultra Goes to War* (1978); Amnon Sella, 'Surprise Attack and Communication', *Journal of Contemporary History* (1978).
[84] Boyd, *The Conceptual Spiral*, p.32.

The last mentioned feature implies that novelty is not only endemic property of our environment, it is also a fundamental characteristic of social systems and activities. Our own schemata and the interaction among schemata of people produce mismatches. The OODA loop is both the way we make sense of the world as well as the source of further uncertainty:

> Novelty is produced by a mental/physical feedback process of analysis and synthesis that permits us to interact with the world so that we can comprehend, cope with, and shape that world as well as be shaped by it[85].

Boyd further highlights how novelty is the one feature that social systems need to take into account:

> The presence and production of mismatches are what sustain and nourish the enterprise of science, engineering, and technology, hence keep it alive and ongoing - otherwise there would be not basis for it to continue[86].
>
> The practice of science/engineering and the pursuit of technology not only change the physical world we interact with - via new systems, new processes, new etc.- but they also change the mental/physical ways by which we think about and act upon that world.
>
> In this sense
>
> The practice of science/engineering and the pursuit of technology permit us to continually rematch our mental/physical orientation with that changing world so that we can continue to thrive and grow in it.
>
> Put simply
>
> The practice of science/engineering and the pursuit of technology affects us personally as individuals, as groups, or as societies by changing our orientation to match with a changing world that we, in fact, help change[87].

In a lengthy section he explains how this relates to his investigation on winning and losing. In a passage which seems to marry ideas ranging from Polanyi to those of Gell-Mann, Boyd states that

> Novelty is produced continuously, if somewhat erratically or haphazardly. In order to thrive and grow in such a world we must match our thinking and doing, hence our orientation, with that emerging novelty. Yet, any orientation constrained by experiences before that novelty emerges introduce mismatches that confuse or disorient us. However, the analytical/synthetic process permits us to address these mismatches so that we can rematch thereby reorient our thinking and action with that novelty. Over and over this continuing whirl of re-orientation, mismatches, analysis/synthesis enables us to comprehend, cope with, and shape as well as be shaped by novelty that literally flows around and over us[88].

[85] Ibid, p.22.
[86] Ibid, p.23.
[87] Ibid, p.24.
[88] Ibid, p.28.

Novelty enters strategy when Boyd concludes that winning and losing revolves around the capability to deal with uncertainty and to exploit this feature of novelty in the contest with opponents:

> Since survival and growth are directly connected with the uncertain, ever-changing, unpredictable world of winning and losing we will exploit this whirling (conceptual) spiral of orientation, mismatches, analysis/synthesis, reorientation, mismatches, analysis/synthesis[89].

It seems then that in *Conceptual Spiral* of 1992 Boyd comes full circle when we compare this statement with the following of Piaget:

> Dialectic over and over again substitute 'spirals' for the linear or 'tree' models with which we start, and these famous spirals or non-vicious circles are very much like the genetic circles or interactions characteristic of growth[90].

Science obviously influenced the content of his slides, the themes of his thinking, as has been amply illustrated. Boyd's work is clearly rooted in a fundamental philosophical debate, and Boyd derived specific insights from this debate on the nature of knowledge and the process of knowing. Both revolve the pervasive presence of uncertainty. This theme would become the starting point, and the foundation, of his work. The cognitive process, which through various strategies constantly exerts itself to minimize the effects of uncertainty, in both individuals and organizations would become the second point of gravitation of his work. The third, and closely related process Boyd was constantly focusing concerned the dynamics of open systems, and more precisely, the myriad processes of adaptation at the various levels of a system and its subsystems. The question of course is whether his application of these insights to the military environment was, and is, warranted.

Chaos everywhere

Early expectations

Boyd formulated his ideas in a period which was marked by an emerging recognition in a wide variety of phenomena of the existence of dissipative structures, entropy, non-linearity, far-from-equilibrium, self-organization, and evolution. It was a period which saw the move from equilibrium seeking systems, to open systems, and then to complex adaptive systems. And as Prigogine and Stengers noted already in 1984,

> This development clearly reflects both the internal logic of science and the cultural and social context of our time[91].

Indeed, the studies revealed that these phenomena were not confined to the world of small particles or inorganic chemical substances. There was already an abundance of suggestions in the literature Boyd was reading while developing his strategic theory that indeed human conflict could show symptoms of chaotic and complex behavior. Boyd certainly was not the first one to apply the emerging insights from chemistry, biology, neurophysiology and

[89] Ibid, p.38.
[90] Ibid, p.125.
[91] Prigogine and Stengers, p.309.

mathematics, in short chaos and complexity theory to the social realm. It was not long after nonlinear dynamics gained legitimacy in the late 1970s and early 1980s that sometimes cautious, sometimes bold forays were made into applications of chaos theory to human history. Already early authors such as Jantsch and Capra made allusions to the relevance of self-organization, dissipative systems etc for understanding social phenomena. Prigogine made a few direct comparisons from physics and chemistry to human history, though they were mostly of a speculative nature. For instance he suggested that:

> We know now that societies are immensely complex systems involving a potentially enormous number of bifurcations exemplified by the variety of cultures that have evolved in the relatively short span of human history. We know that such systems are highly sensitive to fluctuations[92].

In particular after the publication of James Gleick's book *Chaos: Making a New Science* did the field of chaoplexity emerge as a full-blown pop-culture phenomenon[93]. This book was filled with illustrations of chaotic behavior in natural and human life. In medicine for instance chaotic behavior was noted in heart failures and the rise, spread and adaptation of viruses, in the prey-predator relationships and in the human immune system. He noted the paradigmatic character of this new scientific development:

> Now that science is looking, chaos seems to be everywhere […] chaos appears in the behavior of the weather, the behavior of an airplane in flight, the behavior of cars on an expressway, the behavior of oil flowing in underground pipes. No matter what the medium, the behavior obeys the same newly discovered laws. That realization has begun to change the way business executives make decision about insurance, the way astronomers look at the solar system, the way political theorists talk about the stresses leading to armed conflict.

We must recognize the intrinsic complexity of reality and accept a radical re-conceptualization, Coveney and Highfield claimed in 1990[94]. Mitchell Waldrop noted in 1992 that:

> Complexity, adaptation, upheavals at the edge of chaos - these common themes are so striking that a growing number of scientists are convinced that there is more here than just a series of nice analogies…they all share the vision of an underlying unity, a common theoretical framework for complexity that would illuminate nature and humankind[95].

The number of studies in various fields suggesting common concepts underlying the dynamics of the phenomena under investigation since the early eighties had become overwhelming in the early nineties[96]. In economics Brian Arthur, one of the founding

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[92] Ibid. p.313.

[93] Horgan, p.192.

[94] Peter Coveney and Roger Highfield, *The Arrow of Time, The Quest to Solve Science's Greatest Mystery* (Flamingo, London, 1991). This book appeared in 1990.

[95] Waldrop (1992), p.12.

[96] Gell-Mann too jumps from the biological world to the social world in *The Quark and the Jaguar*. Stuart Kauffman makes the case that complex living systems such as species and human societies arise by their own laws of assembly and interaction. Indeed, since the mid-eighties, more and more social phenomena are being brought within the scope of scientific analysis as a result of the methods developed for the study of complexity, see Peter Coveney and Roger Highfield, *Frontiers of Complexity, The Search for Order in a Chaotic World* (Ballantine Books, New York, 1996), p.337. Coveney and Highfield also observe that animal and human societies are replete with complex organization, from

members of the Santa Fe Institute, noted that the theory of equilibrium-seeking markets was fundamentally wrong. Instead, markets are distinctly non-linear and always in dis-equilibrium. The economy must be regarded as a complex adaptive system driven by feedback mechanisms (supply and demand fluctuations keep an economic system in balance) and positive feedback mechanisms (marketing and advertising help one firm get a jump on others, which give it more capital to increase its marketing and advertising, and so on)[97]. Instability was also noted in the financial system. Sudden fluctuations in one region can ripple through the entire tightly connected global financial system. The fact that information is disseminated ever more rapidly increases the awareness of developments which leads to faster action to adapt to change or to anticipate it, which can actually precipitate the arrival of the dreaded effect or ever cause a worsening of it. It may cause a rapid chain reaction. This is explained under the rubric "self-organized criticality" which was defined in 1991 by Bak and Chen as 'large interactive systems perpetually organize themselves to a critical state in which a minor event starts a chain reaction that can lead to a catastrophe…chain reactions of all sizes are an integral part of the dynamics. Furthermore composite systems never reach equilibrium but instead evolve from one metastable state to the next'[98].

Non-linearity, Chaos and organizational life

Not surprisingly, non-linearity, Chaos theory, Complexity theory (including Chaos Theory) have also been widely applied to organizational behavior, both from an intra-organizational perspective (the dynamics within an organization) as well as from the inter-organizational perspective (competition, market dynamics, war). First, the intra-organizational perspective.

Already in 1975 Jantsch pointed out that his findings on self-organization, and understanding human systems in terms of dissipating structures would provide a theoretical basis not only for social and cultural organization but also for self-organization towards higher states of system organization[99]. Prigogine and Gell-Mann too make direct references to the applicability of complexity theory and social systems such as businesses and economies. Another author noted that:

> Chaos theory is a promising framework that accounts for the dynamic evolution of industries and the complex interactions among industry actors. By conceptualizing industries as chaotic systems, a number of managerial implications can be developed. Long term forecasting is almost impossible for chaotic systems and dramatic change can occur unexpectedly; as a result, flexibility and adaptiveness are essential for organizations to survive. Nevertheless, chaotic systems exhibit a degree of order, enabling short-term forecasting to be undertaken and underlying patterns can be discerned. Chaos theory also points to the importance of developing guidelines and decision rules to cope with complexity; and of searching for non-obvious and indirect means of achieving goals[100].

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ant colonies and beehives to the dealing room of a stock exchange. They assert that we can regard such social structures as open an non-linear in which feedback and competition abound. In economics it was found that world's economies possess non-linear characteristic of complex dynamic systems. Market crashes show sensitivity to small disturbances such as a localized financial earthquake or rumors and beliefs among analysts, stockbrokers and speculators. See p.335.

[97] Brian Arthur, 'Positive Feedback in the Economy' , *Scientific American* (February, 1990), 131-40.

[98] Per Bak and Kan Chen, 'Self-organized criticality', Scientific American, January 1991, p.46. Metastable denotes having only a slight margin of stability or only a delicate equilibrium.

[99] Jantsch, p.61.

[100] Michael Lissack, 'Complexity: the Science, its Vocabulary, and its Relation to Organizations, *Emergence*, Vol.1, Iss.1, p.112.

Such efforts have lead to suggestions for managers that very closely mirror those of Boyd and it pays to briefly discuss some ways complexity theory has been applied to management theory. What complexity science metaphors do for an organization is give its members access to both new words and new possibilities for action. Word choice are part of mental models which shape and create contexts and when managers use them they affect organizational reality. Managers who can make use of the metaphors of complexity see their companies in a different light than those who do not and, in a sense, are competing in a different world. Moreover, both complexity science and organization science have a common problem (together with Boyd) they wish to address: uncertainty[101].

An early and renowned study was published by Charles Perrow. He examined the dynamics of complex systems in two influential books in the 1980s while a large number of studies appeared in the 1990s applying the concepts of *CAS* to businesses thus making the shift from open systems theory to chaoplexity theory. Perrow introduced the idea that organizations can be categorized as either simple or complex systems, and they consist of processes that are either linear or non-linear. Linear interactions are those in expected and familiar production or maintenance sequence, and those that are quite visible even if unplanned, whereas non-linear interactions are those of unfamiliar sequences, or unplanned and unexpected sequence, and either not visible or not immediately comprehensible.

Complex as well as simple systems can have *tight* and/or *loose coupling* among sub-systems and sub-processes. Tight coupling is a mechanical term meaning there is no slack or buffer between two items. What happens in one directly affects what happens in the other[102]. Loose coupling is the opposite. There still is a connection but because there is slack or a buffer, what happens in the one item may not affect the other, until the buffer has been exceeded. Unexpected demands, or lack of resources can be handled. Loosely coupled systems tend to have ambiguous or perhaps flexible performance[103]. Processes are not necessarily optimized for efficiency. Loose coupling allows certain parts of the system to express themselves to their own logic or interests. It is possible to allow some parts latitude. Tight coupling restricts this. Loosely coupled systems can incorporate shocks and failures and pressures for change without destabilization. Tightly coupled systems will respond more quickly to these perturbations, but the effects may well prove disastrous due to the rapid onset of non foreseeable non linear effects.

Tightly coupled systems have more time-dependent processes. They cannot wait or stand by until attended to. For instance, storage room may not be available, so products must move through constantly. Reactions, as in chemical plants, are almost instantaneous and cannot be delayed or extended. In loosely coupled systems, delays are possible, processes can remain in a standby mode; partially finished products will not change much while waiting and buffers will allow sub-processes to continue for a while despite lack of raw material supply. Also the sequence in tightly coupled systems are more invariant. B must follow A, because that is the only way to make the product. Y depends upon X having been performed. Tightly coupled systems have little slack. Quantities must be precise, resources cannot be substituted for one another. In loosely coupled systems supplies, equipment and manpower can be wasted to some extend without serious impact on the process. Something can be done twice if it is not correct the first time or one can temporarily get by with lower quality in supplies or products ion the production line. Additionally, in tightly coupled

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[101] Ibid, pp.117-21.
[102] Charles Perrow, *Normal Accidents* (Princeton, 1999), p.90.
[103] Ibid, p.91.

systems, not only are the specific sequences invariant, but the overall design of the process and the number of specialized personnel and other essential, non-substitutionable production resources allow only one way to reach the production goal. Loosely coupled systems generally can design quick work arounds to come up with the same product.

The concept of coupling is germane to the factor of risk and severity of failure. When something in the process does go wrong, what is the effect? Is it local or does it spread? How fast? Horizontally or (also) vertically? Generally, tightly coupled systems react more violently and in more directions, with several layered effects, than loosely coupled systems[104]. In loosely coupled systems there is generally more time for recovery[105]. In tightly coupled complex systems failure may not only be rapid, it may also manifest itself in various dimensions, at various moments and in various parts in the system and probably in totally unexpected places. The chance of incidents turning into accidents and system-wide catastrophe is larger in complex tightly coupled systems due to these factors, and the demands made on failure prevention and recovery measures are very high. Interesting for the study of Boyd's view on command and control, Perrow argues that the type of control one selects depends on the level of complexity of a system, on the level of coupling of subsystems and processes and on the risks involved.

To cope with the varying potential of failures, different strategies are available. Perrow proposes that in tightly coupled systems buffers, redundancies and substitutions need to be designed in; they must be thought of in advance. In loosely coupled systems there is a better chance that expedient, spur of the moment buffers, redundancies and substitutions can be found, even though they were not planned ahead of time. Personnel from other departments or from outside can be quickly dispatched to help out, and alternative suppliers may be contracted, standard equipment may be bought off the shelf to replace broken ones, etc[106]. These measures, in both types of systems can reduce somewhat the frequency and severity of incidents, but cannot by themselves eliminate risk, and this in particular applies to tightly coupled complex systems.

An alternative theory, High Reliability Theory, developed in response to Perrow, and one closely mirroring Auftragtaktik principles, posits that organizations, also tightly coupled ones, have more strategies available to enhance reliability[107]. They can for instance also decentralize the authority to make decisions while equipping these lower level decision makers with a proper set of decision premises, training, skills, organizational objectives and appropriate culture. This is done in order to enable those closest to the problem at hand to solve problems as they emerge. In this way rapid problem solving is ensured. And it gives them the autonomy and competence to respond to complex interactions, once these reach the surface, and correct them before tightly-coupled processes are set in motion which might lead to disaster.

Additionally this same school of thought argues that those organizations that have successfully weathered many storms were those that applied a strategy of conceptual slack: a number of diverging theories pertaining to the organization's technology and production

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[104] For an in-depth account of the working of tightly coupled and non linear effects see in particular Robert Jervis, *System Effects, Complexity in Political and Social Life* (Princeton, 1997).

[105] Perrow (1999), pp.93-94. See also Perrow, *Complex Organizations; A Critical Essay* (Glenview, Illinois, 1979); and Jos A. Rijpma, 'Complexity, Tight coupling and Reliability: Connecting Normal Accidents Theory and High Reliability Theory', *Journal of Continengies and Crisis Management*, Volume 5, Number 1, March 1997.

[106] Perrow (1999), pp.94-95

[107] This school is often labelled the "High Reliability Theory" school whereas Perrow is associated with the "Normal Accident Theory" school. See Rijpma.

processes are maintained simultaneously. During a crisis onset a course of action is agreed upon only after intense debate concerning the appropriate theory. In this way complex interactions which might have been overlooked when seen from one perspective are taken into account.

Finally this view posits that reliability will be enhanced, and the effects of future failures diminished, through organizational learning through real world practice of trial and error, training, simulation while improving standards accordingly[108]. Complexity, however, may limit the effectiveness of them. Learning for instance from complex past events is a highly ambiguous activity[109]. What happened because of what, is a most difficult question when the effects occur delayed, in various and unexpected dimensions, because of the non linear interaction of failures and feedbacks of failures through multiple parts of a system. Likewise, in complex systems there may not be sufficient time to confer and agree on the proper course of action, making the option conceptual slack perhaps counterproductive. Redundancy may also enhance complexity if redundant parts, or processes, are located near each other, in place or in time. One big blow may obliterate both, or if redundancy creates a dependency on one contingent factor, it creates an extra liability and thus increases complexity. The two identical O-rings that failed in the Space Shuttle in 1986 both relied on outside atmospheric conditions not exceeding certain identical limits. When they did, both rings failed.

This leaves the question concerning organization. Perrow discusses the question about centralization versus decentralization and concludes that both have merit for reducing risk, enhancing reliability while accomplishing the job, but which one is appropriate depends on the level of coupling and complexity. Perrow argues that loosely coupled complex systems such as universities generally allow a distinctly wide degree of decentralization. Perrow argues that *complexity requires that those at the point of disturbance are free to interpret the situation and take corrective measures, because that is where the incident is first noted*, a view very close to Boyd's. They should be allowed to diagnose the situation and take steps to contain the problem before the effects spread to other parts of the system. Because the interactions are loosely tight, there is time to develop a coherent picture and appropriate responses. Together with non-directive modes of synchronization and coordination, such as informal processes, shared culture, shared professional ethos, stable interaction patterns, slack and buffers, decentralization will allow a sufficient degree of control and sufficient failure recovery potential. These element appear in Boyd's work on command and control.

On the other hand when a system is linear and tightly coupled, centralization is required because the situation is fully the mirror image of complex but loosely coupled systems. Failures will result in predictable and visible effects. Responses can be pre-programmed, and rehearsed by all concerned, and subsequently initiated and controlled from the central authority. Top level detailed control and monitoring, and lower level meticulous obedience is required because response times need to be minimal and the response precise. Subsequently there is hardly room for lower level deviation/adjustment.

Linear and loosely coupled systems can operate on either control set up. Centralization is possible because of linearity, decentralization is feasible because of the loose coupling. A special problem is the class of complex and tightly coupled systems, which also

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[108] Ibid, p.17.

[109] Ibid, p.19. See also Jervis (1997). For a well known example of complex effects from the military history see the debate on 'the effectiveness' of the strategic bombing campaigns during WW II in Richard Overy, *The Air War 1939-1945* (New York, 1981); or Richard Overy, *Why The Allies Won* (London 1995), Chapter 4, or James Roche and Barry Watts, 'Choosing Analytic Measures', *Journal of Strategic Studies* 14 (June 1991), p. 176.

pose the most risk for incidents getting out of hand. The demands on a control system are inconsistent and neither set up is optimal. Complexity would suggest decentralization to but tight coupling suggests centralization to ensure rapid recovery from failure before tightly coupled processes push the system over the brink. Suggestions that lower levels can be allowed latitude by setting decision premises by higher levels are invalid, because due to the unforeseeable nature of failures throughout the system, it is impossible to set correct decision premises. In fact, those premises, according to Perrow, may actually be counterproductive[110]. So, decision making elites will need to balance both requirements.

Managing complex organizations

This is substantiated by recent studies. Various authors argue that models of organization that are based on living systems are naturally organic and adaptive. By design the interface between organization and its environment is on the edge of chaos. This is in contrast to the mechanistic models of bureaucracy, where discontinuous change requires a complete overhaul of the organization if it is to survive.

The problem for organization is autopoiesis. As discussed above, as with autopoietic systems in general, organizations are open to data inflows but are closed systems with respect to information and knowledge. The system maintains its defining organization throughout a history of environmental perturbation and structural change and regenerate their components in the course of operation. For organizations to survive however, they need to co-evolve with their environment. This requires variety, creativity and learning communities. An organization must embody enough diversity to provoke learning but not enough to overwhelm the legitimate system and cause anarchy.

These studies maintain that, like ecosystems, organizations thrive when equipped with variety. Practically speaking, organizations (should) posses a range of coupling patterns, from tight to loose. Loosely coupled structures allow an organization to adjust to environmental drift, and when environmental shocks are particularly severe, loose structures react sluggishly, thus buying time to recover. Moderate and tightly coupled structures prevent an organization from over-responding to environmental perturbation. Coupling patterns, then, allow organizations to maintain relative stability in most environments and protect the system even against severe shocks[111].

"Robust" systems are characterized by 'rich patterns of tight, moderate, and loosely coupled linkages; chains of interdependency branch in complicated patterns across nearly every actor in a broad network of interaction. Such complex patterns of interaction protect the organization against environmental shock by providing multiple paths for action. If one pattern of interdependency in a network is disrupted, the dynamic performed by that subsystem can usually be rerouted to other areas of the network. Such robustness makes it difficult to damage or destroy the complex system, for complex interaction lends it amazing resilience'[112].

The organizational form of such organic organizations reflect this. Here the key theme is self-organization[113]. The optimal organizational form for adaptation in turbulent environments is seen as the "cellular" form operating in a network, an idea included in

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[110] Perrow, p.331-34.

[111] Russ Marion and Josh Bacon, 'Organizational Extinction and Complex Systems', *Emergence*, 1(4), 1999, p.76.

[112] Ibid.

[113] Susanne Kelly & May Ann Allison, *The Complexity Advantage, How the Sciences Can Help Your Business Achieve Peak Performance* (New York, 1999), p.5.

Boyd's views on command and control. Small teams operating relatively autonomously, pursue entrepreneurial opportunities and share know-how among themselves[114]. Cellular organizations tend to mirror the complexity of the environment with requisite variety, as individual cells sense new entrepreneurial opportunities. When environmental demands change, new cells can be formed and old ones disbanded as necessary. Like an amoeba changing with its surroundings, the operating logic of the form is based on flexibility with accepted protocols of knowledge sharing substituting for hierarchical controls. *The freedom of activity is a key to enabling self-organizing behavior*, a theme residing in the heart of Boyd's work.

Control of such a networked organization is not provided by tights top-down controls. In stead, a combination of loose-tight controls is applied. The shared values of corporate culture in belief systems provide tight, but internal and perhaps even 'tacit' control as a form of protocol. Loose control comes from interaction between supervisor and employees that encourages information sharing, trust and learning. The key to loose control is management's trust in employees to act according to the shared values, therefore setting them free to search for opportunities, learn, and apply accumulating knowledge to innovative efforts[115]. Successful leaders of complex organizations allow experimentation, mistakes, contradictions, uncertainty and paradox, so the organization can evolve. Leaders in tune with a complexity approach shared a common trait: tolerance for paradox. The fundamental paradox in this leadership style is leading by not leading. Since processes unfold in complex systems in non-linear ways, leading organizational change cannot come about by simply adhering to a conventional command and control approach, which is essentially linear. Managing an organization as a complex system means letting go of control and a focus instead on the power of the interconnected world of relationships and the feedback loops. How people interact influences what emerges. By focusing on relationships organizations can be viewed as interconnected human webs, living organisms that unfold and adapt. A management practice that focuses on a network of relationships is a way of engaging the dynamics of a complex adaptive system. It is effective because enhancing interactions leads to the emergence of a creative and adaptable organization[116]. These too are ideas recognizable in Boyd's work.

Strategy and planning do not escape from the application of insights from complexity theory. Relating Complexity Theory to Strategic Management Theory, Gell-Mann observes two sources of unpredictability are the problem. The first is that the fundamental laws of the universe are quantum mechanical: these give a set of probabilities for alternative histories of the universe-not a clear prediction that one history will occur instead of the others. Second, there is the phenomenon of chaos to contend with, which involves extreme sensitivity to initial conditions. Tiny changes in initial conditions can distort the outcome by huge amounts. Thus it is frequently impossible to find a best strategy. Instead what is most important is to have a family of strategies, such that one can vary the response to one's changing circumstance according to success. Robustness doesn't consist so much in having a particular pattern of response as in having an enormous set of possible responses'[117]. Or as

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[114] Henry Coleman, 'What Enables Self-Organizing Behavior in Businesses', *Emergence*, Volume 1, issue 1, p.37.

[115] Ibid, p.40.

[116] Roger Lewin and Birute Regine, 'An Organic Approach to Management', *Perspective on Business Innovation*, Cap Gemini Ernst & young Journal, Issue 4, pp. 19-26.

[117] Murray Gell-Mann, 'The Complex Adaptive Business', *Perspective on Business Innovation*, Cap Gemini Ernst & Young Journal, Issue 1, p. 75-76. The literature on Complexity Theory and its relevance for the humanities, social sciences, management theory is burgeoning. See for instance:; Shona L. Brown & Kathleen M. Eisenhardt, *Competing on the Edge, Strategy as Structured Chaos* (Boston, 1998); Uri Merry,

Lissack asserts, in a complex world, strategy is a set of processes for monitoring the behaviors of both the world and of the agents of the organization, observing where potential attractors are and attempting to supply resources and incentives for future moves. It may be than command and control are impossible (at least in the absolute and in the aggregate), but the manager retains the ability to influence the shape of what complexity theory refers to as "the fitness landscape"[118].

The following overview shows the array of possible implications of Complexity Theory for strategic management of commercial organizations. It contrasts the holistic approach that managing complex organizations requires, to the mechanistic view of earlier management theorist such as Taylor[119].

THE NEW PLANNING PARADIGM AS DEFINED BY THE NEW SCIENCES

From	**To**
Linear	Non-linear
Static, cause-effect view of individual factors	Dynamic, constantly changing field of interactions
Microscopic, local	Wide angle, global
Separateness	Relatedness
Marketplace	Environment
Reductionist	Non-reductionist
Component thinking	Seeing and thinking in wholes
Time cards, task analysis	Complex Adaptive Systems
Problem solving	Butterfly Effect, system feedback
Brainstorming	Self-organization, adaptation
Polarization	Environmental scanning plus mapping
Structure creates process	Underlying processes and interactions of a system's variables create self-organizing patterns, shapes and structures
Pays attention to policies and procedures that are usually fixed and inflexible	Pays attention to initial conditions, perking information, emerging events, and strange attractors
Standing committees	Ad hoc working groups, networks
Politics	Learning
Planning as discrete event	Planning as continuous process
Planning by elite specialist group	Planning requires whole system input
Implementation of plan	Implementation flexible and constantly evolving in response to emerging conditions
Forecasting through data analysis	Foresight through synthesis
Quantitative	Qualitative
Controlling, stabilizing or managing change	Responding to and influencing change as it emerges
Dinosaur behavior	Entrepeneurial behavior
Change as threat	Change as opportunity
Leads to stagnation and extinction	Leads to renewal and growth

Source: adapted from T. Irene Sanders, *Strategic Thinking and the New Sciences, Planning in the Midst of Chaos, Complexity and Change* (New York, 1998), pp. 146-150.

Coping With Uncertainty, Insights from the New Sciences of Chaos, Self Organization, and Complexity (Westport, 1995); Raymond A. Eve et al, *Chaos, Complexity, and Sociology* (London, 1997); L. Douglas Kiel & Euel Elliott, *Chaos Theory in the Social Sciences* (University of Michigan, 1996); Kathleen Eisenhardt and Donald N. Sull, 'Strategy as Simple Rules', *Harvard Business Review*, January 2001, pp. 107-116; Eric D. Beinhocker, 'Robust Adaptive Strategies', *Sloan Management Review,* Spring 1999, pp. 95-106; Michael Church, 'Organizing Simply for Complexity: Beyond Metaphor Towards Theory', *Long Range Planning*, Vol.32, No.4, 1999, pp.425-40.

[118] Lissack, p.114.

[119] Her views are shared by O'Connor & Mc Dermott.

Several of these ideas surface in Boyd's vision on command and control, which he re-conceptualizes as the process of appreciation and leadership, and which hinges on trust, implicit communication, open flow of information, and a shared view on the organizational purpose. Boyd argues for a relaxed approach on command, allowing units and commanders sufficient latitude to respond to and shape their rapidly changing environment. He advocates lateral relations among subordinate units which will encourage self organization. Boyd allows uncertainty to exist and he want commanders not to impose a certain course of action but to set the boundaries of behavior, the overall direction and to develop relevant organizational orientation patterns (schemata).

In Boyd's work there is also evidence of emergent properties, another character of complex adaptive systems. Several small systems combine to form a higher level system with new properties. The survival of this system depends on the survival of the smaller lower level units and the coherence of their behavior within the overall goal oriented behavior of the whole system. Boyd's theory expressly addresses attacking the cohesion of the enemy's systems and their behavior, and thereby paralyzing the entire system. He wants to disable the emergence of coherent behavior. Others too have examined the applicability of the new scientific worldview for understanding war.

Non-linearity, chaos, and war

The non-linearity of the social world

Non-linearity and Chaos Theory have also been applied to inter-organizational dynamics, such as war (which can be considered a clash of organizations). While the application of the new sciences to organizations seems quite straightforward, it is still a conceptual leap from chaos theory to the study of war and the formulation of military strategy, this leap has nevertheless distinctly been made in the past decade. Lagging the exact sciences for some time, Chaos and Complexity Theory were applied in rigorous fashion in the social sciences, including History and International Relations, to see the value of this emerging paradigm of the "hard sciences".

We live in a highly non-linear world, one social scientist asserted in 1987[120]. Chaos theory offers a reuniting of the so-called physical sciences with the so-called social sciences, concluded a critical author[121]. Two editors of a compendium of studies relating chaos and complexity theory to the social sciences agree, noting that 'the social realm is clearly non-linear, where instability and unpredictability are inherent, and where cause and effect are often a puzzling maze. The obvious fact that social systems are historical and temporal systems also stresses the potential value of chaos theory to the social sciences. Social systems are typified by changing relationships between variables'[122]. Three other editors of studies on chaos theory and sociology conclude very boldly that:

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[120] Jay Forrester in L.Douglas Kiel and Euel Elliott (ed), *Chaos Theory in the Social Sciences, Foundations and Applications* (The University of Michigan Press, Ann Arbor, 1996), p.2. See for other examples of investigations on the relevance of chaos/complexity theory and social sciences for instance David Byrne, *Complexity Theory and the Social Sciences, An Introduction* (Routledge, London, 1998) and Paul Cilliers, *Complexity and Postmodernity* (Routledge, London, 1998).

[121] Raymond Eve, et al (ed), *Chaos, Complexity and Sociology, Myths, Models and Theories* (Sage Publications, Thousand Oaks, Ca, 1997), p.279.

[122] L.Douglas Kiel and Euel Elliott (ed), p.2.

> probably not since victory was seized in the […]battle to displace the Earth from the center of the physical solar system has a set of ideas and the new accompanying mathematics been so likely to change the nature of how we see everything in the cosmos and every individual in the cosmos[123].

The disciplines of History and International Relations too have been exposed to the new paradigm. The rise of societies and social structures of ever growing complexity has been examined through the lens of complexity theory. The complexity of human interactions has been fostered throughout the ages by communications technology, which facilitates the exchange of information on all levels. The more information is exchanged, the more feedback processes occur and thus the more complexity[124]. William McNeill asserted in 1996 that

> A grand convergence of the sciences seems to be emerging around an evolutionary vision of how new aspects of reality emerge locally from new levels of complexity, like the heavier atoms, forged in stellar furnaces, the living molecules that arose in earth's primordial seas, and the symbolic systems invented by human societies perhaps as recently as forty thousand years ago. History might even become something of a model for other disciplines, since it deals with most complex levels of reality we are aware of, that is, the world of agreed-upon meanings that guides our interaction with one another and with the biological, chemical, and physical world around us[…]Surprising new forms of collective behavior arise from what appears to be spontaneous appearances of increasing levels of complexity, whether as the physical, chemical, biological, or symbolic levels. This strikes me as the principal unifying theme that runs through all we know; or think we know about the world around us[125].

Already in 1990 James Rosenau had noted that the international system was in a state of turbulence because the fundamental parameters of the system were marked by extensive variability and complexity. This necessitated a novel conceptualization. He noted it was 'not enough to sense that deep changes are at work, rather one has to develop an overall perspective on the essential nature of world politics through which to transform the perception of a disorderly world into sensitivities for the sources and consequences of the dynamics of change'. And he found such a perspective in the language of chaos and complexity theory as developed by Gleick and Prigogine[126]. This provides a 'mental set that does not specify particular outcomes or solutions but one that offers guidelines and lever points that analysts and policy makers can employ to more clearly assess the specific

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[123], Eve, p.xxxii. John Casti (another SFI fellow and whose work Boyd had read), explored several types of physical phenomena and their correspondence in the social historical realm including: *catastrophic* (earthquakes and political revolutions); *chaotic* (the weather and the stock market); *paradoxical* (adding more lanes to a freeway increases congestion; *irreducible* (books and symphonies are more than the sum of their parts); and *emergent* (life, cities, and civilizations). See John Casti, *Complexification: Explaining a Paradoxical World through the Science of Surprise* (New York, 1994).

[124] Coveney and Highfield (1995), p.338.

[125] William McNeil, 'History and the Scientific Worldview', *History and Theory*, Feb. 1998, Vol 37, issue 1, pp.1, 10. In 1995 he had already made allusions to this view. He employs concepts of complexity theory to explain the rise of cultures and civilizations in 'The Changing Shape of World History', *History and Theory*, May 1995, Vo.34, Issue 2.

[126] James Rosenau, *Turbulence in World Politics* (Harvester Wheatsheaf, New York, 1990), pp.47, 58. Chapter 3 deals entirely with chaos and complexity theory. He likens the transformation of the interstate system to a Prigoginian bifurcation point, for instance.

problems they seek to comprehend or resolve'[127]. The awareness of fundamental unpredictability of complex systems caused four leading scholars to exasperate that 'God gave physics the easy problems'. And they subsequently suggest that 'evolutionary biology is a more productive analogy for social science'[128].

Robert Jervis too promotes the non-linear systems perspective, noting that international history is full of inter-connections and complex interactions and indeed very little in social and political life makes sense except in the light of systemic processes. Exploring them gives us new possibilities for understanding and effective action; in their absence we are likely to flounder[129]. A short discussion of some of their observations will assist in the correct interpretation of Boyd's work. Jervis notes that within non-linear complex systems[130]:

- It is impossible to do merely one thing;
- Results cannot be predicted from the separate actions;
- Strategies depend on the strategies of others;
- Behavior changes the environment.

Connections, interactions and interdependencies are the all important and problematic features of complex systems. In a system the chains of consequences extend over time and many areas. The effects of action are always multiple. Some call it that actions have side effects but besides being mostly undesired there is nothing that distinguishes one effect from another. Basically it is impossible to do merely one thing[131]. When the interconnections are dense, it may be difficult to trace the impact of any change even after the fact, let alone predict it ahead of time, making the system complex and hard to control[132]. Interconnections can defeat purposive behavior. Not only can actions call up counteractions, but multiple parties and stages permit many paths to unanticipated consequences[133]. And because most systems have either been designed to cope with adversity or have evolved in the face of it, breakage or overload at one point rarely destroys them. Systems have ways to compensate. They are flexible and may have redundancy built in. So actions against interconnected systems may not lead to direct results but they will produce disturbances at other points[134].

This leads to the observations that tightening the connections between elements will increase efficiency when everything works smoothly but will spread any problems that arise.

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[127] James Rosenau, 'Many Damn Things Simultaneously: Complexity Theory and World Affairs', in Davids and Czerwinski (1997), Chapter 4, p.1.

[128] Steven Bernstein, Richard Ned Lebow, Janice Gross Stein, Steven Weber, 'God Gave Physics the Easy Problems: Adapting Social Science to an Unpredictable World', *European Journal of International Relations*, Vol.6(1), 43-44.

[129] Robert Jervis, 'Complexity and the analysis of Political and Social Life', *Political Science Quarterly*, Volume 112, Number 4 (1997-1998), p.593; and 'Complex Systems: The Role of Interactions', chapter 3, in Paul Davis and Thomas Czerwinski, *Complexity, Global Politics and National Security* (NDU Press, Annapolis, 1997).

[130] See Robert Jervis, *System Effects,* and Jervis (1997-1998).

[131] Jervis (1997), p.10.

[132] Ibid, p.17.

[133] Ibid, p.18.

[134] Jervis includes the example of the Allied Combined Bomber Offensive during WW II. When the Allied Bombers attacked the German railroad system industry was able to divert railtraffic along the widely developed railsystem. But doing so after a period of bombing created bottlenecks in response to which individual industries began to take individual measures which took away the flexibility of the system and subsequently paralyzed it.

Some arrangements of connections will make a system resistant to change and others can facilitate instability[135]. When one element or relation cannot change unless others do, small and slow adjustments will not be possible, each element has a veto over all the others. In other cases one element controls another, which in turn controls a third thereby producing great indirect influence. The point is however that the character of interconnections are not always obvious. If the chains are short or the processes are familiar the character of the relationship may be obvious but when chains are long and intricate the results are more likely to be surprising. The importance of this observations is that the perception of the character of interconnections strongly influence policy preferences[136].

So we cannot understand systems if we only know the attributes and goals of a systems. The shape of the interconnections is crucial. The result of interconnections is that effects of actions are oftentimes indirect, mediated and delayed and indirect effects may be more important than direct ones. Related to this is that the short term impact of any action will be different than the long term outcome and if an actor is basing his subsequent actions on the short term results of his previous actions it will be hard to establish effectiveness of any action.

An extension of this observation is that actions often interact in non-linear ways. Where two chemicals are not toxic when taken in separately, when combined they may be lethal. The problem for strategists is that a variable in a system may operate through a non-linear function, that means that it may have a disproportionate effect after a while when the effects of an action have passed through the chain. Another interesting trait is that the direction as well as the size of an effect can be reversed as the stimulus increases. After an initial scare from being bombed researchers have noted a stiffening of resistance in populations in Germany and Great Britain, so instead of breaking the morale, it actually stiffened it. The conclusion of this is that because the trajectory being followed is not unilinear, moving toward a goal may bring one further from it rather than closer to it.[137]

An important observation for a strategic planner is that complex behavior may lead to false conclusions about the effectiveness of attacking a variable. The fact that one has tried to change the behavior of a system by affecting a variable without the expected effect does not mean that variable is unimportant but that change requires that more than just this one variable needs to be altered[138]. Non-linearity and the interaction of variables also lead to the fact that jumps rather than smooth incremental changes and progressions characterize operations of systems. [139] Complex systems often fail because of the failure of several components, each of which would have been harmless had the other not occurred[140].

So results cannot be predicted from the separate actions. The effect of one variable frequently depends on the state of another and it is therefore difficult to apportion the responsibility among them as the extent and even the direction of the impact of each depends on the status of the others. Further complexities are introduced when we look at the interactions that occur between strategies when actors consciously react to others and anticipate what they think others will do. An actor's policies can make possible or foreclose the adversaries strategies, so judgment about the merit of a strategy should always keep in view the one of the opponent. But actors often fail to appreciate both the degree to which their strategies are sensitive to those of others and the ability of the adversary to change its

[135] Ibid, p.18.
[136] Ibid, p.24.
[137] Ibid, p.37.
[138] Ibid.
[139] Ibid.
[140] Ibid, p.41.

behavior in reaction to what the other is doing. Jervis mentions the example of North Vietnam reverting to guerrilla warfare to mitigate the effects of the conventional strategy of the US[141]. Which leads to the observation that actions lead to alterations in the environment. And this in turn has the effect that identical but later behavior does not produce identical results.

Indirect and delayed effects, the unpredictable interactions of variables, learning and anticipation, they all lead to the familiar problem of lack of predictability of actions. The use of yardsticks for effectiveness also becomes problematical. Looking at a single or even multiple quantitative yardsticks to measure success in a complex system is likely to mislead because it fails to capture the multiple and indirect effects that will become increasingly important as the system reacts to the actor's behavior. It may not give the correct picture about the state of a system's effectiveness[142].

Jervis concludes his book with three suggestions for strategies that may overcome or take into account the problems we have discussed:

- Constraining the opponent's options;
- Understanding the non-linearity of the environment;
- Aim for indirect effects and apply multiple strategies.

First people can *constrain* other actors and reduce if not eliminate the extent to which their environment is highly systemic and characterized by unintended consequences. Constraint can be induced by foreclosing options and severing interconnections. It limits the decision space of an opponent[143]. It reduces the number of alternatives one needs to take into account in devising counter strategies. It makes the system more predictable. Secondly, *understanding* of the fact that one is operating within and against a system both within an environment may enable one to compensate for the result that would otherwise occur[144]. If one knows that something might happen one can anticipate it, prepare for it thereby reducing the chance of it occurring if only by making the other belief that that particular option has been covered. A third strategy is *aiming for indirect effects and apply multiple policies* both in the expectation that the cumulative effect will lead to the other having problems to adapt[145]. If one measure fails, another one may succeed or the interaction of them may be too much to cope with. A form of this is manipulating the environment in which the systems operate, for example widening or narrowing the number of allies. A final suggestion Jervis makes is to leave yourself some slack, some flexibility and room to respond if their anticipations are incorrect[146].

The non-linear nature of war

In similar vein several authors have attempted to relate war with chaoplexity. An early study was done by Alvin Saperstein who examined the outbreak of war, arms races, underlying causes of stability and instability of regions from a chaoplexity theoretical point of view. He pointed out that while the international system shows considerable stability and hence

141 Ibid, p.45.
142 Ibid, p.89.
143 Ibid, p.261.
144 Ibid.
145 Ibid.
146 Ibid, p.194.

predictability in an overall sense, crisis represent episodes of fundamental instability, ergo unpredictability[147]. In 1994 Roger Beaumont published an interesting study on *War, Chaos and History* in which he highlighted the paradoxical and chaotic nature (as in chaos theory) of war, the collision of two most elemental human urges - one to produce chaos and the other to impose order, and the nature of doctrines which he regards as schemata[148].

Boyd's list of personal papers includes three papers on war and chaoplexity that appeared in the early 1990s, besides the work by Barry Watts on non-linearity and strategy that appeared in the 1980s. In 1992 Steven Mann published a paper on chaos theory and strategy[149]. Boyd read it. Mann lists four factors of the environment of a strategic entity which shape the criticality of a system of which it is part: (1) initial shape of the system, (2) underlying structure of the system, (3) cohesion among the actors, (4) conflict energy of the individual actors. These factors, he states, should be examined before we can begin with creating strategies. The initial shape, that is, the contours of a system at the beginning influence the system's later development. Understanding the underlying structure means the physical environment, the geo-strategic situation (for example the proximity of certain nations like Kuwait and Iraq) is a fundamental fact that shapes all subsequent policy in that area. Cohesion determines the rate at which reordering takes place. Ideologically and ethnically homogeneous systems have different dynamics than multiethnic or ideologically various societies.

On a military level, deterrence and arms control serve to increase cohesion among states. Increased cohesion does not prevent criticality; it only means that the progression to criticality is slowed. Ineffective arrangements create false cohesion, several attempts to create a global order in this century come to mind. Finally each actor in politically critical systems possesses conflict energy, an active force that instigates change in the status quo. This energy drives from motivations, values and capabilities of the specific actors, whether governments, political or religious movements or individuals. Effective treaties and compacts can slow the progress of a system towards criticality, but, Mann states, we delude ourselves if we believe absolute stability is attainable, all stability is transient in international affairs. Stability, presence, peace, etc. are contextless goals. Stability is no more than a consequence and should never be a goal. Mann proposes to use criticality to one's advantage by aiming to shape the broad context of security affairs. Policy should be directed at the broad context. Of the four mentioned factors only the latter two are somewhat within reach of policy makers and therefore policy efforts must center on achieving cohesion and mitigating conflict energy. He concludes that we must develop an encompassing definition of strategy; not simply a match of means to ends but a match of paradigm to the particular strategic challenge.

In 1990 Alan Beyerchen produced a path-breaking study that appears also on Boyd's reading list, and one that contains insights which could only convince Boyd of the soundness of his own views in which fundamental uncertainty plays such a dominant role. Titled *Clausewitz, Nonlinearity, and the Unpredictability of War,* he emphasizes the relevance of the new

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147 See Alvin Saperstein, 'Chaos - A Model for the Outbreak of War', *Nature* 309, pp.303-305. See also 'The Prediction of Unpredictability: Applications of the New Paradigm of Chaos in Dynamical Systems to the Old Problem of the Stability of a System of Hostile Nations', in L. Douglas Kiel and Euel Elliott, pp.139-64.

148 Roger Beaumont, *War, Chaos, and History* (Westport,1994).

149Steven Mann, 'Chaos Theory and Strategic Thought', *Parameters,* Vol. XXII, No.2. Autumn, 1992, pp.54-68.

sciences, which he termed a new intellectual vision, for the study of war[150]. He argues that the concept has been implicitly present already in the cornerstone of Western military thought, Clausewitz' *On War*. Notwithstanding the fact that Clausewitz used mechanical Newtonian metaphors, Beyerchen asserts that Clausewitz denied that there is anything deterministic about war. In fact Beyerchen argues that Clausewitz understood that war is inherently a non-linear phenomenon. He is not claiming that Clausewitz somehow anticipated today's "chaos theory", but that he perceived and articulated the nature of war as an energy-consuming phenomenon involving competing and interactive factors, attention to which reveals a messy mix of order and unpredictability.

According to Beyerchen in recognizing and emphasizing the interactive nature of war, Clausewitz sees war as a system driven by psychological forces and characterized by positive feedback, leading "in theory" to limitless extremes of mutual exertion by the adversaries and efforts to get the better of one another. But Clausewitz contends that an actual war never occurs without a context; that it always takes time to conduct, in a series of interactive steps; and that its results are never absolutely final - all of which imposes restrictions on the analytically simple "pure theory" of war. Any specific war is subject to historical contingencies; thus he concludes that the theoretical basis for prediction of the course of the war dissolves from any analytical certainties into numerical possibilities[151]. Wars, therefore, are not only characterized by feedback (a process distinctly involving nonlinearities), but inseparable from their contexts. The unique political situation is the context that bounds the system constituted by a given war. It must be considered carefully, Clausewitz argues, for the same political object can elicit differing reactions from different peoples, and even from the same people at different times[....]Between two peoples and two states there can be such tensions, such a mass of inflammable material, that the slightest quarrel can produce a wholly disproportionate effect-a real explosion[152].

Consideration of the political environment leads Clausewitz to generate his famous second definition of war as "merely the continuation of policy [Politik, which also means "politics" in German] by other means."[153] He claims that war is never autonomous, for it is always an instrument of policy. Yet the relationship is not static; it implies neither that the instrument is unchanging nor that the political goal or policy itself is immune to feedback effects. The ends-means relationship clearly does not work in a linear fashion. The constant interplay is an interactive, feedback process that constitutes an intrinsic feature of war. Clausewitz's conception is that the conduct of any war affects its character, and its altered character feeds back into the political ends that guide its conduct. War is, he says, a "true chameleon" that exhibits a different nature in every concrete instance[154].

Another aspect that reveals Clausewitz's grasp of the non linear character of war lies in his famous notion of the trinity that shape the form of war. In the last section of Chapter 1, Book One, he claims that war is "a remarkable trinity" (eine wunderliche Dreifaltigkeit) composed of (a) the blind, natural force of violence, hatred, and enmity among the masses of people; (b) chance and probability, faced or generated by the commander and his army; and (c) war's rational subordination to the policy of the government[155]. Then he concludes with a visual metaphor: "Our task therefore is to develop a theory that maintains a balance between

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150 Alan Beyerchen, 'Clausewitz, Nonlinearity, and the Unpredictability of War', *International Security*, Vol. 17, No.3. Winter 1992.
151 Clausewitz, *On War* (Princeton, 1976), p. 77-80.
152 Ibid, p.81.
153 Ibid, p.87.
154 Ibid, p.89.
155 Ibid, p.89.

these three tendencies, like an object suspended between three magnets."[156]. This metaphor implicitly confronts us with the chaos inherent in a nonlinear system sensitive to initial conditions. When a pendulum is released over three equidistant and equally powerful magnets, it moves irresolutely to and fro as it darts among the competing points of attraction, sometimes kicking out high to acquire added momentum that allows it to keep gyrating in a startlingly long and intricate pattern.

The probability is vanishingly small that an attempt to repeat the process would produce exactly the same pattern. Even such a simple system is complex enough for the details of the trajectory of any actual "run" to be, effectively, irreproducible. Contrary to Newtonian assumptions in the pure theory of war, in the real world it is not possible to measure the relevant initial conditions (such as position) accurately enough to replicate them in order to get the same pattern a second time, because all physical measurements are approximations limited by the instrument and standard of measurement. And what is needed is infinitely fine precision, for an immeasurably small change in the initial conditions can produce a significantly different pattern. Nor is it possible to isolate the system from all possible influences around it, and that environment will have changed since the measurements were taken. Anticipation of the overall kind of pattern is possible, but quantitative predictability of the actual trajectory is lost.

Clausewitz's emphasis on unpredictability is another key manifestation of the role that nonlinearity plays in his work. Unpredictability is caused by "*interaction*, *friction*, and *chance"*. Clausewitz emphasized frequently that war is an interactive process and that this interactive nature is one of the causes that the outcome of action cannot be predicted:

> war is not an exercise of the will directed at inanimate matter, as is the case with the mechanical arts, or at matter which is animate but passive and yielding, as is the case with the human mind and emotions in the fine arts. In war, the will is directed at an animate object that reacts[157].

A military action produces not a single reaction, but dynamic interactions and anticipations that pose a fundamental problem for any theory. Such patterns can be theorized only in qualitative and general terms, not in the specific detail needed for prediction. Clausewitz thus understood an essential feature of nonlinearity and applied its consequences in his understanding of war: *the core cause of analytical unpredictability in war is the very nature of interaction itself,* according to Beyerchen.

The ubiquity of "friction", - the 'only concept that more or less corresponds to the factors that distinguish real war from war on paper'[158] – adds to the non-linear nature of war. The concept of friction is not just a statement that in war things always deviate from plan, but a sophisticated sense of why they do so. Friction as used by Clausewitz entails two different but related notions that demonstrate the depth of his powers of observation and intuition. One meaning is the physical sense of resistance embodied in the word itself, which in Clausewitz's time was being related to heat in ways that would lead ultimately to the Second Law of Thermodynamics and the concept of entropy. Friction is a nonlinear feedback effect that leads to the heat dissipation of energy in a system. The dissipation is a form of increasing degradation toward randomness, the essence of entropy. Even in peacetime, the degradation of performance in an army is a continual problem. In war, the difficulties are amplified. Military friction is counteracted by training, discipline, inspections,

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[156] Ibid, p.89.
[157] Ibid, p.149.
[158] Ibid, p.119.

regulations, orders, and other means, not the least of which, according to Clausewitz, is the "iron will" of the commander[159]. New energy and effort are sucked into the open system, yet things still never go as planned; dissipation is endemic due to the interactive nature of the parts of the system.

The second meaning of "friction" is the information theory sense of what has come to be called "noise" in the system. Entropy and information have some interesting formal similarities, because both can be thought of as measuring the possibilities for the behavior of systems. According to information theory, the more possibilities a system embodies, the more "information" it contains. Constraints on those possibilities are needed to extract signals from the noise. Clausewitz understands that plans and commands are signals that inevitably get garbled amid noise in the process of communicating them down and through the ranks even in peacetime, much less under the effects of physical exertion and danger in combat. His well-known discussion of the difficulty in obtaining accurate intelligence presents the problem from the inverse perspective, as noise permeates the generation and transmission of information rising upward through the ranks.[160]

From this perspective, his famous metaphor of the "fog" of war is not so much about a dearth of information as how distortion and overload of information produce uncertainty as to the actual state of affairs. Clausewitz's basic intuition here is that organizations are always slower and more inflexible than the natural events they are intended to control. Seen in this light, training, regulations, procedures, and so on are redundancies that enhance the probability of signal recognition through the noise. On the basis of linear assumptions, one expects major obstacles to produce proportionately serious errors in responding to the message. Clausewitz emphasizes, however, the disproportionately large role of the least important of individuals and of minor, unforeseeable incidents. Friction conveys Clausewitz's sense of how unnoticeably small causes can become amplified in war until they produce macro-effects, and that one can never anticipate those effects. Due to our ignorance of the exact initial conditions, the cause of a given effect must, for all intents and purposes, often be treated as unavoidable chance.

Chance is the final one of the trinity, and he emphasizes that 'no other human activity is so continuously or universally bound up with chance as is war'[161]. It is associated also with the fog of uncertainty in war, which obscures or distorts most of the factors on which action is based. For Clausewitz, 'in the whole range of human activities, war most closely resembles a game of cards' [162]. This analogy suggests not only the ability to calculate probabilities, but knowledge of human psychology in "reading" the other players, sensing when to take risks, and so on.

Unnoticeably small causes can be disproportionately amplified. Decisive results can often rest on particular factors that are "details known only to those who were on the spot" [163]. We can never recover the precise initial conditions even of known developments in past wars, much less developments in current wars distorted by the fog of uncertainty. Interactions at every scale within armies and between adversaries amplify micro-causes and produce unexpected macro-effects. Here we see too again the interaction between the tactical and the strategic level. Since interaction is intrinsic to the nature of war, it cannot be eliminated. The precise knowledge needed to anticipate the effects of interaction is unattainable. Unpredictability in war due to this second form of chance is thus unavoidable.

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[159] Ibid.
[160] Ibid, p.101 and 117-18.
[161] Ibid, p.85.
[162] Ibid, p.86.
[163] Ibid, p.595.

There is yet a third type of chance, which is a result of our inability to see the universe as an interconnected whole. The drive to comprehend the world through analysis, the effort to partition off pieces of the universe to make them amenable to study, opens the possibility of being blind-sided by the very artificiality of the partitioning practice. This form of chance is a particularly acute problem when our intuition is guided by linear concepts. Clausewitz had a profound sense of how our understanding of phenomena around us is truncated by the bounds we place on them for our analytical convenience, Beyerchen asserts. As Clausewitz writes of critical analysis and proof:

> It is bound to be easy if one restricts oneself to the most immediate aims and effects. This may be done quite arbitrarily if one isolates the matter from its setting and studies it only under those conditions. But in war, as in life generally, all parts of the whole are interconnected and thus the effects produced, however small their cause, must influence all subsequent military operations and modify their final outcome to some degree, however slight. In the same way, every means must influence even the ultimate purpose.[164]

The third paper included in Boyd's list is the study of Pat Pentland, *Center of Gravity Analysis and Chaos Theory*[165]. His main argument is that, considering the insights provided by the paradigm shift, the key to the analysis of enemy centers of gravity is to incorporate the real and dynamic complexities of the natural world explained by chaos theory. Interestingly, he also incorporates Boyd's OODA loop, acknowledging that this model and the essay, although developed in the 1970s, anticipated many of tenets of chaos theory, and is consistent with it[166].

Pentland disaggregates an adversary's system in elements of power. Each element exists in three dimensions: a *source*, a *linkage* and a *manifestation*. The linkage assists in transforming the source into a force, and it provides connectivity within and between the elements of power. Each element of power is a center of gravity as well as a strange attractor. Power is determined by the *mass* of the source, the *intensity* of the force, *interconnectivity* within the system, and the *rate of exchange flow* within the linkages[167]. This offers the following set of potential centers of gravity[168]:

Source	**Linkage**	**Force**
Armed forces	Command and Control, Logistics, Training	Military
Government bureaucracy	Leadership and Communication	Political & Diplomatic
Industry & natural resources	Transportation & Technology	Economic
Society & culture	Family, Education, Socialization	Social-Cultural
Value system	Religion & Philosophy, Indoctrination	Ideological

Chaos theory comes into play in this construct as it describes what can happen when additional external force is introduced into open systems, or what happens when the linkages of power are severed[169]. He constructs an analytical approach for selecting centers of gravity

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164 Ibid, p 158.
165 Pat Pentland, *Center of Gravity Analysis and Chaos Theory* (Maxwell Air Force Base, Al., April 1993).
166 Ibid, p.33, footnote 60.
167 Ibid, p.17.
168 Ibid, p.25.
169 Ibid, p.31.

as focus for military planning on the following description of the dynamics of non-linear systems[170]:

- Chaos theory predictions are general in nature, and describe system interactions rather than specific end states;
- Initial conditions and the dynamic factors that govern system dynamics can seldom be absolutely known or defined;
- It is possible to anticipate certain processes and functions;
- Long term prediction is, however, impossible, you cannot predict specifically what will happen next after an event or when an event will occur;
- They are often self-repeating , exhibiting scaled structures;
- Minute differences over time can produce surprisingly diverse results;
- Patterns within a dynamic system will form around functions ('strange attractors'); these patterns will resemble each other by exhibiting similar properties, but will never exactly repeat themselves;
- Systems open to their environment will self-organize into similar patterns in accordance with their fundamental structures;
- Non-linearity can stabilize systems as well as de-stabilize them;
- Open systems can be driven to crises points where they will either bifurcate and self-organize again, or go into a period of stochastic chaos (exhibiting erratic randomness);

Based on the model of the adversary and on the dynamics of chaotic systems, Pentland asserts that crises points can be precipitated by:

- closing a system off from its environment and propelling it into equilibrium;
- by eliminating feedback within the system;
- driving any of the dimensional dynamics to singularity by overloading or destroying it;
- applying quantum amounts of broad external energy to the entire system.

Only if massive force disparities exist is the latter available option. Chaotic systems tend to be very resilient. Any chaotic system can maintain its structure and even organize into higher levels of organization as long as energy can be drawn from their environment. This also applies to disturbances to the system. An important feature of chaotic systems is the interdependence and self-compensating characteristic of systems. If targeted, an element of power adjusts from within to compensate, and draws upon resources from the other elements of power through interconnected linkage mechanisms. In the economic sphere, for instance, an opponent can opt for economic slack, substitution, reallocation, reengineering, reconstitution, and increased productivity. Other forms of compensation are stockpiling, rationing, importing and dispersing. And while a society may be defeated militarily, deep cultural and political powers are almost immune to military force, short of prolonged occupation. Alternatively, different sorts of military power may be sought after, for instance by responding to a conventional attack with a long low intensity irregular campaign. This feature forces one to acknowledge that war is a process of appraisal, innovation and adaptation. The opponent's society will constantly appraise, innovate, and adopt new combinations of power to achieve different results[171].

[170] Ibid, pp.11-12.
[171] Ibid, pp.34-36.

This overview, despite being far from exhaustive, offers a representative overview of studies in which authors of varying backgrounds have attempted to apply insights of non-linearity chaos theory and complexity theory to the social realm, in the belief that these developments were indeed relevant for understanding social phenomena and could improve upon the reductionist mode of analysis. While Boyd was only familiar with some of the early studies, both early and more recent works show consistency in the themes and ideas that they advance: uncertainty and unpredictability; hierarchies and networks of subsystems; a variety of connections between subsystems; the pervasiveness of non-linear dynamics; the focus on cognitive processes, learning, and the function of schemata; the requirement of variety, the requirement and determinants of adaptability under uncertainty, the merits of cellular organization structure, etc. *Combined, they offer view of armed forces, or indeed, social systems, operating as Complex Adaptive Systems in the non-linear environment of war.*

And indeed, they argue that warfare is a nonlinear phenomenon with two or more co-evolving, adapting competitors. The actions of every agent in the conflict, from individual pilots and infantrymen to numbered air forces and corps, and up to the political leadership, influence and shape the environment. Environmental changes in turn cause adaptations in all hierarchical levels of the warring parties. As both allied and enemy actions influence the environment, warfare involves the co-evolution of all involved parties. Friction, uncertainty and unpredictability reign and are irremovable from war[172].

The literature suggest that indeed insights from systems theory, chaos theory and complexity theory are also relevant for understanding the behavior of economic, financial, industrial, transportation and other social and technical systems. Furthermore the literature suggests that the international political arena of states forms a complex system and war is a non-linear phenomenon. Finally, as management literature suggests, commercial organizations can be open, chaotic and/or complex systems too, and by extension, so can armed forces, a fact noted by an increasing number of authors. Subsequently, Boyd's application of insights of dynamic processes in chemical and biological systems to the social arena was not only very fruitful, it offers him important insights, but it was also warranted.

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[172] The literature on military applications of chaos and complexity Theory has burgeoned in the nineties. To illustrate this, an inventory of articles dealing with Nonlinearity and Military Affairs drawn up by the US National Defense University in July, 1999 listed 144 entries. See *www.clausewitz.com.* For some accessible papers see for instance Glenn E. James, *Chaos Theory, The Essentials for Military Applications* (Naval War College Press, Newport, 1996); Linda Beckerman, 'The Non-linear Dynamics of War', *www.belisarius.com/modern _business_strategy/beckerman/non_linear.htm* date visited 4/27/99 (this article, though technical, is often referred to. It is particularly good on the notions of fitness landscape and bifurcation. She regards attrition style warfare as a linear process and, interestingly, refers to Boyd's OODA loop as a model which captures the dynamics of non-linear systems); and Tanner, Jason B., Walter E. Lavrinovich, and Scott R. Hall: 'Looking at Warfare Through a New Lens', *Marine Corps Gazette*, Vol. 82, Iss.9, September 1998, pp. 59-61; David S. Alberts and Thomas Czerwinski, *Complexity, Global Politics, and National Security* (National Defence University Press, Washington, D.C., 1998); and Thomas J. Czerwinski, *Coping with the Bounds, Speculations on Nonlinearity in Military Affairs* (National Defence University Press, Washington, D.C., 1999). For a recent study relating Clausewitz to chaos see Stephen J. Cimbala, *Clausewitz and Chaos, Friction in War and Military Policy* (Preager, Westport, Connecticut, 2001), in particular chapters 1 and 7.

A Discourse and the scientific *Zeitgeist*

Science, strategic theory and thinking strategically

The survey of the scientific *Zeitgeist* thus far has not only offered a window into the literature Boyd studied, it also introduced ideas, themes and insights that Boyd thought relevant for military strategy and strategic thinking. Some observations about the impact of the scientific *Zeitgeist* on Boyd's work and on the interpretation of it will conclude the examination of this formative factor.

The first observation is that Boyd's contribution to strategic theory lies in part in his use of the insights of the new sciences. Boyd deliberately made science an essential element in his work. The panorama of the scientific *Zeitgeist* of the past decades, incorporating various references to Boyd's work and based on part on the works Boyd read during the period he developed his ideas, strongly indicate the extent and ways science permeated Boyd's essay and his subsequent briefings.

It starts with an essay, which is firmly grounded in the epistemological debates of the sixties. The influence of science increased over the years. Even *Patterns of Conflict,* which is at heart a survey of military history and for which he studied works on military history and strategy, the list of sources he consulted includes several books from other scientific disciplines. Interestingly, an 1981 version of *Patterns of Conflict* lists Dawkins, E.O. Wilson and Gregory Bateson as the few notable studies not directly related to military history and strategy. In the final 1986 edition he expanded the number of slides, and the number of non-military works in the bibliography grows to 30. Not surprisingly Burton describes *Patterns of Conflict* as the product of Boyd's analysis of historical patterns of conflict and his synthesis of scientific theories for succesful operations[173]. In briefings developed after *Patterns of Conflict* the number of references to scientific insights, the number of scientific works included in the bibliography, and use of scientific illustrations increases significantly, while the number of references to, and illustrations from military history decrease markedly. The briefing *Strategic Game of ? & ?* is almost devoid of references to military history. In *The Conceptual Spiral* there is no military history at all but science and engineering dominate the slides, showing how both grow and shape our lives.

On a somewhat different level science played a different role too. The effort itself of reading, studying, analyzing, taking ideas apart, making connections by analogy with other books and articles he had analyzed, and creating a new synthesis would become as much an integral part of his ideas on strategy as the content. It represents the didactic approach Boyd took toward analysis and synthesis. His research on cognition, on learning, on creativity also inspired his idea that making strategy, devising military plans *works like* these mental processes. Strategic theory development is like the scientific enterprise which is like the way organisms develop, modify or discard schemata. And as the literature he read manifested a thorough interdisciplinary approach, strategic theory, like cognitive sciences, systems-theory, complexity and chaos theory, should incorporate and follow from a thoroughly interdisciplinary and even creative approach. Innovation in ideas came not from only thinking inductively, but the real advances are the breakouts of creative thinking beyond the limits of the then known. Boyd finds fault with the separation of inductive and deductive approaches. One needs both and must mix and match analysis and synthesis. It is not a matter of choosing between cumulative inductive processes; rather, their combination

[173] Burton, pp.46-47.

enriches the cumulative inductive and deductive achievements and provides what Boyd refers to as many-sided, implicit cross-references.

Boyd's study of science was essential to the development of his arguments. As Hammond states 'his study of chemistry, physics, and biology, his investigations about how the brain works, the nature of memory, how one learns, thinks, and questions, were central to his worldview'[174]. Boyd himself specifically included a list of 'disciplines or activities to be examined' when going to the heart of strategy. This list mentions mathematical logic, physics, thermodynamics, biology, psychology, anthropology and conflict studies[175]. His enormous appetite for books on such a diversity of subjects was not ephemeral to him. Appreciating the relevance of Boyd's interest in science therefore is an essential ingredient for understanding *A Discourse*.

Science plays a more distinct role as formative factor in Boyd's work than in that of other strategic theorists. Whereas the previously discussed authors were mostly indirectly influenced by the scientific climate of their time, such as Clausewitz, or where others tried to formulate a theory that fit a specific scientific model, such as Jomini or Fuller, Boyd actively and purposefully oriented himself in a variety of disciplines in order to acquire new insights, a better understanding of the complex phenomenon of war and strategic behavior. Contrary to Jomini, for instance, and later J.F.C. Fuller, who both aimed to formulate a theory that could hold up to the way physics developed theory, in order to gain an aura of universality (and a good measure of scientific acceptability), Boyd deliberately did not favor one scientific model or discipline over the other. He recognized similarities (for instance the essential role of uncertainty) among the various disciplines. They all pertained on the study of the behavior of human organizations in violent conflict, and he valued disciplines for the insight they provided, the metaphors they offer for seeing new things in familiar object, the way they improved his understanding.

Additionally he paid close attention to the *process* of scientific progress itself. Boyd was conscious of the formative factors that shaped his work, and actually made a deliberate effort to look for possible new angles on war and strategy, it was part of his efforts to improve his own "orientation". For Boyd combining different perspectives was crucial for learning and understanding. Anything that could prove relevant to increase his understanding about strategic behavior had his interest. Hammond describes Boyd's Way as 'a sort of Western Zen':

> It is a state of mind, a learning of the oneness of things, an appreciation for fundamental insights known in Eastern philosophy and religion as simply the Way [or Tao]. For Boyd, the Way is not an end but a process, a journey […] The connections, the insights that flow from examining the world in different ways, from different perspectives, from routinely examining the opposite proposition, were what were important. The key is mental agility[176].

And the mind of a strategist should combine the analytical as well as the synthetical. Concerning methodology in strategic theory Boyd argues for, and demonstrates, an eclectic approach, because for Boyd the fields and disciplines he studied were all related[177]. As Hammond summarizes Boyd's view:

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[174] Ibid, pp.12-13.

[175] Boyd*, Strategic Game of ? and ?,* p.12.

[176] Hammond, p.15.

[177] Or as Hammond notes on p.186: 'from biology to chaos, future defense scenarios to information war, Sun Tzu and Musashi to the Ames spy case, genetic algorithms to how one thinks and learns,

> Sharpening our mental capabilities is critically important if we are to adapt and survive in a complex, uncertain, constantly changing environment. Your best weapon is your mind. Learning how to think well and quickly is the first prerequisite of survival[178].

Awareness of this process of analysis and synthesis and of the value of combining insights from seemingly unrelated fields of knowledge was thus a crucial point Boyd wanted to get across. Boyd emphasized the importance of using different theories and disciplines to look for connections and new lines of causality that might explain and illuminate familiar processes and events, all the while looking for connections that might lead to a more general elaboration of what is taking place. In short, he emphasized looking for those insights and connections that might provide some universal pattern, process or a model as a tool for explanation and for sound military thinking. As a result, Boyd states in the 'Introduction',

> A Discourse' represents the key to evolve tactics, strategies, goals, unifying themes, etc., that permit us to actively shape and adapt to the unfolding world we are part of, live in and feed upon[179].

In the two page written introduction Boyd makes it quite clear that what really matters about *A Discourse* is the way the whole set of ideas had come together, how it was synthesized from looking at war and strategy from different angles, using different frames of reference and not necessarily only those from the more obvious social sciences but also from other seemingly unrelated fields. As he states:

> The theme that weaves its way through this 'Discourse on Winning and Losing' is not so much contained within each of the five sections, per se, that make up the 'Discourse'; rather, it is the kind of thinking that both lies behind and makes up its very essence[180].

He put forward his ideas in several evolving presentations that, combined, form *A Discourse.* Thus *A Discourse* emerged in its final form after numerous changes that resulted from a dialectic process of destruction and creation. In fact it evolved through the application of the OODA loop. Boyd inserted and discarded ideas and insights, he altered the verbiage and added or deleted historical illustration based on discussions, further study and new books he had read, also taking into account whether adding another piece would help to make a particular point come across. *A Discourse* is thus the result of a discourse with history, science and the audience, inspired by an insight from his experience as a fighter pilot. Like the growth of scientific knowledge, Boyd's work evolved.

For Boyd then, this deliberate search for novel insights by studying various fields of knowledge, a deliberate maintenance of an open attitude towards various disciplines had a normative character. According to Boyd it is the way strategy and war should be studied. Studying scientific literature in an interdisciplinary way, and gaining an understanding how scientific knowledge develops was as normative as the study of military history if one wanted to gain a proper understanding of conflict, winning and losing. The metaphors, analogies and illustrations Boyd employed were deliberately chosen. Moreover, they were, and are, also part

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airbase security and police to the Japanese art of war, evolutionary epistemology and the growth of biological thought - to Boyd they were all clearly interrelated'.

[178] Hammond, p.182.

[179] John Boyd, *A Discourse*, Abstract, p.2.

[180] Ibid.

of the scientific and cultural *Zeitgeist*. Boyd was riding a wave in science and translating it and applying it to the military realm, and he was leading in this effort.

Boyd was most likely the first military theorist to note the significance of this emerging paradigm for understanding war and strategy. Two editors recognize in Boyd in retrospect a "nonlinearist". They assert however that in the context of the time and vocabulary, this realization could only be implicit[181]. The previous chapters however have indicated that, based on the literature Boyd studied from the early 1970s till the time of his death, on the examples he included in his work, on the remarks by several experts who knew Boyd on a personal basis and on Boyd's own assertion, the conclusion is warranted that Boyd explicitly employed the Prigoginian perspective when he developed his work, in particular in the presentations he developed after *Patterns of Conflict*.

Boyd's metaphors

The second implication of Boyd's avid and varied reading frenzy lies in the metaphors these works provided. Boyd hints at this in the assertion:

> the key statements of these presentations, the OODA Loop Sketch and related insights represent an evolving, open-ended, far-from-equilibrium process of self-organization, emergence and natural selection[182].

The large extent to which Boyd incorporated concepts, illustrations, analogies and metaphors from science into his work has become quite evident by now. Thus, when studying Boyd's work, indeed, one must pay due regard for the perspectives he employed. His thinking matured and his presentations evolved against the background of remarkable and widely discussed scientific developments. The impact of science on Boyd is not only obvious, but also fundamental for Boyd's views on strategy and military theory, as it is for understanding Boyd properly. Boyd's knowledge of concepts and ideas outside of the traditional field of military history and strategic studies contributed to his perception of patterns in history and the parallels in processes of adaptation in several arena's; the biological, the military, the sciences.

It provided him with novel conceptual lenses to approach and explain military conflict. Reading literature from a variety of disciplines provided him with disparate pieces of information which he would over time connect. He could interpolate among and between these bits of information and create sweeping insights. Habitually thinking by analogy, these intuitive leaps were frequent and allowed Boyd to paint broad-brushed understandings of complex issues that others could only grasp in pieces[183]. Science provided him with novel metaphors, analogies and illustrations that appear throughout *A Discourse* and that provided a dominant lens through which Boyd viewed war. Theoretical physics, thermodynamics, systems theory, evolution theory and neuro-physiology, etc, provided examples, insights and illustrations.

To understand Boyd's work it is essential to appreciate the metaphors embedded in his work, metaphors he used both to examine war and strategic behavior, to bolster his propositions and to illustrate and explain them. There is great merit in developing and using metaphors to improve understanding of complex and perhaps yet unknown phenomena. As Robert Shaw noted, 'you don't see something until you have the right metaphor to let you

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[181] Davis and Czerwinski, (1997), electronic version, Preface, p.1.
[182] Boyd, *The Essence of Winning and Losing*, p.4; and Hammond, p.191.
[183] Hammond, p. 12; Coram, p.330.

perceive it'[184]. By trying to compare an unfamiliar object with a familiar one, we can discover similarities and differences and perhaps form some hypothesis how and why that unfamiliar object will behave. On the other hand it can provide new perspectives on familiar phenomena or objects[185]. Boyd implicitly, and sometimes even explicitly, employs the following interrelated metaphors to describe war, strategy and the functioning of armed forces:

- Armed forces as organisms;
- Armed forces as brains;
- Armed forces as processes of transformation;
- Armed forces as systems
- Armed forces as Complex Adaptive Systems

Several of these by now are self-explanatory. First he employs the *organic metaphor*: armed forces are and behave *like* organisms. The OODA loop and Boyd's theory for success, explain what is necessary to survive. The OODA loop can be compared with the genetic reproduction cycle of organic species. Instead of genes, an organization passes on ideas, orientation and action repertoires from one to the next cycle, discarding those orientation patterns and actions that appeared to be dysfunctional. Like organisms, according to Boyd, armed forces compete, learn, evolve, survive, or not. Military doctrine and strategic theory also are seen in this evolution theoretical light. The ones that "work" survive and will be retained (up to a point when it leads to dogma and specific effective counter doctrines). Boyd adopts the idea that, like science, strategic theory develops according to a self-correcting mechanism. This is related to the metaphor of armed forces as *brains*. They have brain-like elements that think, observe, learn. Boyd's model is a model for double loop learning. Boyd wants armed forces to operate as learning organizations.

The third metaphor regards *armed forces like processes of transformation and flux*. Boyd is keen to direct the attention on the underlying processes at play in combat. Information flows through the organization across subsystems and between systems levels. Relations are adjusted, the organization changes, evolves and this is a continuous process. To survive the organization is never fixed, not static, but always in some form of transformation to adjust itself to the ever-changing situation. The fourth metaphor lies in considering *armed forces as open systems*. Throughout the work Boyd emphasizes connections, tendons, relationships between various interdependent sub-systems laterally and among hierarchical levels of organization.

Extending this metaphor, Boyd also regarded *armed forces as Complex Adaptive Systems* such as ecosystems. Here the themes of non-linearity, novelty, variety, levels of organized complexity and different ways, modes and timescales of adaptation and evolution are at play. War is like the non-linear clash of two Complex Adaptive Systems. Units are filling niches in the ecosystem and should be able to operate with a sufficient level of autonomy yet in an interdependent way with other systems. Doctrines, procedures, tactics, organizational culture are *like* the strange attractors of Chaos Theory, explaining the overall behavior of a system. They are also *like* schemata that need to evolve. Armed forces are *like* autopoietic systems, continually making efforts to maintain their distinctive character despite the turbulent environment. Defeat, demoralization and a disorganized retreat can be seen as symptoms of

[184] Gleick, p.262.

[185] On the merit of metaphors see for instance Morgan, Chapter 11. The first three metaphors I mention here I directly from this book, Chapters 3, 4 and 8.

a system disintegrating after the bifurcation point, unable to cope in the available time with the radical changes imposed on it by the environment, unable to adjust the schemata or to speed up the rate of adjustment.

Conceptualizing military strategies of Complex Adaptive Systems

This has implications for the interpretation of his work. As will become evident from reading his work and following logically from the panorama of the scientific *Zeitgeist*, his work revolves around the theme of adaptability. Boyd focusses on the factors that can impair an opponent's capability to adapt and those that preserve one's own capacity to do so. Adaptability is one of the premier themes in the literature on (complex adaptive) systems, this and the previous previous chapters have indicated. The system for which the strategic theory is designed will be the armed forces and its environment. An armed force is by design a fairly robust system. It is designed to cause change in an opponent and oppose the need to do so itself. It will equip itself with redundant connections, ample units of diverse nature, good sensors, relevant schema and a supportive environment. It will do anything to ensure a modicum of coherence of its actions.

The aim is therefore to push a system away from its ordered disciplined state towards a pure complex state where indeed the several subsystems need to self-organize because of lack of higher direction and then towards a state of randomness, but not necessarily in such a time sequenced order. Randomness, the loss of cohesion is the opposite of the capability to adapt. The units may still exist but not as part of a higher complex system. This mechanism of decreasing cohesion and fading capability to adapt can be applied to any system and subsystem to the lowest level that can be described as a system, in armed forces this is the individual soldier. But it is not necessary to have the system completely disintegrate in one massive blow. Because an error in response or a slower response will magnify in impact over time through the feedback loops it is basically only necessary to create an initial advantage and prevent the opponent from compensating for it. That last remark is essential because a system will react and attempt to find workarounds.

The nature of a system can change from less complex to complex, or alternatively, to the point where there is hardly any connection anymore, where information is not shared and where cohesion of action ceases to exist. Then the different elements of a system act at random and do not constitute a part of a system. Applied to armed forces, we can envision an army at the beginning of a conflict executing a plan in a well ordered fashion with a high degree of cohesion, but after setback, degradation of capabilities, the loss of connections and units cohesion of the system degrades. Initially the central directing body can issue new orders to maintain cohesion thus providing part of new schema's (what is expected of units, how to behave) and how the environment should look like (by providing intelligence). When the capability to communicate degrades units need to look after themselves for longer periods of time and through doctrine and training will be able to self organize for some time. After longer periods the lastly provided schema's will not match reality anymore and without connections and inputs, the units will fail to react properly and the more units do so the more the system as a whole will fail to adapt correctly to unfolding circumstances. This explains the importance of the cognitive factor in Boyd's work.

Building on Jervis, Perrow, Pentland, and the insights of the previous chapters, several interrelated methods can be distilled from the dynamics of open, complex, non-linear adaptive systems that can be translated into strategic moves – albeit abstract - to accomplish the basic aim of social systems in conflict. Most, if not all, are present in Boyd's work:

- Ensure a large variety of conceptual lenses;
- Organize in semi-autonomous cells, avoid rigid hierarchical structures/culture;
- Use multiple strategies/avenues;
- Affect the accuracy of the cognitive/feedback process. If comprehension helps to achieve cohesion, and maintain purposeful behavior, the corollary is that confusion helps to create collapse;
- Overload his cognitive capacity;
- Eliminate (and/or threaten) particular crucial (real or imaginary) subsystems;
- Diminish the variety of subsystems (affecting the capability to respond to a variety of threats, and diminishing the decision- or adaptation space) alternatively achieving and maintaining a relative and relevant advantage in variety;
- Disrupt the moral, physical and/or informational vertical and horizontal relations (i.e. cohesion) among subsystems;
- Close the enemy off from his physical/social environment;
- Shape the environment of a system faster than the opponent's capability to cope with it;
- Disrupt the information flow between the environment and the system and,
- Ensure the irrelevance of the schemata of the opponent, or the inability to validate those while ensuring sufficient accuracy of one's own schemata;
- Change the nature of war: waging a form of warfare that does not correspond to the opponent's doctrine and strategic preference (schemata);
- Change the environment in terms of alliances, location and/or stakes involved.

It is this conceptualization of war and strategic behavior that underlies Boyd's thinking, as will become evident from the description of *A Discourse* that follows in the next chapters.

Conclusion

To conclude, Boyd was developing his work during a time of significant scientific developments. Boyd was aware of these and consciously studied them. He incorporated various themes and insights central to these developments in his work and constructed his work on the philosophical foundation laid by philosophical studies published in this period. The scientific *Zeitgeist* provided him with metaphors and new insights that connected to patterns he discerned in military history and strategic theory, as well in his own military experience. He may be considered the first strategist to incorporate the paradigm shift in science of the 20th century into strategic theory, deliberately and normatively, and to construct a theory based on the insights the paradigm shift spawned. When it comes to interpreting his work, these chapters strongly suggest that Boyd argues much more then "merely" the rapid OODA loop idea and that within the OODA loop idea a wealth of concepts and insights add levels of meaning to the simple graphic.

6. CORE ARGUMENTS

'Patterns of Conflict' represents a compendium of ideas and actions for winning and losing in a highly competitive world'
John Boyd

A Discourse in prose

Introduction

The previous chapters have provided a conceptual lens through which we can examine Boyd's presentations. In the following chapters I have elaborated in full prose what Boyd sketched out in his slides. This exercise will substantiate one of the arguments of this study that although the idea of "rapid OODA looping" is indeed an important theme in Boyd's work and significant in its own right, in fact his work is much broader and more complex than "merely" this insight suggests. Reading Boyd's own words and following Boyd through all of his slides and the essay will show that there are several other important themes that Boyd wanted to get across, indeed, it will demonstrate the richness of Boyd's body of strategic thought.

In *A Discourse* Boyd not only developed an approach for fighting conventional war which later was labeled the maneuvrist approach with the rapid OODA loop notion as its conceptual heart. It will become clear that Boyd recognized there are several "categories of conflict", all valid modes of warfare in particular contexts, and all with their own particular logic. It will also demonstrate that Boyd did not stop at the tactical and operational levels of war. On the contrary; as already alluded to in the previous chapters, he addresses the strategic and grand strategic levels as well and in considerable detail. Indeed, he is at pains to reconceptualize the meaning of these terms by putting them in the context of adaptability, as levels in the game of survival.

Furthermore, in his discussion on these issues, he departs from the rapid OODA loop idea in recognition of the fact that other factors come into play at the higher levels of war. In particular in his last two presentations Boyd takes his arguments towards higher levels of abstraction, turning his military theory into a general theory of strategy, or rather, a general theory of organizational survival. Finally, these chapters will illustrate Boyd's view on the proper approach for strategic thinking, for *A Discourse* is both an argument on a specific approach for winning in conflict, a re-conceptualization of the term strategy, as well as an argument for how one should think strategically.

Preceded by an introduction to each presentation, the chapters stay close to Boyd's slides and the structure of his argument. This does not allow for much analysis, commentary or explanation for that would obscure Boyd's own work, but it does have the benefit of giving a good introduction into Boyd's strategic thought in the absence of an established and accepted interpretation of his work. It also offers a view on the typical Boydian style of language. Already the previous chapters incorporated various sections of *A Discourse* with the purpose to show the extent, the way and the places insights from science have influenced this work. And for purposes of clarification and explanation of the character and meaning of a (section of a) presentation, I sometimes refer back to the previous chapters. Some repetition is therefore unavoidable.

The main intent of the effort is to provide the content of his slides in readable prose and to connect the slides if and where the slides themselves are either not self-explanatory, or where it is not clear what the specific contribution or logic is of a slide, an argument, an illustration or a slight amendment of wording Boyd deemed necessary. As much as possible Boyd's own language and terminology is adhered to. Moreoever, the original structure of each presentation is kept clearly visible. In that, this rendering of Boyd's work differs from the accounts offered by Coram and in particular Hammond[1].

Structure

However, in the description of the separate parts of Boyd's work, I do not follow the Boyd's order. I am interested in showing the way he builds his arguments and to understand how he developed his ideas and why. To that end I follow a chronological order. The essay is so central to both the content and the development of his entire work that proper comprehension of Boyd's work is not served by discussing it last. Just to underline this, it is worthwhile mentioning here that in his last two briefings he returns to his earliest insights and themes from the essay and elaborates on them even further.

The sections are devided in two chapters for organizational purposes and for the qualitative distinction between the essay and *Patterns of Conflict* (this chapter) on the one hand and the shorter presentations on the other hand, that can be considered elaboration of specific themes introduced in the essay and *Patterns*. This chapter starts with the essay *Destruction and Creation*, written in 1976, which Boyd put almost at the end of *A Discourse*. The essay is followed by *Patterns of Conflict*. Both contain the the complete array of themes, insights and arguments Boyd wanted to get across, and together they initially formed *Patterns of Conflict*. Chapter 7 consists of the presentations *Organic Design for Command and Control*, *The Strategic Game of ? and ?,* and the very brief *Revelation*. Moreover, although *Conceptual Spiral* and *The Essence of Winning and Losing* do not form an integral part of *A Discourse*, they do constitute two more key elements of his work, so I have included them as well. These presentations build upon the foundation laid by the essay and *Patterns,* elaborating, exploring and refining specific themes and arguments, taking the audience to new levels of abstraction.

The interesting thing about this structure is that it emphasizes how he expands upon impressions and themes formulated in *A New Conception in Air-to-Air Combat*, the essay and *Patterns of Conflict*. His later work is a logical sequence to this. The early insights provided a frame of reference for his search for insights in different areas of knowledge. Early on he discovered a pattern, a core process and his presentations build upon and reinforce the idea. Furthermore, they provide fresh substantiation and they explain in layman's language and through the use of newspaper articles and book sections in practical terms quite abstract concepts of the essay. It also informs his entire development, his dialectic approach to the project.

Despite these modifications I think that, by sticking rather closely to the actual wording of his slides, but armed with the conceptual lenses provided by the previous chapters, we can develop a good feel of the message and the structure of Boyd's argument and the unique Boydian way for peeling new insights from familiar matter and his unique strategic lexicon. We can at least see his mind at work. This starts already with the 'Abstract' he offers, in which he clearly alludes to the overarching themes embedded in this work that he considered important. *It is here offered verbatim.*

[1] See Hammond (2001), chapters 8-10, and pp.188-191.

Boyd's 'Abstract' of *A Discourse*

To flourish and grow in a many-sided uncertain and ever changing world that surrounds us, suggests that we have to make intuitive within ourselves those many practices we need to meet the exigencies of that world. The contents, hence the five sections, that comprise this "Discourse" unfold observations and ideas that contribute toward achieving or thwarting such an aim or purpose. Specifically:

- 'Patterns of Conflict' represents a compendium of ideas and actions for winning and losing in a highly competitive world;
- 'Organic Design for Command and Control' surfaces the implicit arrangements that permit cooperation in complex, competitive, fast moving situations;
- 'The Strategic Game of ? and ?' emphasizes the mental twists and turns we undertake to surface appropriate schemes or designs for realizing our aims or purposes;
- 'Destruction and Creation' lays out in abstract but graphic fashion the ways by which we evolve mental concepts to comprehend and cope with our environment;
- 'Revelation' makes visible the metaphorical message that flows from this 'Discourse'.

As one proceeds from 'Patterns' through 'Organic Design', 'Strategic Game', and 'Destruction and Creation' to 'Revelation' he or she will notice that the discussion goes from the more concrete and obvious to the more abstract. In this sense, one will notice the rise away from many particular actions and ideas to fewer and more general concepts to account for these many actions and ideas. In this context, 'Patterns' emphasizes historical readings, primarily military, as the backdrop for its discussion while the final four sections draw away from this historical framework an increasingly emphasize theory spread over scientific backdrop as the medium for discussion.

Yet, the theme that weaves its way through this 'Discourse on Winning and Losing' is not so much contained within each of the five sections, per se, that make up this 'Discourse', rather, it is the kind of thinking that both lies behind and makes-up its very essence. For the interested, a careful examination will reveal that the increasingly abstract discussion surfaces a process of reaching across many perspectives; pulling each and every one apart (analysis), all the while intuitively looking for those parts of the disassembled perspectives which naturally interconnect with one another to form a higher order, more general elaboration (synthesis) of what is taking place. As a result, the process not only creates the 'Discourse' but it also represents the key to evolve the tactics, strategies, goals, unifying themes, etc., that permit us to actively shape and adapt to the unfolding world we are a part of, live-in, and feed-upon.

Destruction and Creation

Introduction

The foundation of *A Discourse* was laid in September 1976 with a concise, 16-page essay entitled *Destruction and Creation*. According to Hammond it is the culmination of a quest to find scientific, mathematical, and logical verification for principles Boyd knew instinctively to

be true. Thus tested and refined, it became the basis for most of his thoughts thereafter[2]. In this essay he combined concepts from the seemingly unrelated fields of mathematical logic, physics, and thermodynamics. Boyd thus became the first individual ever to link Gödel's Incompleteness Theorem, Heisenberg's uncertainty principle, and the Second Law of Thermodynamics[3]. But other concepts are either explicitly or implicitly incorporated in it as well, such as the arguments of Polanyi, Popper and Kuhn. The essay consists of an abstract and eight paragraphs. The essay is rendered in its entirety without explanatory text or interpretation, as the essay is self-explanatory (when read with the previous chapters as a conceptual background), contrary to the presentations that follow it. The only difference lies in the bibliography, which I have included not at the end of the essay, but as Appendix A of this study.

The heart of the essay is the discussion about the nature of knowledge and the way we can obtain knowledge. It is highly philosophical and obviously rooted in the debate on scientific progress and the nature of knowledge that raged in the sixties. Not surprisingly Boyd associates these epistemological issues with struggles for survival. The fundamental, unavoidable and all-pervasive presence of uncertainty is the starting point. It leads to the requirement to learn, to develop adequate mental models, and to continually assess the adequacy of these models is the basis for survival for any organism. This process requires both analysis and synthesis, both induction and deduction.

Because fighting a war is about the survival of a unit or a social organism like the nation-state, the insights from this discussion about the process of learning – or rather making sense of this constantly changing world - cannot be anything but relevant for war fighting and strategic theory. Boyd returned to the notions developed in this essay when developing his ideas about the character of a good command and control system and the essence of the strategic game. In 1996, he condensed his ideas in his final presentation, and in the five slides that make up this briefing again he returns to themes introduced in the essay. In the abstract of the essay he introduces the central theme. Then follows *the literal and entire text of the essay including Boyd's use of underlining.*

'Abstract'

To comprehend and cope with our environment we develop mental patterns or concepts of meaning. The purpose of this paper is to sketch out how we destroy and create these patterns to permit us to bath shape and be shaped by a changing environment. In this sense, the discussion also literally shows why we cannot avoid this kind of activity if we intend to survive on our own terms. The activity is dialectic in nature generating bath disorder and order that emerges as a changing and expanding universe of mental concepts matched to a changing and expanding universe of observed reality.

Goal

Studies of human behavior reveal that the actions we undertake as individuals are closely related to survival, more importantly, survival on our own terms. Naturally, such a notion implies that we should be able to act relatively free or independent of any debilitating external influences —otherwise that very survival might be in jeopardy. In viewing the instinct for survival in this manner we imply that a basic aim or goal, as individuals, is to

[2] Ibid, p.118.
[3] Hammond, *The Essential Boyd*, p.8.

improve our capacity for independent action. The degree to which we cooperate, or compete, with others is driven by the need to satisfy this basic goal. If we believe that it is not possible to satisfy it alone, without help from others, history shows us that we will agree to constraints upon our independent action -- in order to collectively pool skills and talents in the farm of nations, corporations, labor unions, mafias, etc.-- so that obstacles standing in the way of the basic goal can either be removed or overcome. On the other hand, if the group cannot or does not attempt to overcome obstacles deemed important to many (or possibly any) of it's individual members, the group must risk losing these alienated members. Under these circumstances, the alienated members may dissolve their relationship and remain independent, form a group of their own, or join another collective body in order to improve their capacity for independent action.

Environment

In a real world of limited resources and skills, individuals and groups form, dissolve and reform their cooperative or competitive postures in a continuous struggle to remove or overcome physical and social environmental obstacles[4]. In a cooperative sense, where skills and talents are pooled, the removal or overcoming of obstacles represents an improved capacity for independent action for all concerned. In a competitive sense, where individuals and groups compete for scarce resources and skills, an improved capacity for independent action achieved by some individuals or groups constrains that capacity for other individuals or groups. Naturally, such a combination of real world scarcity and goal striving to overcome this scarcity intensifies the struggle of individuals and groups to cope with both their physical and social environments[5].

Need for decisions

Against such a background, actions and decisions become critically important. Actions must be taken over and over again and in many different ways. Decisions must be rendered to monitor and determine the precise nature of the actions needed that will be compatible with the goal. To make these timely decisions imply that we must be able to form mental concepts of observed reality, as we perceive it, and be able to change these concepts as reality itself appears to change. The concepts can then be used as decision-models for improving our capacity for independent action. Such a demand for decisions that literally impact our survival causes one to wonder: How do we generate or create the mental concepts to support the is decision-making activity?

Creating Concepts

There are two ways in which we can develop and manipulate mental concepts to represent observed reality: We can start from a comprehensive whole and break it down to its

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[4] In the essay Boyd frequently inserts a numbers that refers to the number of a book listed in the bibliography attached to 'Destruction and Creation', and indicates the source for a particular insight. For clarity, here both the number and the works referred to are given. The entire bibliography can be found in Attachment A. The sources Boyd refers to here are books number 11: Nicholas Georgescu-Roegen, *The Entropy Law and the Economic Process*; and 13: Robert Heilbronner, *An Inquiry into the Human Prospect*.

[5] Ibid.

particulars or we can start with the particulars and build towards a comprehensive whole[6]. Saying it another way, but in a related sense, we can go from the general-to-specific or from the specific-to-general. A little reflection here reveals that deduction is related to proceeding from the general-to-specific while induction is related to proceeding from the specific-to-general. In following this line of thought can we think of other activities that are related to these two opposing ideas? Is not analysis related to proceeding from the general-to-specific? Is not synthesis, the opposite of analysis, related to proceeding from the specific-to-general? Putting all this together: Can we not say that general-to-specific is related to both deduction and analysis, while specific-to-general is related to induction and synthesis? Now, can we think of some examples to fit with these two opposing ideas? We need not look far. The differential calculus proceeds from the general-to-specific -- from a function to its derivative. Hence, is not the use or application of the differential calculus related to deduction and analysis? The integral calculus, on the other hand, proceeds in the opposite direction -- from a derivative to a general function. Hence, is not the use or application of the integral calculus related to induction and synthesis? Summing up, we can see that: general-to-specific is related to deduction, analysis, and differentiation, while, specific-to-general is related to induction, synthesis, and integration.

Now keeping these two opposing idea chains in mind let us move on a somewhat different tack. Imagine, if you will, a domain (a comprehensive whole) and its constituent elements or parts. Now, imagine another domain and its constituent parts. Once again, imagine even another domain and its constituent parts. Repeating this idea over and over again we can imagine any number of domains and the parts corresponding to each. Naturally, as we go through life we develop concepts of meaning (with included constituents) to represent observed reality. Can we not liken these concepts and their related constituents to the domains and constituents that we have formed in our imagination? Naturally, we can. Keeping this relationship in mind, suppose we shatter the correspondence of each domain or concept with its constituent elements. In other words, we imagine the existence of the parts but pretend that the domains or concepts they were previously associated with do not exist. Result: We have many constituents, or particulars, swimming around in a sea of anarchy. We have uncertainty and disorder in place of meaning and order. Further, we can see that such an unstructuring or destruction of many domains -- to break the correspondence of each with its respective constituents -- is related to deduction, analysis , and differentiation .We call this kind of unstructuring a destructive deduction.

Faced with such disorder or chaos, how can we reconstruct order and meaning? Going back to the idea chain of specific-to-genera1, induction, synthesis, and integration the thought occurs that a new domain or concept can be formed if we can find some common qua1ities, attributes, or operations among some or many of these constituents swimming in this sea of anarchy. Through such connecting threads (that produce meaning) we synthesize constituents from, hence across, the domains we have just shattered.[7]. Linking particulars together in this manner we can form a new domain or concept -- providing, of course, we do not inadvertently use only those "bits and pieces" in the same arrangement that we associated with one of the domains purged from our imagination. Clearly, such a synthesis would indicate we have generated something new and different from what previous1y existed. Going back to our idea chain, it follows that creativity is related to induction,

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[6] Here Boyd refers to sources 28: Michael Polanyi, *Knowing and Being* ; and 24: Alex F. Osborne, *Applied Imagination*.

[7] Boyd refers to Osborne again.

synthesis, and integration since we proceeded from unstructured bits and pieces to a new general pattern or concept. We call such action a creative or constructive induction. It is important to note that the crucial or key step that permits this creative induction is the separation of the particulars from their previous domains by the destructive deduction. Without this unstructuring the creation of a new structure cannot proceed -- since the bits and pieces are still tied together as meaning within unchallenged domains or concepts.

Recalling that we use concepts or mental patterns to represent reality, it follows that the unstructuring and restructuring just shown reveals a way of changing our perception of reality[8]. Naturally, such a notion implies that the emerging pattern of ideas and interactions must be internally consistent and match-up with reality[9]. To check or verify internal consistency we try to see if we can trace our way back to the original constituents that were used in the creative or constructive induction. If we cannot reverse directions the ideas and interactions do not go together in this way without contradiction. Hence, they are not internally consistent. However, this does not necessarily mean we reject and throw away the entire structure. Instead, we should attempt to identify those ideas (particulars) and interactions that seem to hold together in a coherent pattern of activity as distinguished from those ideas that do not seem to fit in. In performing this task we check for reversibility as well as check to see which ideas and interactions match-up with our observations of reality[10]. Using those ideas and interactions that pass this test together with any new ideas (from new destructive deductions) or other promising ideas that popped out of the original destructive deduction we again attempt to find some common qualities, attributes, or operations to re-create the concept -- or create a new concept. Also, once again, we perform the check for reversibility and match-up with reality. Over and over again this cycle of Destruction and Creation is repeated until we demonstrate internal consistency and match-up with reality[11].

Suspicion

When this orderly (and pleasant) state is reached the concept becomes a coherent pattern of ideas and interactions that can be used to describe some aspect of observed reality. As a consequence, there is little, or no, further appeal to alternative ideas and interactions in an effort to either expand, complete, or modify the concept[12]. Instead, the effort is turned inward towards fine tuning the ideas and interactions in order to improve generality and produce a more precise match of the conceptual pattern with reality[13]. Toward this end, the concept -- and its internal workings -- is tested and compared against observed phenomena over and over again in many different and subtle ways[14]. Such a repeated and inward-oriented effort to explain increasingly more subtle aspects of reality suggests the disturbing idea that perhaps, at some point, ambiguities, uncertainties, anomalies, or apparent

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[8] Again Boyd refers to Polanyi.

[9] Here Boyd refers to sources 14 and 15: two works of Werner Heisenberg: *Physics and Philosophy*, and *Across the Frontiers*.

[10] Boyd refers to sources 27: Jean Piaget, *Structuralism*; as well as to both works of Heisenberg listed above.

[11] Besides the two works of Heisenberg, Boyd here refers to source 19: Thomas Kuhn, *The Structure of Scientific Revolutions*.

[12] This description of the dynamics of normal science Boyd derived from Kuhn.

[13] Ibid.

[14] Ibid.

inconsistencies may emerge to stifle a more general and precise match-up of concept with observed reality[15]. Why do we suspect this?

On one hand, we realize that facts, perceptions, ideas, impressions, interactions, etc. separated from previous observations and thought patterns have been linked together to create a new conceptual pattern. On the other hand, we suspect that refined observations now underway will eventually exhibit either more or a different kind of precision and subtlety than the previous observations and thought patterns. Clearly, any anticipated difference, or differences, suggests we should expect a mismatch between the new observations and the anticipated concept description of these observations. To assume otherwise would be tantamount to admitting that previous constituents and interactions would produce the same synthesis as any newer constituents and interactions that exhibit either more or a different kind of precision and subtlety. This would be like admitting one equals two. To avoid such a discomforting position implies that we should anticipate a mismatch between phenomena observation and concept description of that observation. Such a notion is not new and is indicated by the discoveries of Kurt Gödel and Werner Heisenberg.

Incompleteness and consistency

In 1931 Kurt Gödel created a stir in the World of Mathematics and Logic when he revealed that it was impossible to embrace mathematics within a single system of logic[16]. He accomplished this by proving, first, that any consistent system -- that includes the arithmetic of whole numbers -- is incomplete. In other words, there are true statements or concepts within the system that cannot be deduced from the postulates that make-up the system. Next, he proved even though such a system is consistent its consistency cannot be demonstrated within the system.

Such a result does not imply that it is. impossible to prove the consistency of a system. It only means that such a proof cannot be accomplished inside the system. As a matter of fact, since Gödel, Gerhard Gentzen and others have shown that a consistency proof of arithmetic can be found by appealing to systems outside that arithmetic. Thus, Gödel's Proof indirectly shows that in order to determine the consistency of any new system we must construct or uncover another system beyond it[17]. Over and over this cycle must be repeated to determine the consistency of more and more elaborate systems[18].

Keeping this process in mind, let us see how Gödel's results impact the effort to improve the match-up of concept with observed reality. To do this we will consider two kinds of consistency: The consistency of the concept and the consistency of the match-up between observed reality and concept description of reality. In this sense, if we assume -- as a result of previous destructive deduction and creative induction efforts -- that we have a consistent concept and consistent match-up, we should see no differences between observation and concept description. Yet, as we have seen, on one hand, we use observations to shape or formulate a concept; while on the other hand, we use a concept to shape the nature of future inquiries or observations of reality. Back and forth, over and over

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[15] Ibid.

[16] Boyd refers to sources 12: Kurt Gödel, *On Formally Undecidable Propositions of the Principia Mathematica and Related Systems* pages 3-38, 'The Undecidable'; and 23: Ernest Nagel and James Newman, *Gödel's Proof*.

[17] Boyd derived this insight from sources 29: Jagjit Singh, *Great Ideas of Modern Mathematics*; and 27: Jean Piaget, *Structuralism*.

[18] Ibid.

again, we use observations to sharpen a concept and a concept to sharpen observations. Under these circumstances, a concept must be incomplete since we depend upon an ever-changing array of observations to shape or formulate it. Likewise, our observations of reality must be incomplete since we depend upon a changing concept to shape or formulate the nature of new inquiries and observations. Therefore, when we probe back and forth with more precision and subtlety, we must admit that we can have differences between observation and concept description; hence, we cannot determine the consistency of the system -- in terms of its concept, and match-up with observed reality -- within itself.

Furthermore, the consistency cannot be determined even when the precision and subtlety of observed phenomena approaches the precision and subtlety of the observer -- who is employing the ideas and interactions that play together in the conceptual pattern. This aspect of consistency is accounted for not only by Gödel's Proof but also by the Heisenberg Uncertainty or Indeterminacy Principle.

Indeterminacy and Uncertainty

The Indeterminacy Principle uncovered by Werner Heisenberg in 1927 showed that one could not simultaneously fix or determine precisely the velocity and position of a particle or body[19]. Specifically he showed, due to the presence and influence of an observer, that the product of the velocity and position uncertainties is equal to or greater than a small number (Planck's Constant) divided by the mass of the particle or body being investigated. In other words:

$$\Delta V \, \Delta Q \geq h/m$$

where ΔV is velocity uncertainty
ΔQ is position uncertainty and h/m is Planck's constant (h) divided by observed mass (m).

Examination of Heisenberg's Principle reveals that as mass becomes exceedingly small the uncertainty, or indeterminacy, becomes exceedingly large. Now -- in accordance with this relation -- when the precision, or mass, of phenomena being observed is little, or no different than the precision, or mass, of the observing phenomena the uncertainty values become as large as, or larger than, the velocity and size frame-of-reference associated with the bodies being observed[20]. In other words, when the intended distinction between observer and observed begins to disappear[21], the uncertainty values hide or mask phenomena behavior; or put another way, the observer perceives uncertain or erratic behavior that bounces all over in accordance with the indeterminacy relation. Under these circumstances, the uncertainty values represent the inability to determine the character or nature (consistency) of a system within itself. On the other hand, if the precision and subtlety of the observed phenomena is much less than the precision and subtlety of the observing phenomena uncertainty values become much smaller than the velocity and size values of the bodies being observed[22]. Under these circumstances, the character or nature of a system can be determined --

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[19] Boyd refers to source 14 again (Heisenberg (1962)); and source 9: George Gamow, *Thirty Years That Shook Physics.*

[20] Gamow is referred to again.

[21] Here Boyd refers to source 3: Spencer Brown: *Laws of Form.*

[22] Gamow.

although not exact1y -- since the uncertainty va1ues do not hide or mask observed phenomena behavior nor indicate significant erratic behavior.

Keeping in mind that the Heisenberg Principle implicitly depends upon the indeterminate presence and influence of an observer[23], we can now see -- as revealed by the two examples just cited -- that the magnitude of the uncertainty values represent the degree of intrusion by the observer upon the observed. When intrusion is total (that is, when the intended distinction between observer and observed essentially disappears[24]) the uncertainty values indicate erratic behavior. When intrusion is low the uncertainty va1ues do not hide or mask observed phenomena behavior, nor indicate significant erratic behavior. In other words, the uncertainty values not only represent the degree of intrusion by the observer upon the observed but also the degree of confusion and disorder perceived by that observer.

Entropy and the Second Law of Thermodynamics

Confusion and disorder are also related to the notion of Entropy and the Second Law of Thermodynamics[25]. Entropy is a concept that represents the potential for doing work, the capacity for taking action or the degree of confusion and disorder associated with any physical or information activity. High entropy implies a low potential for doing work, a low capacity for taking action or a high degree of confusion and disorder. Low entropy implies just the opposite. Viewed in this context, the Second Law of Thermodynamics states that all observed natural processes generate entropy[26]. From this law it follows that entropy must increase in any closed system -- or, for that matter, in any system that cannot communicate in an ordered fashion with other systems or environments external to itself[27]. Accordingly, whenever we attempt to do work or take action inside such a system -- a concept and its match-up with reality -- we should anticipate an increase in entropy hence an increase in confusion and disorder. Naturally, this means we cannot determine the character or nature (consistency) of such a system within itself, since the system is moving irreversibly toward a higher, yet unknown, state of confusion and disorder.

Destruction and Creation

What an interesting outcome![28] According to Gödel we cannot -- in general -- determine the consistency, hence the character or nature, of an abstract system within itself. According to Heisenberg and the Second Law of Thermodynamics any attempt to do so in the real world will expose uncertainty and generate disorder. Taken together, these three notions support the idea that any inward-oriented and continued effort to improve the match-up of concept with observed reality will only increase the degree of mismatch. Naturally, in this environment, uncertainty and disorder will increase as previously indicated by the Heisenberg Indeterminacy Principle and the Second Law of Thermodynamics, respectively. Put another way, we can expect unexplained and disturbing ambiguities, uncertainties, anomalies, or apparent inconsistencies to emerge more and more often. Furthermore, unless

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[23] Heisenberg (1962).
[24] Brown.
[25] For this introduction into thermodyamics Boyd consulted Georgescu-Roegen and source 20: David Layzer, 'The Arrow of Time', and article in *Scientific American* of December 1975.
[26] Layzer is referred to as the source.
[27] Ibid.
[28] As before, these are Boyd's own words.

some kind of relief is available, we can expect confusion to increase until disorder approaches chaos -- death.

Fortunately, there is a way out. Remember, as previously shown, we can forge a new concept by applying the destructive deduction and creative induction mental operations. Also, remember, in order to perform these dialectic mental operations we must first shatter the rigid conceptual pattern, or patterns, firmly established in our mind. (This should not be too difficult since the rising confusion and disorder is already helping us to undermine any patterns). Next, we must find some common qualities, attributes, or operations to link isolated facts, perceptions, ideas, impressions, interactions, observations, etc. together as possible concepts to represent the real world. Finally, we must repeat this unstructuring and restructuring until we develop a concept that begins to match-up with reality. By doing this -- in accordance with Gödel, Heisenberg and the Second Law of Thermodynamics -- we find that the uncertainty and disorder generated by an inward-oriented system talking to itself can be offset by going outside and creating a new system. Simply stated, uncertainty and related disorder can be diminished by the direct artifice of creating a higher and broader more general concept to represent reality.

However, once again, when we begin to turn inward and use the new concept -- within its own pattern of ideas and interactions -- to produce a finer grain match with observed reality we note that the new concept and its match-up with observed reality begins to self-destruct just as before. Accordingly, the dialectic cycle of destruction and creation begins to repeat itself once again. In other words, as suggested by Gödel's Proof of Incompleteness, we imply that the process of Structure, Unstructure, Restructure, Unstructure, Restructure is repeated endlessly in moving to higher and broader levels of elaboration. In this unfolding drama, the alternating cycle of entropy increase toward more and more disorder and the entropy decrease toward more and more order appears to be one part of a control mechanism that literally seems to drive and regulate this alternating cycle of destruction and creation toward higher and broader levels of elaboration.

Now, in relating this deductive/inductive activity to the basic goal discussed in the beginning, I believe we have uncovered a Dialectic Engine that permits the construction of decision models needed by individuals and societies for determining and monitoring actions in an effort to improve their capacity for independent action. Furthermore, since this engine is directed toward satisfying this basic aim or goal, it follows that the goal seeking effort itself appears to be the other side of a control mechanism that seems also to drive and regulate the alternating cycle of destruction and creation toward higher and broader levels of elaboration. In this context, when acting within a rigid or essentially a closed system, the goal seeking effort of individuals and societies to improve their capacity for independent action tends to produce disorder towards randomness and death. On the other hand, as already shown, the increasing disorder generated by the increasing mismatch of the system concept with observed reality opens or unstructures the system. As the unstructuring or, as we'll call it, the destructive deduction unfolds it shifts toward a creative induction to stop the trend toward disorder and chaos to satisfy a goal-oriented need for increased order. Paradoxically, then, an entropy increase permits both the destruction or unstructuring of a closed system and the creation of a new system to nullify the march toward randomness and death.

Taken together, the entropy notion associated with the Second Law of Thermodynamics and the basic goal of individuals and societies seem to work in dialectic harmony driving and regulating the destructive/creative, or deductive/inductive, action -- that we have described herein as a dialectic engine. The result is a changing and expanding universe of mental concepts matched to a changing and expanding universe of observed

reality[29]. As indicated earlier, these mental concepts are employed as decision models by individuals and societies for determining and monitoring actions needed to cope with their environment -- or to improve their capacity for independent action.

Patterns of Conflict

Introduction

Patterns of Conflict is a massive slide set of 193 pages. It represents the main body of Boyd's thoughts. It is the largest and still the core component of his magnus opus, and although not a ready-reference document, it nonetheless became the touchstone of the military reform movement and the means by which the philosophy of the movement was spread. It is wide-ranging and complex, it combines an immense amount of historical data, insightful interpretations, and provocative questions. It is a discourse on the events, people, issues, social forces, political motivations, and technologies of the past and how they affect the process of winning and losing[30].

In one sense it can be read as an exercise to apply his arguments developed in *Destruction and Creation*. Indeed, the way Boyd constructs *Patterns of Conflict* is informed by the inductive-deductive approach. Here as well as in subsequent presentations Boyd offers an initial suggestion, argument or insight, which he then sets out to illustrate, to substantiate, to refute or to affirm, albeit then in modified form, taking into account the additional findings this exercise has generated.

In fact, *A Discourse* can be regarded in this light. The essay forms the inductive part, after which *Patterns of Conflict* seeks to affirm/refute these findings through a survey of military history and existing strategic theories. Having found sufficient grounds for accepting the validity of his initial arguments, he then proceeds to take the theory further into related questions – *Organic Design for Command and Control* – and to extrapolate the conceptual implications and possible generalizations – *Strategic Game of ? and ?*. One the other hand, *Patterns* must be read as an argument in its own right, but one which is informed by and entirely consistent with the abstract argument from the essay. In *Patterns of Conflict* Boyd develops and substantiates his main arguments concerning warfighting – or rather operational art and strategy.

The first 12 pages contain the core of his theory, or actually what he calls 'an impression'. He then sets out on a survey of military history in a series of historical snapshots. It proceeds in a generally chronological fashion, a reverse of Boyd's course of studying military history, and focuses on the evolution of war fighting. Gradually during the briefing this idea is expanded to become the key for grand strategy, but by then the concept of fast transients has gained in dimensions and layers. From this broad survey he distills three distinct categories of conflict as well as a synthesis of the essence, the core elements that characterize these categories. It includes also a 6 pages long list of sources, revealing his deep study of military history and strategic theory and the burgeoning interest in various non-military subjects such as the developments in the 'new sciences' discussed before.

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[29] Here Boyd refers to sources 27: Jean Piaget, *Structuralism*; and 28: Michael Polanyi, *Knowing and Being*.

[30] Hammond (2001), p.122.

Patterns of Conflict is a prime reflection of Boyd deep study of military history and strategic theory. In the first half of the presentation Boyd takes his audience first through the exploits and ideas of Sun Tzu, Alexander, Hannibal, Belisarius, Genghis Kahn and Tamerlane. He also discusses the 18th century French theoreticians Saxe, Bourcet, Guibert and Du Teil. His study of Napoleon and his interpreters brings him to the disastrous developments in the 19th century. This investigation then leads him to WW I and German infiltration techniques, T.H. Lawrence's theory of guerrilla warfare, the revolutionary warfare theories of Marx, Lenin ands Mao, J.F.C. Fuller's work on maneuver warfare, the German Blitzkrieg doctrine, and modern guerrilla and finally to counter-guerilla and counter-blitz methods, indicating his view on strategy as a dialectic interactive process.

Boyd recognized a fundamental similarity among the processes that produced success at the tactical level and at the grand tactical level (what we would call the operational level) in guerrilla warfare, in the swarms of Genghis Kahn that raided Europe, and in the Blitzkrieg concept (and in the second part of his presentation he extrapolates this idea to the grand strategy level). Boyd sees parallels between the theories about, and practitioners of these concepts. Regarding these concepts as superior he uses them as contrasts to the developments in the 19th century and WWI, the 'attritionist' era.

In the second half of the presentation he moves from the descriptive into to prescriptive/suggestive sphere and attempts to abstract his thoughts in a more universal model. Altogether it is an interesting tour de force, a great survey of military history and strategic theory. On the other hand, it is also a biased approach to military history. Not unlike Liddell Hart, Boyd wants to convey a message, an argument, and not necessarily write a proper military historical overview according to established principles of investigation. This agenda becomes evident in the first pages of *Patterns* when he outlines the mission of the presentation.

Mission

The mission of Patterns of Conflict is fourfold:

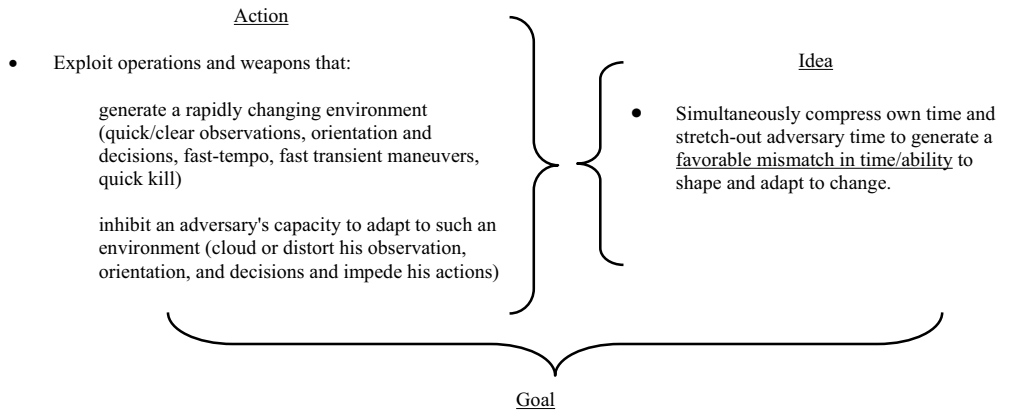
- to make manifest the nature of Moral-Mental-Physical Conflict;
- to discern a Pattern for successful operations
- to help generalize Tactics and Strategy
- and to find a basis for Grand strategy.

And the intent is nothing less than 'to unveil the character of conflict, survival and conquest'[31]. He starts with presenting his audience with a number of impressions. First, he introduces his point of departure which are the fast transients of fighters as discussed in *A New Conception of Air-to-Air Combat*. Next he introduces the OODA loop for the first time. The idea of fast transients, according to Boyd, suggests that

> In order to win we should operate at a faster tempo or rhythm or, better yet, operate inside adversary's Observation-Orientation-Decision-Action time cycle or loop[32].

[31] *Patterns of Conflict*, p.2, underlining as in original. Where used in the following chapters, underlining directly follows Boyd's text.
[32] Ibid, p.5.

He then incorporates a section of the slide 'a new conception' from this slightly older presentation. The goal is to have the adversary's system collapse into confusion and disorder by causing him to over- or under- react to activity that appears simultaneously menacing as well as ambiguous, chaotic or misleading. The mechanism for creating this situation, is by creating a rapidly changing environment, thereby either effecting a compression of his available decision time or creating many mismatches in his normal decision cycle thus inhibiting his capacity to adapt to such an environment. Below shows how Boyd made this point in graphic form[33].



Human nature, is the subsequent topic he introduces, which reveals his Darwinian (or Hobbesian) take on life. The goal of organisms, according to Boyd, is:

- To survive, survive on own terms, or improve our capacity for independent action. The competition for limited resources to satisfy these desires may force one to:
- Diminish adversary's capacity for independent action, or deny him the opportunity to survive on his own terms, or make it impossible for him to survive at all.

The implication for Boyd is that *life is conflict, survival, and conquest*[34]. And this naturally leads him to 'the Theory of Evolution by Natural Selection and The Conduct of War' (J.F.C.

[33] Ibid, p.7.

[34] Ibid, p.10. This is quite remarkeble as Boyd had also studied Dawkins and Axelrod who both noted that various other survival strategies exist. Cooperation as the optimal mode for long term survival often overrides the short term strategy of direct conflict. Moreover, Darwin actually stated that 'its not the strongest who survive, but those most responsive to change', a message Boyd would strongly agree with. Survival is the consequence of differences in fitness, resulting in greater reproduction, along with persistent variation in heritable traits that make for fitness differences. The most concise summary of Darwin's view on the dynamics of selection was provided by Lewontin in 1970. According to Lewontin, Darwin argued that organisms could affect their chances of survival and reproduction if (1) there is variation among traits; (2) some of this variation is heritable; and (3) some variants reproduce more than others. See Robert Brandon and Alex Rosenberg, 'Philosophy of Biology', in Peter Clark and Katherine Hawley, *Philosophy of Science Today* (Oxford University Press, Oxford, 2003), in particular pp.167-175.

Fuller's book), since 'both treat conflict, survival and conquest in a very fundamental way'[35]. Boyd then offers the notion, not more than that, that

- it may be advantageous to possess a variety of responses that can be applied rapidly to gain sustenance, avoid danger and diminish an adversary's capacity for independent action.
- Organisms must also cooperate and harmonize their activities in their endeavors to survive as an organic synthesis.
- Furthermore to shape and adapt to change, one cannot be passive, but instead one must take the initiative.
- Thus variety, rapidity, harmony and initiative seem to be the key qualities that permit one to shape and adapt to an ever-changing environment[36].

The entire presentation that follows is an elaboration of these ideas. He explains the working of the mechanism, the process and, using history as illustration and as a source for credibility, he applies it to several levels; the individual, the tactical, the operational (or grand tactical) on to the grand strategic level. So in a very few slides Boyd unfolds the basic contours of his entire strategic theory. And from here on he proceeds with a long section containing historical snapshots aimed at revealing patterns of winning and losing.

Historical Snapshots

From Sun Tzu to Napoleon. The fundamental influence of several key theorists, most notably of Sun Tzu becomes evident right away for it is indeed with Sun Tzu that Boyd begins his investigations after having presented us this basic outline of his theory. Starting with Sun Tzu was not incidental nor only inspired by the chronological ordering of his subject matter. In Sun Tzu Boyd discovered an idiom and themes that reflected his own thoughts. Comparing the classical commanders Alexander, Hannibal to Tamerlane (all of which he calls Eastern commanders) with the Western commanders, he states that the philosophy of the Eastern commanders seems more consistent with ideas of Sun Tzu in their attempts to shatter the adversary prior to battle. The approach advanced by Sun Tzu thus amounts to a distinct pattern in military history, and one which serves to contrast the pattern of attrition warfare. The following themes, taken from Sun Tzu's famous but often misinterpreted work *The Art of War*, characterize this pattern:

- Harmony
- swiftness of action
- dispersion/concentration
- shock

deception,
fluidity of action,
surprise

According to Boyd, Sun Tzu advocates a strategy with four key elements:

- probe the enemy's organization and dispositions to unmask his strengths, weaknesses, patterns of movement and intentions.
- "Shape" the enemy's perception of the world to manipulate his plans and actions.

[35] Ibid. p.11.
[36] Ibid, p.12.

- Attack enemy's plans as best policy. Next best disrupt his alliances. Next best attack his army. Attack cities only when there is no alternative
- Employ Cheng and Ch'I[37] maneuvers to quickly and unexpectedly hurl strengths against weaknesses.

And the desired outcome for Sun Tzu is, in Boyd's words, 'to subdue the enemy without fighting and avoid protracted war'.

Western commander by contrast, according to Boyd have been more concerned with winning the battle. In order to make the argument that the approach of Sun Tzu has often been superior to this Western approach, Boyd then explored several selected examples which not only bolster Boyd's argument but also illustrate in some detail what such an approach entails in terms of force structure, the employment of maneuver, movement, mass and shock. He described the battles of Marathon (490 B.C.) of the Greek against the Persians, the Battle of Leuctra (371 B.C.) which saw combat between the Thebans and the Spartans, the Battle of Arbela (331 B.C.) in which the Persian King Darius was defeated by Alexander, and the Battle of Canae (216 B.C.).

The forces available to commanders such as Hannibal consisted of light troops, heavy troops and cavalry. The successful commanders combined these in patterns of maneuver with the light troops to 'unmask the enemy's disposition and hide one's own real strength and confuse the enemy'. Heavy troops in turn and in synergetic fashion would 'charge and smash thinned-out/scattered or disordered/bunched-up enemy formations generated by the interaction with light troops'. Alternatively, they would 'menaced enemy formations to hold them in tight, or rigid, arrays thereby make them vulnerable to missiles of swirling light troops'. Thus, according to Boyd, 'light and heavy troops in appropriate combination pursue, envelop, and mop-up isolated remnants of enemy host'. The idea underlying this pattern for winning was to 'employ maneuver action by light troops with thrust action of heavy troops to confuse, break up, and smash enemy formations'[38]. An additional idea, also in line with Sun Tzu, was the deliberate employment of unequal distribution of forces, as the basis to achieve for local superiority at the decisive point, and for decisive leverage to collapse adversary resistance[39].

However, Boyd notes, these battle arrangements and maneuvers do not provide insight on how they play upon 'moral factors such as doubt, fear, anxiety'[40]. For this he turns to Genghis Khan's Mongol hordes and Napoleon's mass armies. Genghis Khan's established four "key asymmetries":

- superior mobility
- superior communications
- superior intelligence
- superior leadership.

Guarding and exploiting these asymmetries to the fullest enabled the widely separated strategic maneuvers, the baited retreats, the hard-hitting thrusts and swirling envelopment he is remembered for. These movements uncovered and exploited an adversary's vulnerabilities and weaknesses. Rapid unexpected threatening movements in conjunction with propaganda

[37] This refers to the use of 'the orthodox and the unorthodox' methods of employing troops, as discussed in chapter 3.
[38] Ibid, p.16.
[39] Ibid, pp.19, 24.
[40] Ibid, p.24.

and terror produced fear, anxiety and superstition. This in turn undermined an opponent's resolve and will to resist[41]. The outnumbered Mongols were capable of creating the impression of being everywhere and coming from nowhere. Mobility, swiftness and terror combined to produce collapse by draining the opponent's moral fiber[42]. Thus he makes the connection between physical movement and the moral factors:

- Subversive propaganda, clever stratagems, fast breaking maneuvers, and calculated terror not only created vulnerabilities and weaknesses, but also played upon moral factors that drain-away resolve, produce panic, and bring about collapse.

Indeed, he asserts, in doing so 'the Mongols operated inside adversary observation-orientation-decision-action loops'[43].

The loss of flexibility: Napoleon and his interpreters. In contrast, Boyd finds fundamental faults in the whole way of waging war in the 19th century. It is the beginning of the costly and wasteful attrition style of warfare that characterized World War I and the strategic mindset ever since in the West, with some exceptions that Boyd does not fail to highlight. Within the Napoleonic campaigns he discerns a shift in approach from the flexible to the rigid, from the unpredictable to the stereotype, from maneuver and focus on enemy weakness to set piece battles, which pit strength against strength.

And this is remarkable in light of the fact that the French theoreticians, such as de Saxe, Bourcet, Guibert and Du Teil, who were of great influence on Napoleon, stressed several of Boyd key themes. According to Boyd these authors emphasized flexible planning 'with several branches, mobility and fluidity of forces, cohesion, dispersion and concentration'. Furthermore, they stressed operating 'on a line that threatens alternative objectives'. At the tactical level these theorists prescribed 'to concentrate direct artillery fire on key points to be forced'[44].

Boyd explains that in the early campaigns Napoleon used the ideas of the theorists about variety (as in "unexpected ways"), ambiguity, deception and rapidity in movement, to surprise and defeat fractions of superior forces. In addition, Boyd also recognized that these ideas are also at home with guerilla warfare for American colonists, Spanish and Russian guerilla's 'exploited variety and rapidity associated with environment background (terrain, weather, darkness, etc.) and mobility/fluidity of small bands with harmony of common cause against tyranny/injustice as basis to harass, confuse, and contribute toward the defeat of the British and the French under Napoleon'[45]. Here too he addresses the nexus of movement, ambiguity, rapidity, variety, mobility, fluidity on the one hand with their impact on the moral factor on the other.

Boyd shows how Napoleon was handed an inspired army with citizen-soldiers and new leaders generated by the revolution[46]. This army was organized along self- contained, but mutually supporting units (divisions) and could travel fast by living off the countryside without extensive baggage or supply trains. It could disperse and concentrate faster than opponents. The general features of Napoleon's way of employing these were:

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[41] Ibid, p.25.
[42] Ibid, p.27-28.
[43] Ibid, p.28.
[44] Ibid, p.31.
[45] Ibid.pp.30-31.
[46] Ibid, pp.33-34 for the following section.

- planning process which included variations and contingency plans;
- extensive information gathering operations which reduced uncertainty and simplified the planning process;
- the use of flexible and confusing configurations of units,
- that combined with screening operations masked his real intentions and movements thus ensuring security;
- the use of strategic dispersion and tactical contraction to create strategic confusion;
- which led to tactical dislocation of units,
- which by rapid concentration of one's own troops could be overwhelmed;
- and finally by a rapid succession and evershifting kaleidoscope of (strategic) moves and diversions which upset the enemy's actions, unsettle his plans and unbalance him psychologically which combined ensure a constant level of initiative.

Napoleon furthermore used unified lines of operations as the basis for mutual support between units. He threatened enemy communications to isolate the opponent. He forced the opponent to fight under unfavorable conditions through operations that held or diverted the enemy (feints, pinning maneuvers) and by attacks against exposed flanks or through weak fronts. All the while he maintained freedom of maneuver by setting up centers of operations and alternative lines of communications and keep (at least some) open. As for command and control, Napoleon initially used a centralized concept with a low degree of tactical variety, which created strategic success to produce tactical success. So higher level confusion within the enemy camp must make up for lower level uniformity of Napoleon's units and their operations.

In later campaigns Napoleon exchanged variety, rapidity and surprise for rigid uniformity and massed artillery fire, dense infantry columns and heavy artillery against regions of strong resistance. He deemphasized loose, irregular methods at the tactical level. And in the end he thus failed[47]. In his analysis of Napoleon Boyd sees in the early victories a substantiation of Boyd's own views and in the latter of Napoleon's less victorious campaign he finds fault with the loss of variety and flexibility. In light of the fact that both Clausewitz and Jomini, the premier analists of Napoleon's art of war, in particular focus on the later campaigns, it should not be surprising to see Boyd turn his critique on these very influential theorists too.

Boyd lists some key elements of the Clausewitzian view on strategy. According to Boyd, Clausewitz proposed a strategy along the following lines:

- Exhaust the enemy by influencing him to increase his expenditure of effort.
- Seek out centers of gravity upon which all power/movement depend and, if possible, trace them back to a single one.
- Compress all effort, against those centers, into the fewest possible actions.
- Subordinate all minor or secondary actions as much as possible.
- Move at the utmost speed.
- Seek a major battle (with superiority of number and conditions) that will promise a decisive victory.

[47] Ibid, p.31. Here he obviously followed the contentious views of Liddell Hart, Lawrence and Fuller. As Azar Gat makes clear, Liddell Hart too made the mistake of missing the points that (1) the allied forces learned during the protracted wars against Napoleon and (2) that the blatant aggression led to their adoption of several tactical and stragical methods of Napoleon including mass mobilization. So Napoleon's failure cannot be attributed to his tactical concepts. See Gat(1998) p.165.

The aim for Clausewitz, Boyd thought, was to 'render the enemy powerless', which strongly implies 'the destruction of the opponent's armed forces'. And whereas Boyd, with Sun Tzu, regarded friction, uncertainty as fundamental and unavoidable but also a potential crucial tool, Clausewitz considered uncertainty, fear, anxiety and other moral factors as an impediment[48]. These ideas were in obvious contradiction with Boyd's views and he captures his critique on one slide. Boyd asserts that[49]:

- Clausewitz over-emphasized decisive battle and under-emphasized strategic maneuver.
- Clausewitz emphasized method and routine at the tactical level.
- Clausewitz was concerned with trying to overcome or reduce friction/uncertainty and failed to address the idea of magnifying adversary's friction/uncertainty.
- Clausewitz was concerned with trying to exhaust adversary by influencing him to increase his expenditure of effort. He failed to address, or develop, the idea of trying to paralyze adversary by denying him the opportunity to expend effort.
- Clausewitz incorrectly stated: "a center of gravity is always found where the mass is concentrated most densely" - then argued that this is the place where the blows must be aimed and where the decision should be reached. He failed to develop idea of generating many non-cooperative centers of gravity by striking at those vulnerable, yet critical, tendons, connections, and activities that permit a larger system's center of gravity to exist.

Boyd blames Clausewitz for not seeing 'that many non-cooperative, or conflicting, centers of gravity paralyze the adversary by denying him the opportunity to operate in a directed fashion, hence they impede vigorous activity and magnify friction'. And the likely result of the Clausewitzian approach, with its lack of variety, so Boyd argued, would be operations that 'end in a bloodbath via the well regulated, stereotyped tactics and unimaginative battles of attrition suggested by Clausewitz'[50].

Boyd turns his attention next to Baron Henri de Jomini in whose work he discerns some interesting ideas. Jomini stresses free and rapid movements, which carry the bulk of the forces successively against fractions of the enemy. He advises to strike in the most decisive direction - that is to say against the center of one wing or the center and one wing simultaneously. If possible, one should seize the adversary's communications and force him to fight on a reverse front, by using bulk of the forces to hit the flank and attack him in the rear. Detachments can be employed, if necessary, to block the arrival of reinforcements as well as for drawing the opponent's attention elsewhere. If the enemy's forces are too much extended, one should pierce his center to divide and crush his fractions separately.

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[48] Ibid, p.40. Again the influence of Liddell Hart, Lawrence and Fuller is evident. Interestingly, at the time Boyd developed *Patterns of Conflict* other authors advocated a revival of Clausewitz, not because of the strategic advice, but because of the insight he offers in the nature of war. See for instance Bernard Brodie's *War and Politics*. These authors point out the relevance of Clausewitz's advice concerning the strong relationship between politics and war. Moreover, in a time in which nucelar weapons and body counts were emblematic of the managerial, technocratic and deterministic attitude among political and military elites, in Clausewitz they discerned an awareness of the moral and psychological factors affecting battles and wars. For a recent assessment of Clausewitz see Colin Gray, *Modern Strategy*, Chapter. 3. Interestingly Boyd borrows heavily from Clausewitz by using the concepts of center of gravity and friction. Clausewitz actually allows for several centers of gravity, some of which are not military in nature such as alliances and cities, making him quite compatible with Sun Tzu.

[49] Ibid, p.41.

[50] Ibid, p.42.

Boyd does not find fault with these recommendations. However, he does disagree with Jomini's 'preoccupation with the form of operations, spatial arrangement of bases, formal orders of battles and tactical formations while showing a lack of appreciation for the use of loose, irregular swarms of guerrilla's and skirmishers for masking one's own operations and for confusing and disrupting the enemy's operations'. For Jomini also asserts that one should divide the theater of war and its subordinate components (zones, fronts, positions, etc) into three subdivisions - a center and two wings - to facilitate envelopment of the opponent. In addition one should approach the opponent with one's forces aligned in an oblique order. Such an approach, like the one proposed by Clausewitz could not but lead to stereotyped predictable operations[51].

Summarizing his critique on Napoleon, Clausewitz and Jomini, Boyd returns to the theme of adaptability. None of the three 'appreciated the importance of loose, irregular tactical arrangements and activities to mask or distort own presence and intentions as well as confuse and disorder adversary operations'. The main flaw according to Boyd was the fact that they 'viewed the conduct of war and related operations in essentially one direction - from the top down - emphasizing adaptability at the top and regularity at the bottom'[52]. And this set the scene for the slaughters of the 19th century and World War I.

The curse of the industrial revolution. Boyd lists six key military "ingredients" of the 19th Century only served to reinforce tendencies of the Napoleonic era:

Railroad	quick fire artillery
Machine gun	repeating rifle
Barbed wire	trenches

Boyd observes an 'emphasis toward massed firepower and large armies supported by rail logistics; an increased emphasis on holding defense and flanking or wide turning maneuvers into the adversary's rear to gain a decision; and a trend of continued use of frontal assaults by large stereotyped infantry formations (e.g. regiments, battalions) supported by artillery barrages, against regions of strong resistance'. Not only were tactics now stereotyped. Strategy too had lost the elements of flexibility and surprise, and Boyd puts emphasis on this element of stereotyped operations at both levels in several slides. As Boyd noted:

> huge armies, and massed firepower and other vast needs supported through a narrow fixed logistics network, together with tactical assaults by large stereotyped formations, suppressed ambiguity, deception, and mobility hence surprise of any operation[53].
>
> The legacy of Napoleon, Clausewitz, and Jomini's tactical regularity and the continued use of large stereotyped formations for tactical assaults, together with the mobilization of large armies and massing of enormous supplies through a narrow logistics network, "telegraphed" any punch hence minimized the possibility of exploiting ambiguity, deception, and mobility to generate surprise for a decisive edge[54].

In this sense, technology was being used as a "crude club" that generated frightful and debilitating casualties on all sides. Evolution of tactics did not keep pace with increased weapons lethality developed and produced by 19th Century technology. The failure to evolve

[51] Ibid, pp.44-45.
[52] Ibid, p.46.
[53] Ibid, p.48.
[54] Ibid, p.49.

mentally and tactically in parallel with the technological (r)evolution, resulted in the massacres of the American Civil War (1861-1865), the Austro-Prussian War (1866), the Franco-Prussian War (1870-71), the Boer War (1899-1902), the Russo-Japanese War (1904-1905) and of WWI[55].

For Boyd World War I is the highlight of the attritional style of warfare. Here he sees offensives conducted on wide frontages, emphasizing few (rather than many) harmonious yet independent thrust. The advance was maintained in an even way to protect flanks and to provide artillery support as the advance made headway. Reserves were thrown in whenever an attack was held-up, against regions or points of strong resistance. The defense was organized in response of this type of operation. It was organized into depth of successive belts of fortified terrain. Attackers would be stopped and pinned down by massed artillery and machine-gun fire. Any ground that would still be lost would be won back through counter attacks. The predictable result was 'stagnation and enormous attrition since advances were generally made along expected paths of hardened resistance which in turn were dictated by both the dependence upon railroads and as well as the choice of tactics of trying to reduce strong points by massed firepower and infantry'[56].

Boyd thus gave his audience something to think about. First he introduced Sun Tzu (who was relatively unfamiliar in the sixties and seventies for most audiences) and some other practitioners of strategy. These strategists all succeeded not by concentrating large numbers of forces in an attritional battle, but by movement, speed, surprise, variety and creating and subsequently attacking weaknesses instead of enemy strengths. Having described an ideal type he proceeded criticizing the very masters of modern strategic thought and practice that have been taught about, and have been hailed, in most war colleges in the West. In effect what he has done implicitly is delivering a fundamental critique of the traditional Western style of warfare[57].

After developing this argument, Boyd continued *Patterns of Conflict* with developing the argument that during Western Wars in the 20th century there have been ideas and concepts that resembled the Eastern style of warfare, and which, an important point, had produced astounding success. And, interestingly for he wrote this during the Cold War, he notes that the founding fathers of Communism such as Marx, Lenin and Stalin actually have some important lessons to teach for they too think along the lines of Sun Tzu.

Rediscovering flexibility. According to Boyd the solution to the enduring stalemate in the trench-warfare during WW I came in the form of infiltration- and guerrilla-tactics. And in

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[55] Ibid. Like Fuller in *The Conduct of War*, after this slide Boyd makes a brief excursion to Marxist revolutionary thought, noticing however that at this point in his presentation it is not clear how revolutionary strategy and guerilla tactics fit in his argument and he tells his audience that this will become evident after his discusision of WW I.

[56] Ibid, p.55.

[57] Boyd basically followed familiar analysis. Still it seems Boyd was willing to oversimplify here, again, probably due to his acceptance of Liddell Hart's views but also to get his message across. However, as Azar Gat has recently convincingly argued, and which Michael Howard did before him, there certainly were genuine efforts, to counter the increased lethality of the battlefield. In focussed studies of recent military history, in evaluations of Clausewitz, through theory formulation and through field practice in particular the influential French lecturers of the Ecole de Guerre made serious efforts in this erea. However, due to several problems these efforts did not result in real doctrinal changes in the French army. See Azar Gat, *Military Thought: The Nineteenth Century*, (1992), in particular chapter 3, and Michael Howard, 'The Influence of Clausewitz', in Clausewitz, *On War*, (1976). For the German efforts in this vein, and a similar corrective message, see Antulio J. Echevarria II, *After Clausewitz, German Military Thinkers Before the Great War* (University Press of Kansas, 2000).

both methods the same processes seem to be at work for Boyd. Infiltration tactics as practiced by the Germans under Ludendorff consisted of brief but intense artillery bombardment, that included gas and smoke shell, to disrupt and suppress defenses, to obscure the assault. Small light teams of troops without any linear formation followed the barrage and spread out along the front in depth and in width. They did not attempt to maintain a uniform rate of advance or align formations. Instead, as many tiny, irregular swarms spaced in breadth and echeloned in depth, they seep or flow into any gaps or weaknesses they can find in order to drive deep into the adversary's rear. These small shock troops would be followed by small battle groups consisting of infantry, machine-gunners, mortar teams, artillery observers and field engineers. These groups were better equipped to deal with remaining exposed enemy flanks and to mop-up isolated centers of resistance. Subsequently. Reserves and stronger follow-on echelons move through newly created breaches to maintain momentum and exploit success, as well as attack flanks and rear positions to widen the penetration and consolidate gains against the expected counter-attack[58]. The idea behind this was to:

> Hurl strength (echeloned in great depth) via an irruption of many thrusts, thru weaknesses along (many) paths of least resistance to gain the opportunity for breakthrough and development.

However, such a focus on maneuver did not sufficiently address how and why infiltration fire and movement schemes work. Again Boyd addresses the way physical movement, artillery fire, gas and smoke and size and mode of operation of the attack units affected enemy perception and psyche. The key points to note about infiltration tactics relate to this relation between one's own actions and the enemy's mental processes[59]:

- Fire at all levels by artillery, mortars, and machine-guns is exploited to hold adversary attention and pin him down hence -
- Fire together with gas and smoke (as well as fog and mist) represent an immediate and ominous threat to capture adversary attention, force heads down and dramatically obscure view, thereby cloak infiltration movements.
- Dispersed and irregular character of moving swarms (as opposed to well defined line abreast formations) permit infiltrators to blend against irregular and changing terrain features as they push forward.
- Taken together, the captured attention, the obscured view, and the indistinct character of moving dispersed/irregular swarms deny adversary the opportunity to picture what is taking place

The result of this dynamic is that

- Infiltration teams appear to suddenly loom-up out of nowhere to blow thru, around, and behind disoriented defenders.

In more abstract terms, Boyd defines the essence of infiltration tactics as[60]:

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[58] Ibid, p.57.
[59] Ibid, p.59.
[60] Ibid, p.60.

- Cloud/distort signature and improve mobility to avoid fire yet focus effort to penetrate, shatter, envelop, and mop-up disconnected or isolated debris of adversary system.

The intent if this is to:

- Exploit tactical dispersion in a focused way to gain tactical success and expand it into a grand tactical success.

This in turn implies, in yet more abstract terms that:

- Small units exploiting tactical dispersion in a focused way - rather than large formations abiding by the "Principle of Concentration" - penetrate adversary to generate many non-cooperative (or isolated) centers of gravity as basis to magnify friction, paralyze effort, and bring about adversary collapse.

In infiltration tactics Boyd saw the solution to the problem of the massive increase in weapons lethality developed in the 19th and early 20th century. Up to the latter part of WW I, commanders had not been able to develop such a tactic due to various organizational and cultural obstacles. According to Boyd 'the aristocratic tradition, the top-down command and control system, the slavish addiction to the "Principle of concentration" and the drill regulation mind-set, all taken together, reveal an "obsession for control" by high-level superiors over low-level subordinates to evolve the indistinct-irregular-mobile tactics that could counter the increase in weapons lethality'[61].

These ingrained features also prevented Ludendorff from capitalizing on the tactical successes of his platoon, company and battalion level infiltration units. Ludendorff violated his own novel concept by his tendency to use strategic reserves to reinforce against hardened resistance. Thus, at the strategic level, he seduced himself into supporting failure and not success. Moreover, the logistics set up was not flexible enough to support rapid/fluid penetration and deeper exploitation of breakthroughs. Communication technology was still too immobile to allow command to quickly identify and reinforce successful advances. This caused infiltration units to end operating beyond the reach of their own artillery support exposing them to enemy artillery fire and flank attacks[62]. Boyd thus highlights the nexus between strategy and tactics on the one hand, and organization and culture on the other.

Boyd nevertheless advances the idea that conceptually 'infiltration tactics of fire and movement can be viewed as Napoleon's multi-thrust strategic penetration maneuvers being transformed into multi-thrust tactical penetrations maneuvers to the lowest operational/organizational level - the squad'[63]. And infiltration tactics a la Ludendorff also seemed to be similar in nature to irregular or guerilla tactics a la T.E. Lawrence, for both stress 'clouded/distorted signatures, mobility and cohesion of small units as basis to insert an amorphous yet focused effort into or thru adversary weaknesses'[64].

T.E. Lawrence had developed an understanding that combat operations in the Middle-East did not follow the teachings of Clausewitz or Jomini. Indeed, he needed a new conceptualization of war and strategy both to make sense of actual practice in the tribal Arab world he operated in and to formulate a rational, coherent and purposeful approach for

[61] Ibid, p.62.
[62] Ibid, p.63.
[63] Ibid, p.62.
[64] Ibid, p.65.

strategic planning in light of the limited objectives, the scarce resources and the demands of the vast geographical expanses of his environment. According to Boyd, Lawrence developed several key principles of guerilla warfare that conceptually mirror some of the dynamics of infiltration tactics and stand in stark contrast to the attritional style of warfare as taught and practiced during the 19th and early 20th century[65]:

Action

- Gain support of population. Must "arrange the minds" of friend, foe and neutral alike. Must "get inside their minds".
- Must "be an idea or thing invulnerable, without front or back, drifting about like a gas" (inconspicuousness and fluidity-of-action). Must be an "attack-in-depth".
- Tactics "should be tip-and-run, not pushes but strokes", with the "use of the smallest force in the quickest time at the farthest place".
- Should be war of detachment (avoiding contact and presenting a threat everywhere) using mobility/fluidity-of-action and environmental background (vast unknown desert) as basis for "never affording a target" and never on the defensive except by accident and in error .

Idea

- Disintegrate existing regime's ability to govern.

Advances in the Interbellum: Lenin, Guderian and Mao. The theme's of infiltration tactics and Lawrence's guerrilla warfare doctrine resurface in three major conceptual developments of the interbellum: Soviet Revolutionary Strategy, Lightning War (or Blitzkrieg) and Maoist Guerilla War. In introducing these three developments, he offers what for him are one or two key features of each concept[66]. Soviet Revolutionary Strategy, as developed by Lenin and after him Stalin, exploited the idea of crises and vanguard - that arise out of Marxian contradictions within capitalism - to lay-out Soviet Revolutionary Strategy. This resulted in a scheme that emphasizes moral/psychological factors as a basis to destroy a regime from within. Lighting War (Blitzkrieg) arose from the mating of Infiltration tactics of 1918 with technological advances in the tank, motorized artillery, tactical aircraft, motor transport and communications. Key figures in this development were practitioners such as the British general J.F.C. Fuller and the German tank commander Heinz Guderian. This resulted in the Blitzkrieg concept, which aims to generate a breakthrough by piercing a region with multiple narrow thrusts using armor, motorized infantry, and follow-up infantry divisions supported by tactical aircraft. Mao Tse-Tung, finally, synthesized Sun Tzu's ideas, classic guerilla strategy and tactics, and Napoleonic style mobile operations under an umbrella of Soviet Revolutionary Ideas to create a powerful way for waging modern

[65] Ibid, p.64.

[66] It is interesting to point out that here Boyd pays attention to these major development which occurred in countries which were or had been adversaries of the US. Moreover, in selecting these concepts he ignores developments some consider also of prime importance such as the development of (strategic) air power theory (with well known names such as Guilio Douhet and Billy Mitchell) or the introduction of carriers which transformed the face of sea power.

(guerrilla) war. This resulted in modern guerrilla warfare, which has become a comprehensive political, economic, social and military framework for "total" war[67]. In all Boyd recognized similar elements such as a focus on disrupting enemy cohesiveness, use of small shock elements, the exploitation of surprise, the importance of timing and tempo and a focus on enemy weaknesses. And in all again he sees the direct logical connection between actions and the psychological dimension of war.

Boyd next provides a brief introduction on the first, a 20 pages exposé on Blitzkrieg, and Boyd only briefly addresses Mao's version of guerrilla warfare, leaving a more detailed discussion for later when he describes modern guerrilla warfare developments. Before embarking on a 20 page long expose on Blitzkrieg, Soviet Revolutionary Strategy is dealt with in only three pages. Boyd defined the communist task Lenin and Stalin had set as the destruction of capitalism as well as its offspring imperialism and replace it with dictatorship of the proletariat. Then he lists the unique features marking their brand of strategic teaching, citing Lenin frequently[68]. This starts with a phase in which the public mood is the target and the aim is to create, magnify and exploit seams in the societal fabric:

- Employ agitation and propaganda in order to exploit opposing tendencies, internal tensions, etc. Object is to bring about a crisis, to make revolution ripe as well as convince masses that there is a way out. This is accomplished when the vanguard is able to:

  - Fan discontent/misery of working class and masses and focus it as hatred toward existing system.
  - Cause vacillation/indecision among authorities so that they cannot come to grips with existing instability.
  - "Confuse other elements in society so that they don't know exactly what is happening or where the movement is going".
  - Convince "proletariat class they have a function - the function of promoting revolution in order to secure the promised ideal society".

- Select "the moment for the decisive blow, the moment for starting the insurrection, so timed as to coincide with the moment when the crisis has reached its climax, when the vanguard is prepared to fight to the end, the reserves are prepared to support the vanguard, and maximum consternation reigns in the ranks of the enemy".

Boyd refers to quotes from Lenin for describing when this moment - a "tipping point" in modern parlance - has been reached:

- "All the class forces hostile to us have become sufficiently entangled, are sufficiently at loggerheads, have sufficiently weakened themselves in a struggle which is beyond their strength";
- "All the vacillating, wavering, unstable, intermediate elements - the petty bourgeoisie, the petty-bourgeois democrats as distinct from the bourgeois - have sufficiently exposed themselves in the eyes of the people, have sufficiently disgraced themselves through their practical bankruptcy";
- "Among the proletariat a mass sentiment in favor of supporting the most determined, supremely bold, revolutionary action against the bourgeoisie has arisen and has begun to grow vigorously. Then revolution is indeed ripe. Then, indeed, if we have correctly

[67] Ibid, p.66.
[68] Ibid, pp.67-68.

gauged all the conditions indicated above…and if we have chosen the moment rightly, our victory is assured".

When the revolution has already become ripe, perseverance is in order. And again Boyd quotes Lenin at length: "Never play with insurrection, but, when beginning it, firmly realize that you must go to the end". The decisive condition of success then is 'concentration of the main forces of the revolution at the enemy's most vulnerable spot at the decisive moment, when the offensive is going full-steam ahead, when insurrection is knocking at the door, and when bringing the reserves up to the vanguard'. Considering the limited resources you must try to 'take the enemy by surprise and seize the moment when his forces are scattered'. Such concentration and maintenance of the offensive is crucial, for the enemy 'has the advantage of better preparation and organization. The defensive is the death of an armed rising'. 'You must strive for daily successes even if small and at all costs retain the moral ascendancy'.

The Blitzkrieg Concept

Discovering similarities. Boyd next makes the conceptual connection between guerrilla strategy and Blitzkrieg, which at first sight is not an obvious one. For Boyd however the link is obvious and lies in the mutual conceptual foundation in the ideas of Sun Tzu. According to Boyd, both Blitzers and guerrillas 'infiltrate a nation or regime at all levels to soften and shatter the moral fiber of the political, economic and social structure. Simultaneously, via diplomatic, psychological, and various sub-rosa or other activities, they strip-away potential allies thereby isolate intended victim(s) for forthcoming blows'. To carry out this program, a la Sun Tzu, Blitz and Guerrillas:

- Probe and test adversary, and any allies that may rally to his side, in order to unmask strength, weaknesses, maneuvers, and intentions.
- Exploit critical differences of opinion, internal contradictions, frictions, obsessions, etc., in order to foment mistrust, sow discord and shape both adversary's and allies' perception of the world thereby:
  - Create atmosphere of 'mental confusion, contradiction of feeling, indecisiveness, panic,"…
  - Manipulate or undermine adversary's plans and actions.
  - Make it difficult, if not impossible, for allies to aid adversary during his time of trial.

The purpose of this is either to 'force capitulation when combined with external political, economic, and military pressures, or to weaken the adversary to minimize his resistance against military blows that will follow'[69].

Then Boyd enters a long discussion on Blitzkrieg. For Boyd the Blitzkrieg concept was a rich source of ideas[70]. Boyd distilled the elements that produce shock and confusion

[69] Ibid, p.69.

[70] Boyd focusses here on the internal workings of Blitzkrieg in particular to discover, and argue for, the patterns of success of this method. In later presentations he develops the more encompassing notion that organizational learning and evolution are important tools for continued success. Other authors have discussed Blitzkrieg as an example of organizational innovation and evolution, comparing the German case with the British and French solution to the same question facing planers and theorists during the Interbellum; what to do with tanks and aircraft. See for instance: Williamson Murray and Allan R. Millett, *Military Innovation in the Interwar Period* (Cambridge, 1996), in particular Chapters 1 and 4.

within the opponent and those that ensure that cohesion in one's own actions is maintained. The central idea behind actions designed according to guidelines of the Blitzkrieg concept is to:

- conquer an entire region or defeat an armed force in the quickest possible time by gaining initial surprise and exploiting the fast tempo and fluidity of action of armored teams combined with air support, as basis to repeatedly penetrate, splinter, envelop and roll-up/wipe-out disconnected remnants of an adversary's organism in order to confuse, disorder and finally shatter his will or capacity to resist[71].

The mechanism that makes Blitzkrieg an effective method consists of four interdependent elements, and although Boyd does not list them as such, the elements of Observation-Orientation-Decision-Action can easily be discerned in his short description. Boyd also succeeds in pointing at the linkage with infiltration tactics[72].

First is the novel idea (in the thirties) of employing numerous air and ground reconnaissance actions, which together with other intelligence actions probe and test the adversary before and during combat operations both to uncover and to shape changing patterns of strengths, weaknesses, moves, and intentions. The observed patterns of movement and actions, changes, etc., of the opponent are weighed against one's own situation to expose attractive, or appropriate, alternatives that exploit the adversary's vulnerabilities and weaknesses and thus help shape mission commitment and influence command intent.

The second element of the mechanism of Blitzkrieg consists of deriving a mission from the correct assessment of the patterns in enemy behavior and, based on the mission and the observed patterns in enemy behavior, of selecting and nominating a "Schwerpunkt" (center of gravity). This Schwerpunkt serves as the focus of the main effort. The Schwerpunkt can be shifted during actual operations to bypass the enemy's strength and strike at weaknesses. Related or supporting efforts are also established. As discussed above, Boyd labeled these "Nebenpunkte". These are threats, movements, combat actions, feints, etc. that tie-up, focus or drain the attention of the enemy and his strength.

Having formulated a plan, the third element of the Blitzkrieg mechanism comes into play. From Observation, Orientation and Decision, Boyd moves to action. Small teams are inserted into the enemy rear area from the air or through rapid ground infiltration. Aided by agents already present, these teams seize critical objects such as bridges, they destroy railroad crossings and communications, incapacitate or blow up power stations and generally generating confusion in the rear by their mere presence and by disseminating false messages and fake orders. Meanwhile, air power and artillery are used to impede (or channel) enemy movement, to disrupt communications, to suppress forward defensive fires, to mask one's own advance and to divert attention. Shock troops and leading armored columns advance rapidly from least expected regions and infiltrate the enemy's front to find the path of least resistance. Breaches are opened by fire and movement of air-, armored- and infantry-units. This will enforce a breakthrough, through which relatively independent mobile/armored units rush forward at high speed to penetrate the enemy's interior, in close coordination with air support, air reconnaissance and/or air transport. The object is to cut lines of communication, disrupt enemy movement, paralyze enemy command and control and envelop the enemy. Finally, follow-on infantry- and armored-units pour in to overwhelm isolated pockets of resistance, widen the breaches and secure the conquered territory.

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[71] Ibid, p.70.

[72] Ibid. This entire description follows quite closely Boyd's own wording.

Blitzkrieg disrupts the connections between and within units thereby removing cohesion. The enemy system that relied on the combination of centers of gravity (constituting strengths, capabilities, objects or geographical features) and linkages between those centers of gravity, is severely hurt by the disruption or destruction of these linkages. Or in Boyd's words,

> Blitzkrieg generates multiple non-cooperative centers of gravity, as well as undermines or seizes those that adversary depends upon, in order to impede vigorous activity and magnify friction, thereby paralyze adversary by denying him the opportunity to operate in a directed way[73].

Operating philosophy. The obvious question is of course 'how do Blitzers simultaneously sustain rapid pace and abruptly adapt to changing circumstances without losing cohesion or coherence of their overall effort?' To avoid collapse itself, Blitzkrieg employs, as the last element of the mechanism, a concept for command and control in which each unit at the different levels of organization, from simple to complex, has its own specific OODA time cycle. The cycle-time increases commensurate with in increase in the level of organization, as one tries to control more levels and issues. As the number of events increase, the longer it takes to Observe, Orient, Decide and Act. Thus

- the faster rhythm of the lower units levels must work within the larger and slower rhythm of the higher levels so that overall system does not lose its cohesion or coherency[74].

Boyd considered this issue essential, and actually refers to this as the first element of the 'Blitz Operating Philosophy'. He elaborates on it here, as well as in the subsequent presentation 'Organic Design for Command and Control'. According to Boyd, the tension between the maintenance of control and cohesion on the one hand, and the demands of fluid tactical situations is resolved by giving the

- lower level commanders wide freedom "within the overall Mind-Time-Space scheme", to shape/direct their own activities so that they can exploit faster tempo/rhythm at the tactical levels yet be in harmony with the larger pattern/slower rhythm associated with the more general aim and larger effort at the strategic level.

To ensure subordinate commanders stay within the boundaries of acceptable initiative the 'Mission concept, to fix responsibility and shape commitment at all levels and through all parts of the organism'. Likewise, Boyd advocates the use of a 'Schwerpunkt concept through all levels to link differing rhythms/patterns so that each part or level of the organic whole can operate at its own natural rhythm - without pulling the organism apart - instead of the slower pace associated with a rigid centralized control'[75].

Quoting the WW II Blitzkrieg practitioner General Gunther Blumentritt, such a philosophy, or scheme, 'presupposes a common outlook based upon a body of professional officers who have received exactly the same training during the long years of peace and with the same tactical education, the same way of thinking, identical speech, hence a body of officers to whom all tactical conceptions were fully clear'. This in turn presupposes 'an

[73] Ibid, p.71.
[74] Ibid, p.72.
[75] Ibid. Note the use of the term organism.

officer training institution which allows the subordinate a very great measure of freedom of action and freedom in the manner of executing orders and which primarily calls for independent daring, initiative and sense of responsibility'[76].

From this Boyd's insistence of the primary role of a *common outlook* or orientation pattern stems and the element of previous experience in the OODA loop graphic. Indeed he makes it a point that 'without a common outlook superiors cannot give subordinates freedom-of-action and maintain coherency of ongoing action'[77]. In this one page Boyd thus highlights the crucial relations between action and effectiveness during combat, command and control philosophy, organizational culture and peace time training and education and shows how the one is predicated upon the other. However, at this point, neither the Schwerpunkt concept nor the Mission concept have been sufficiently explained and Boyd therefore takes his audience deeper into the Blitzkrieg philosophy.

Mission, Schwerpunkt, and getting inside the OODA loop. The mission concept can be thought of as a contract, he argues, 'hence an agreement, between the superior and subordinate. The subordinate agrees to make his actions serve his superior's intent in terms of <u>what</u> is about what to accomplish, while the superior agrees to give his subordinate wide freedom to exercise his imagination and initiative in terms of <u>how</u> the intent is to be realized. As part of this concept, the subordinate is given the right to challenge or question the feasibility of his mission if he feels his superior's ideas on what can be achieved are not in accord with the existing situation or if he feels his superior has not given him adequate resources to carry it out'[78].

While this explains one element required for maintaining cohesion at higher levels as well as adaptability at the lower level, it actually only gives form and expression to what is expected between an individual superior and subordinate. It does not suggest ways to coordinate or harmonize activities among many superiors and subordinates as a collective group. Here the Schwerpunkt concept comes in view. As Boyd explains it[79]: the

- Schwerpunkt acts as a center, or axis or harmonizing agent that is used to help shape commitment and convey or carry-out intent, at all levels from theater to platoon, hence an image around which:

  - maneuver of all arms and supporting elements are focused to exploit opportunities and maintain tempo of operations,

    and

  - initiative of many subordinates is harmonized with superior intent.

In this sense Schwerpunkt can be thought of as:

- a focusing agent that naturally produces an unequal distribution of effort as a basis to generate superiority in some sector by thinning out others,

  as well as

[76] Ibid, p.74.
[77] Ibid.
[78] Ibid, p.76.
[79] Ibid, p.78.

- a medium to realize superior intent without impeding initiative of many subordinates, hence a medium through which subordinate initiative is implicitly connected to superior intent.

Schwerpunkt thus represents 'a unifying concept that provides a way to rapidly shape focus and direction of effort as well as harmonize support activities with combat operations, thereby permit a true decentralization of tactical command within centralized strategic guidance - without losing cohesion of overall effort. Or put in another way, it represents a unifying medium that provides a directed way to tie initiative of many subordinate actions with superior intent as a basis to diminish friction and compress time in order to generate a favorable mismatch in time and in the ability to shape and adapt to unfolding circumstances'[80].

Here Boyd introduces the issue the effect of the Mission concept and the Schwerpunkt concept on the dimension of time. Before, these concepts were explored as essential elements for maintaining cohesion and harmonizing effort. Now they take on a different role, indeed, they become crucial advantages in themselves, for they allow swifter tempo of operations. Because the German operational philosophy was based upon a common outlook and freedom-of-action, which they realized through their concepts of Mission and Schwerpunkt, 'it emphasized implicit over explicit communication'. This suggests, according to Boyd, that 'the secret of the German Command and Control System lies in what's unstated or not communicated to one another - in order to exploit lower-level initiative yet realize higher level intent, thereby diminish friction and reduce time, hence gain both quickness and security'[81]. And Boyd again quotes Blumentritt to make an important point flowing from this:

- The entire [German] operational and tactical leadership method hinged upon…rapid concise assessment of situations, quick decision and quick execution, on the principle: 'each minute ahead of the enemy is an advantage.

Boyd translated this in the more abstract but now well-known observation that they were able to 'repeatedly operate inside their adversary's observation-orientation-decision-action loops'[82]. Not surprisingly, Boyd's OODA loop graphic includes the elements of implicit guidance and control.

Towards the essence of Blitzkrieg. A last point concerning Blitzkrieg Boyd addresses, as in his discussion of the dynamics of infiltration tactics, is the connection between - the rationale for - the pattern of employing 'multiple thrusts, bundles of multiple thrusts or bundles of thrusts insides bundles of thrusts'. And actually one can see the way Boyd draws his audience into a conversation with him, for he formulates this theme about the rationale as a question for the audience. Boyd himself provides the answer. Multiple thrusts (etc) 'present many (fast-breaking) simultaneous and sequential happenings to generate confusion and disorder - thereby stretch out time for [the] adversary to respond in a directed fashion'. Moreover, they must be regarded as 'multiple opportunities to uncover, create, and penetrate gaps, exposed flanks and vulnerable rears'. They also 'create and multiply opportunities to splinter [the] organism and envelop disconnected remnants thereby dismember [the]

[80] Ibid. Note how Boyd quietly moves to a higher level of abstraction when he asserts that the Schwerpunkt helps in establishing an advantage in adaptability.
[81] Ibid, p.79.
[82] Ibid.

adversary thru the tactical, grand tactical, and strategic levels'[83]. This leads him to reveal the essence of Blitzkrieg[84]:

> Employ a Nebenpunkte/ Schwerpunkte maneuver philosophy to generate ambiguity, realize deception, exploit superior mobility and focus violence as the basis to quickly:
>
> - Create many opportunities to penetrate weaknesses in the form of any moral or mental inadequacies as well as any gaps or exposed flanks that open into adversary's vulnerable rear and interior, hence -
>
> - Create and exploit opportunities to repeatedly penetrate adversary organism, at all levels (tactical, grand tactical, and strategic) and in many ways, in order to splinter, envelop, and roll-up/wipe-out isolated remnants, thereby generate confusion and disorder, hence-
>
> - Create and exploit opportunities to disrupt his system for communication, command, and support, as well as undermine or seize those connections or centers that he depends upon, thus shake his will or capacity to decisively commit his back-up echelons, operational reserves, and/or strategic reserves, thereby magnify adversary's confusion and disorder and convince him to give up.

Note how Boyd connects physical, spatial, temporal, informational, moral and mental dimensions into a logical causal chain and has moved slowly to a high level of abstraction. This culminates in the formulation of the conceptual implication (which is of a yet higher level of abstraction) of this approach. Boyd asserts that 'Blitzers, by being able to infiltrate or penetrate or get inside adversary's system, generate many moral-mental-physical non-cooperative (or isolated) centers of gravity, as well as undermine, or seize those centers of gravity adversary depends upon, in order to magnify friction, produce paralysis, and bring about adversary collapse'[85].

To actually execute such an approach six interrelated conditions (all of which by now he already had addressed) must be met. While taking his inspiration from World War II he concludes this list with a slide, which mentions 12 successful Blitz campaigns versus 5 lost ones, so as to suggest that indeed, the keys to success he advances have proven their worth[86]. The process of OODA is constantly present at the background, and in particular the cognitive elements.

First, there must be an 'emphasis on a common outlook and freedom-of-action that are exploited by the Mission and Schwerpunkt concepts to fix responsibilities as well as to rapidly shape, focus and shift operations and support at all levels'. Second, there must be flexibility in command, 'based on a common outlook and freedom-of-action that are exploited by Mission and Schwerpunkt - that encourages lower-level combat leaders (forward) to exploit opportunities generated by rapid action within a broad loosely woven scheme laid down from central command'. The third condition also relates closely with the command (or better: the cognitive) function: 'intelligence, reconnaissance (air and ground) and stratagem emphasized before and during combat operations to unmask and shape patterns of adversary strengths, weaknesses, moves, and intentions'.

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[83] Ibid, p.86.
[84] Ibid, p.87.
[85] Ibid.
[86] See p.89.

Only the fourth condition relates to physical movements in space and time, but even here he includes the idea that these are tied to the enemy's function of perception and his morale: 'Broad use of Schwerpunkt concept coupled with fast-tempo/fluidity-of-action of armored teams and air support permit Blitzers to repeatedly reshape strength and rapidly shift it against, or through, weaknesses thereby generate doubt and uncertainty which magnify into panic and chaos'.

These actions require (as a fifth condition) 'superior mobile communications to maintain cohesion of overall effort and to enable higher command levels to allocate reserves and support and to reshape as well as shift focus of main effort'. Again, the processes of observation and orientation take central place. The final condition is a small logistics tail (using airlift when appropriate and necessary) to support high-speed movement and rapid shift among routes of advance[87]. This section demonstrates that Boyd's OODA loop idea includes more elements than the notion of outpacing the opponent's decision cycle, as it is often equated with.

The Modern Guerrilla Campaign

A similar dynamic. Boyd thus introduced infiltration tactics and Blitzkrieg warfare and has advanced the idea that in essence the dynamics are quite similar. They "work", because of similar dynamics at play. In his discussion of both he continuously emphasizes how actions work upon the enemy's processes of perception. He shows how the physical, the temporal and the mental dimensions interrelate, and that this connection actually provides the rationale for the physical actions. Already he has briefly suggested that in the revolutionary warfare concept developed in the interbellum such a dynamic could also be discerned. His next topic, which aims to further bolster his argument, is an exploration of modern guerrilla campaigns. In it he also reaches back to his previous discussion of Lenin and Mao. He follows the by now familiar didactic structure. First he describes what in practical terms constitutes a guerrilla campaigns, and the idea underlying it. From this he distills the essence and abstract intent, implications and the keys for success for his discussion concerning patterns of winning and losing.

In a slide filled with dense prose he describes what actions guerrillas employ. The main idea, the logic behind the guerrilla warfare approach, is to

> Defeat the existing regime politically by showing they have neither the moral right, nor demonstrated ability to govern and militarily by continuously using stealth/fast-tempo/fluidity-of-action and cohesion of small bands and larger units in cooperation with political "agitprop" (agitation/propaganda) teams as basis to harass, confuse and ultimately destroy the will or capacity to resist[88].

According to Boyd, guerrillas capitalize on discontent and mistrust which is generated by corruption (real of imagined), exploitation, oppression, incompetence, and the unwanted presence of the existing regime. Thus they can evolve a common cause or a unifying theme as a basis to organize and maintain mass support through a militant political program. They built an administrative and military organization, create a sanctuary, and a communications network under the control of the political leadership of the guerrilla movement. They take care not to arouse the reigning regime's intelligence and security apparatus. A shadow government is created, with parallel hierarchies, in localities and regions that can be made rip

[87] Ibid, p.88.
[88] Ibid, p.90.

for insurrection/revolution by infiltration cadres (vanguards) who can not only subvert the existing authority but also convert leaders and people to the cause and organizational way of the guerrillas. Based upon this structure, they attempt to subvert the government and convert people. This will create an alien atmosphere of security and intelligence in order to "blind" the regime to the plans, operations and organization of the guerrilla movement, while at the same time the regime's strengths, weaknesses, moves and intentions become visible.

The next phase, comes in the form of propaganda, inspiring civil disorder (such as rallies, demonstration, strikes and riots). Selected acts of terrorism and sabotage will be conducted. The resulting misinformation can be exploited to expend mistrust and sow discord, which in turn magnifies the appearance of corruption, incompetence, etc, and the inability of the regime to govern. Tiny cohesive bands can then be employed for surprise hit-and-run raids against lines of communications to gain arms and supplies as well as to disrupt the communication, coordination and movement of the government. When superior government police and armed force do appear, these guerrilla bands should not engage in battle but instead retreat and melt into the environment. This scheme can be expanded. Such tiny bands can scatter across the country to arouse the people (and gain recruits) as well as to harass, wear-out, and spread-out government forces. When indeed government forces are thinly spread and operate not in superior force sizes but in small units, they can be engaged through ambushes and sneak attacks by larger bands, or mobile formations which concentrate to wipe-out these dispersed, isolated, and relatively weak fractions.

Meanwhile the effects of propaganda, re-education and selected military successes should be exploited. The grievances and obsessions of people should be played upon. The government must be encouraged to indiscriminately take harsh reprisal measures against the people in order to connect the government with the expanding climate of mistrust, discord, and moral disintegration. Simultaneously and in stark contrast to the government, guerrillas should exhibit moral authority, offer competence, and provide desired benefits. This will assist in further eroding the government's influence, gaining more recruits and multiplying the base areas. Subsequently, the political infrastructure can expand as well as the influence and control exerted by the guerrilla movement over the population and the countryside. This will culminate with the visible demonstration of the disintegration of the regime which is effectuated by strikes of small fluid bands and ever larger formations in a Cheng/Ch'I fashion, to split-up, envelop, and annihilate fractions of major enemy forces[89].

The <u>essence</u> of the modern guerrilla campaign, according to Boyd, is thus to[90]:

- Capitalize on corruption, injustice, incompetence, etc., (or their appearances) as basis to generate atmosphere of mistrust and discord in order to sever moral bonds that bind people to existing regime

  <u>Simultaneously</u>

- Share existing burdens with people and work with them to root out and punish corruption, remove injustice, eliminate grievances, etc., as basis to form moral bonds between people and guerrillas in order to bind people to guerrilla philosophy and ideals.

The <u>intent</u> of guerrilla activities is to:

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[89] Ibid.
[90] Ibid, p.91.

- Shape and exploit crises environment that permits guerrilla vanguards or cadres to pump-up guerrilla resolve, attract the uncommitted, and drain away adversary resolve as foundation to replace existing regime with guerrilla regime.

The conceptual implication of this is that:

- Guerrillas, by being able to penetrate the very essence of their adversary's moral-mental-physical begin, generate many moral-mental-physical non-cooperative (or isolated) centers of gravity, as well as subvert or seize those centers of gravity that adversary regime must depend upon, in order to magnify friction, produce paralysis, and bring about collapse.

  Yet,

- Guerrillas shape or influence moral-mental-physical atmosphere so that potential adversaries, as well as the uncommitted, are drawn toward guerrilla philosophy and are empathetic toward guerrilla success.

Strategic philosophy. The strategic philosophy underlying modern guerrilla warfare, as well as Soviet Revolutionary Strategy and the Impact of 19th Century Capitalism on Insurrection/revolution can now be discerned. It is only a slightly different rendering of the short essence laid out above. According to Boyd, guerrilla vanguards employ a variety of means to play-upon internal frictions within the regime, obsessions, etc., as well as stimulate discontent and mistrust of the people. In this way, vanguards sow discord that in turn magnifies the internal frictions within the regime. This paralyzes the regime's ability to come to grips with crises that further fan the atmosphere of mistrust and discord that feed the crises. This self-amplifying process pushes the regime out-of-control. The Guerrilla vanguards on the other hand share the burden as well as help the people to cope with the turmoil - that the vanguards themselves keep fanning and enmesh people into - in order to demonstrate the ability to deal with surging crises as well as to shape the image that only guerrillas offer a way out of existing unpleasant circumstances[91].

Now Boyd slowly peals away more layers to get to the core dynamics of modern guerrilla warfare. The discussion above offers the insight, so Boyd suggests, that the 'insurrection/revolution becomes ripe when many perceive an illegitimate inequality - that is, when the people see themselves as being exploited and oppressed for the undeserved enrichment and betterment of an elite few. This means that the guerrillas not only need an illegitimate inequality but they also need support of the people, otherwise insurrection/ revolution is impossible'[92]. The message to be derived from this insight is that[93]:

- Guerrillas must establish implicit connections or bonds with people and countryside.

  In other words

- Guerrillas must be able to blend into the emotional-cultural-intellectual environment of people until they become one with the people.

  In this sense

[91] Ibid, p.93.
[92] Ibid, p.94.
[93] Ibid, p.95.

- People feelings and thoughts must be guerrilla feelings and thoughts while guerrilla feelings and thoughts become people feelings and thoughts: people aspirations must be guerrilla aspirations while guerrilla aspirations become people aspirations; people goals must be guerrilla goals while guerrilla goals become people goals.

  The result is that

- Guerrillas become indistinguishable from people while government is isolated from people.

A survey of 12 successful and 5 failed guerrilla campaigns of the past 200 years reveals, according to Boyd, the 4 keys to success, which again amount to a description of the dynamics of guerrilla warfare from yet a slightly different angle and in more general terms: first, an ability to continuously demonstrate government weakness, to erode government influence and to cause the government to alienate itself from the people; second, the support of people (both psychological and physical) for intelligence, recruits, shelter, transportation, refuge, food, money, and medical aid; third, access to (more of less permanent) safe sanctuaries or base areas and/or fluid bases that can be shifted from place to place, away from enemy forces - in order to rest, recuperate, repair materiel, etc., as well as to indoctrinate, train and equip recruits; and finally, the use of stealth/fast-tempo/fluidity-of-action coupled with cohesion of guerrilla bands as a basis for:

- dispersion, to arouse people, to avoid adversary strength, and to force government to thin-out, or disperse, its strength;
- concentration, to hit and wipe-out isolated fractions;
- shifting of effort (in these as well as other activities), in order to gain and keep initiative[94].

The nucleus of victory: the themes of Blitzkrieg and guerrilla warfare

It is significant the way Boyd describes that guerrillas blend in with the environment just like infiltration units did, how he focuses on bonds and connections, as well as on the theme of the creation of isolation, which also appeared in his description of infiltration tactics and the Blitzkrieg concept. Also the choice of words for describing the keys to guerrilla warfare success is not coincidental. On the contrary, his particular formulation makes readily apparent the connection with other styles of warfare. Indeed, Boyd claims that the elements that made Blitzkrieg successful can also be recognized in guerrilla warfare as theorized by T.E. Lawrence, Soviet Revolutionary Strategy and Mao's guerrilla warfare concept, which combined ideas of Sun Tzu, Napoleon and Lenin. At an abstract level the processes and core concepts are similar, Boyd suggests. All revolve around maintaining cohesion, creating confusion among one's own units, and disrupting cohesion in the enemy camp. By concentrating on processes and core concepts instead of other characteristics that give form to a particular style of warfare, such as technology, he uncovered similarities between these different styles.

Wrapping the essences of guerrilla warfare and Blitzkrieg together and looking for similarities, Boyd concludes that in both styles battles are avoided. Instead the essence of both is to[95]:

[94] Ibid, p.96.

- penetrate an adversary to subvert, disrupt or seize those connections, centers, and activities that provide cohesion (e.g., psychological/moral bonds, communications, lines of communication, command and supply centers,…).

- exploit ambiguity, deception, superior mobility and sudden violence to generate initial surprise and shock, again and again and again.

- roll-up/wipe-out, the isolated units or remnants created by subversion, surprise, shock, disruption and seizure.

These actions aim to:

- exploit subversion, surprise, shock, disruption and seizure to generate confusion, disorder, panic, etc, thereby shatter cohesion, paralyze effort and bring about adversary collapse.

The reasons for the extraordinary level of success, or in Boyd's words, "the message", lies in the fact that in both concepts[96]:

- one operates in a directed yet more indistinct, more irregular and quicker manner than one's adversaries.

This enables one to:

- Repeatedly concentrate or disperse more inconspicuously and/or more quickly from or to lower levels of distinction (operational, organizational and environmental) without losing internal harmony.

For the same reason one is able to:

- Repeatedly and unexpectedly infiltrate or penetrate adversaries' vulnerabilities and weaknesses in order to splinter, isolate or envelop and overwhelm disconnected remnants of adversary organism.

Or put in another way, one can;

- operate inside the enemy's OODA loops or get inside their mind-time-space as a basis to penetrate the moral-mental-physical being of one's adversaries in order to pull them apart and bring about their collapse.

Such amorphous, lethal, and unpredictable activity by Blitz and Guerillas make them appear awesome and unstoppable which altogether produce uncertainty, doubt, mistrust, confusion, disorder, fear, panic and ultimately collapse. They affect the connections and centers that provide cohesion, as Boyd explains in yet another slide on the same theme[97]. Boyd asserts there is actually nothing new under the sun here, for this notion was already implied by Sun Tzu and more recently by the analysis J.F.C. Fuller had made of Ludendorff's infiltration

[95] Ibid, p.98.
[96] Ibid, p.101.
[97] Ibid, p.99.

tactics in 1918. Indeed then, for Boyd there is continuity from Sun Tzu to the Vietnam War, from the early campaigns of Napoleon to the 1973 war in the Middle East.

Not surprisingly Boyd also attempts to seek the counter to such successful stratagems: how can we defend against or counter the Blitz and the Guerrilla movement? The answer is obvious and follows directly from Boyd's analysis of the essence of both types of warfare. The difficulty with the an enemy Blitz is to maintain cohesion while sustaining fast-tempo when the enemy is forced to repeatedly and rapidly shift the concentration of strength against weaknesses. The counter to the Blitz thus lies in the same keys of success for Blitzkrieg, in addition to avoiding linear defense. In stead defense should be in depth, with armored teams as mobile reserves in echelon behind reconnaissance parties, which try to locate the enemy thrusts. The defense should have better intelligence, operate faster, be more mobile, move even more inconspicuously, also with small combat teams operating according to the Schwerpunkt/mission concept, and maintain a higher level of cohesion to shatter the opponent's cohesion with counterstrokes on the enemy flanks and rear. It implies and acceptance of "gaps" and "risks"[98]. The idea is a mirror of the idea underlying the Blitz:

> Smash Blitz offensive by inconspicuously using fast-tempo/fluidity-of-action and cohesion of counter-Blitz combat teams as basis for shifting of forces and quick focus of air and ground effort to throttle momentum, shatter cohesion, and envelop Blitz in order to destroy adversary's capacity to resist[99].

The Achilles heel for the guerrilla movement lies in its need for popular support. Guerrilla vanguards need a cause, the support of people and a crisis. The crisis and the vanguards represent the marriage of instability and initiative that create and expand guerrilla effort. Without support of people, the guerrillas have neither a vast hidden intelligence network nor an invisible security apparatus that permit them to see into the adversary's operations yet blind the adversary to their own operations. This automatically suggest that in order to dry-up a guerrilla upsurge, one should strike at those root causes or illegitimate inequalities that generate and exacerbate crisis as well as provide a favorable climate for vanguards to form and operate in. Thus Boyd states, the idea behind a counter guerrilla campaign is to 'break guerrilla's moral-mental-physical hold over the population, destroy their cohesion, and bring about their collapse via political initiative that demonstrates moral legitimacy and vitality of government and by relentless military operations that emphasize stealth/fast-tempo/fluidity-of-action and cohesion of overall effort'[100].

Categories of Conflict

Three kinds of conflict. Based on his survey - or, in Boyd's words "panorama" - of military history, Boyd argues that one can imagine three kinds of human conflict[101]:

- Attrition Warfare - as practiced by the Emperor Napoleon, by all sides during the 19th Century and during World War I, by the Allies during World War II, and by present-day nuclear planners.

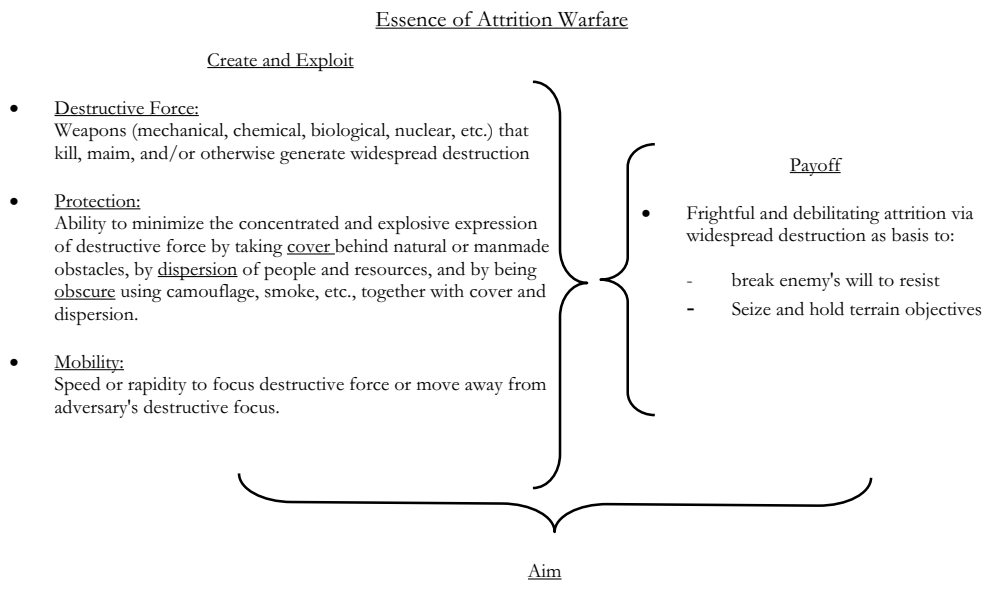
[98] Ibid, pp.104-106.
[99] Ibid, p.105.
[100] Ibid, pp.107-108.
[101] Ibid, p.111.

- Maneuver Conflict - as practices by the Mongols, General Bonaparte, Confederate General Stonewall Jackson, Union General Ulysses S. Grant, Hitler's Generals (in particular Manstein, Guderian, Balck, Rommel) and the Americans under Generals Patton and MacArthur.

- Moral Conflict - as practiced by the Mongols, most Guerrilla Leaders, a very few Counter-Guerrillas (such as Magsaysay) and certain others from Sun Tzu to the present.

Boyd subsequently provides the essence of each kind of conflict, of what Alvin and Heidi Toffler later would label as "warform". He often repeats themes and key principles from the previous discussions. Still, this synthesis offers novel aspects for Boyd often recombines and rephrases the terms or puts them in a different context. And in particular the category of moral conflict offers new material.

Attrition Warfare. Boyd's short summary of the essence of attrition warfare offers few new insights. In one slide Boyd manages to capture the dynamics of attrition warfare, and this stands in marked contrast with his dealing with maneuver and moral conflict[102].

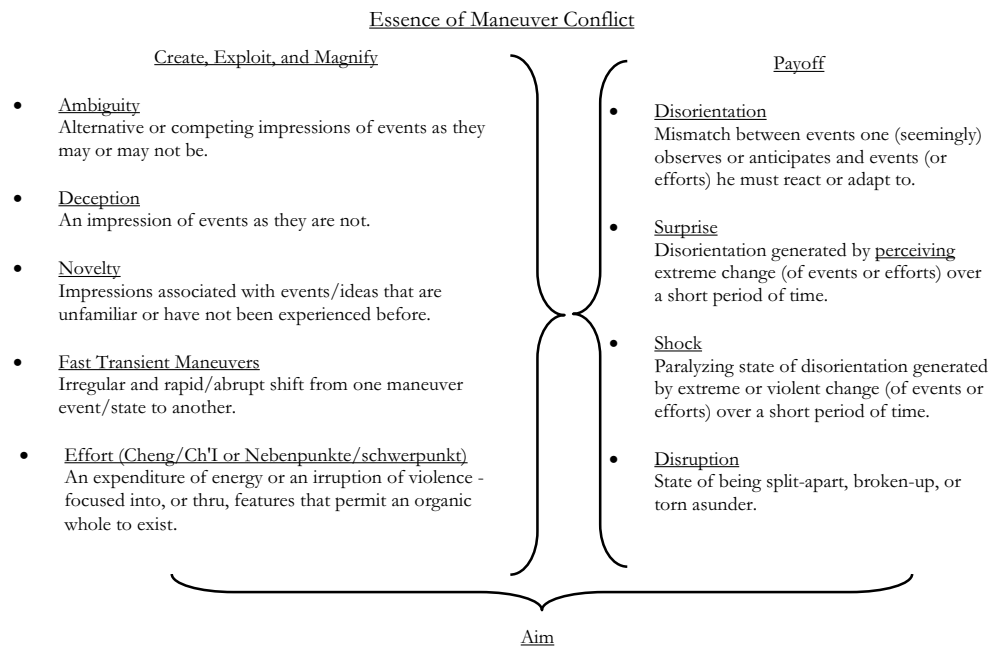


Firepower as a destructive force is king. Protection (trenches, armor, dispersion, etc.) is used to weaken or dilute effects of enemy firepower. Mobility is used to bring firepower to bear or to evade enemy fire. Measures of success are (now) "body count" and targets destroyed. Seize and hold terrain objectives replace Napoleon's dictum: destroy enemy army[103].

[102] Ibid, p.113.
[103] Ibid, p.112. Notice the specific Cold War and post-Vietnam era elements.

Maneuver conflict. Notwithstanding the fact that his summary of maneuver warfare is only 4 slides long, this synthesis offers new insights. Boyd describes it in new terms allowing him to make a leap to a characterization that transcends the historical connection to WW II Blitzkrieg. He deliberately raises the level of abstraction and inserts his theme of adaptability to recast maneuver warfare in yet another mold giving new meaning to his previously discussed key elements.

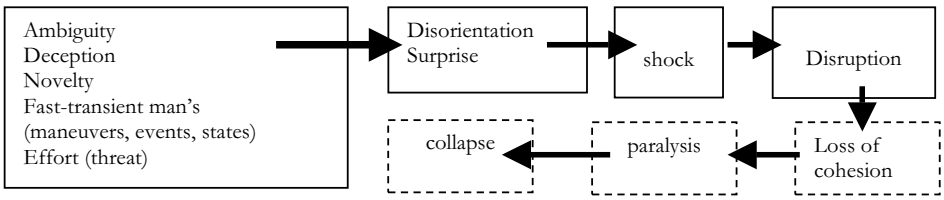
He offers three observations regarding maneuver. First, 'ambiguity, deception, novelty, and violence (or threat thereof) are used to generate surprise and shock. Second, fire and movement are used in combination, like Cheng/Chi'i or Nebenpunkte/Schwerpunkt, to tie-up, divert or drain-away the adversary's attention and strength in order to expose as well as menace and exploit vulnerabilities or weaknesses elsewhere. A final point is that indications of success tend to be qualitative and are related to the widespread onset of confusion and disorder, frequent envelopments, high prisoner counts or any other phenomena that suggest inability to adapt to change'[104]. Again in one slide he paints an impression of the essence of maneuver conflict[105]:



[104] Ibid, p.114.
[105] Ibid, p.115.

In light of his previous observation on the importance of the ability to adapt to change, it is a noteworthy slide for it lists effects, which show an increasing level of erosion of the state of mental/moral coherence with the subsequent decreasing capability to cope and respond adequately. In addition, he returns to the theme of fast transients and the Darwinian perspective he started *Patterns of Conflict* with.

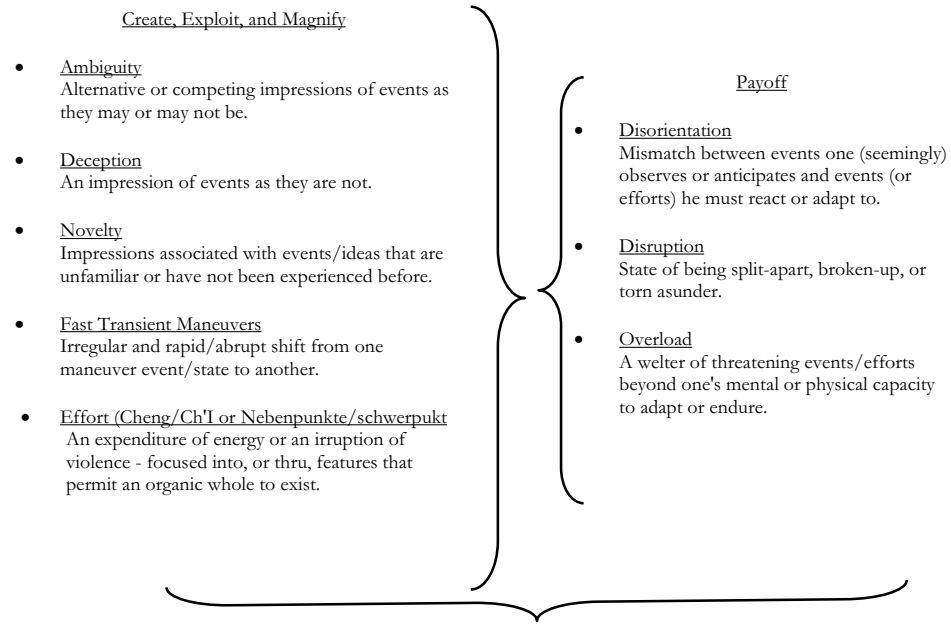
In the following figure these terms have been arranged so as to depict the causal chain that is formed by the induced effects, according to Boyd's slide. The dotted boxes indicate the desired ultimate effects, the ultimate aim.



For Boyd, this still does not sufficiently capture the essence of maneuver conflict. He increases the emphasis on the theme of adaptability when he states next that 'shock and surprise can also be regarded as an overload caused by a welter of threatening events beyond one's mental or physical ability to respond and adapt or endure'. This results in a slightly amended version of the slide above. It contains two notable differences. It not only regards disorientation the only element affecting adaptability, but now also the element of overload due to 'a welter of threatening events'. So adaptability is affected not only by ambiguous information and uncertainty, but is also compounded by fear due to threatening events.

Moreover, Boyd modifies his aim. The employment of the various elements of maneuver conflict may not directly result in collapse, as one may have interpreted his statement on the "aim of maneuver conflict". In stead, he considers it equally valuable to aim for the creation of many isolated remnant of enemy forces that can later be mopped up. In light of the critique that Boyd, like Sun Tzu expects victory through merely going through OODA cycles more rapidly, this is not a trivial transition.

Thus the essence of maneuver conflict can also be viewed as[106]:



Moral Conflict. This category is novel for two reasons. Although it suggests that it equates revolutionary war or guerrilla warfare, it includes but transcends those types. It is also novel in the discussion Boyd had up to this point with his audience. He had not alluded to it before. Therefore Boyd starts his discussion on his third category of conflict with an examination of morale, aiming to uncover the nature of moral strength and the causes for losing it. He chooses the German Blitzer Hermann Balck and Cyril Fall's 1961 book *The Art of War from the Age of Napoleon to the Present Day*.

Balck emphasized the importance of leadership in creating moral strength among troops. Leaders subordinates wide freedom to exercise imagination and initiative, yet harmonize within the intent of superior commanders. Cohesion during combat relied more on moral (as in human values) superiority than on material superiority. Leaders must create this. This requires them to create a bond and breadth of experience based upon trust. They must also lead by example, demonstrating requisite physical energy, mental energy, and moral authority to inspire subordinates to enthusiastically cooperate and take the initiative within the superior's intent. Leaders must be willing to share danger and discomfort with the troops at the front. They must show a willingness to support and even promote (unconventional or

[106] Ibid, p.117.

difficult) subordinates that accept danger, demonstrate initiative, take risks, and come-up with new ways toward mission accomplishment. Finally, they must manifest a dedication and resolve to face-up to and master uncomfortable circumstances that fly in the face of the traditional solution.

From Cyril Falls' book Boyd extracts insights concerning the reverse issue: when does moral strength evaporate. Boyd tells how during the First World War in East End London air raids caused a tendency to panic in the latter part 1917. Moreover, whether there was an air raid or not, some 300.000 people crowded each night into the underground railway stations and slept on the platforms. Although a single German airship did cause a million pounds worth of damage in a raid, the success of airship attacks was mainly moral and measured in terms of absenteeism in factories and sensational drops in production in warlike material. A similar effect was noted by German Blitzers in their employment of dive-bombers, to which the German Armies owed much in their victories in Poland, Belgium and France. Acting in close support to the armor and infantry, they often put hostile artillery out of action, not through destruction but by driving the detachment from their guns. Those successes were won for the most part by moral rather than material effect. To troops unused to them, these dive-bomber attacks proved extremely unsettling[107].

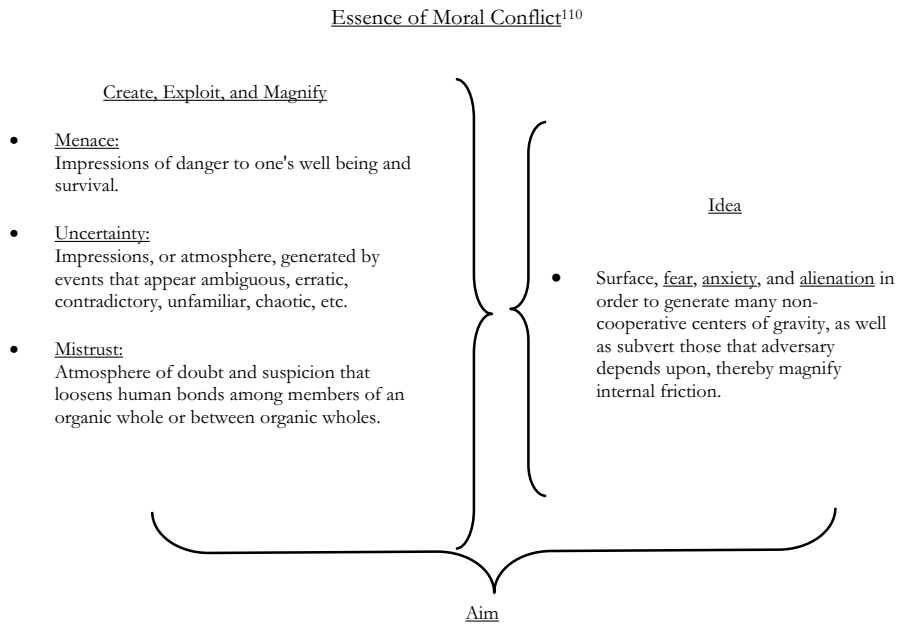
Boyd leads his audience in deriving implications from these examples from history. Cyril Falls' comments suggest, according to Boyd, that moral effects are related to the menace posed by the Zeppelins and dive-bombers, and the uncertainty associated with not knowing what to expect or how to deal with this menace. Put simply, moral effects are related to menace and uncertainty. This also offers a preliminary suggestion that moral strength represents mental capacity to overcome menace and uncertainty.

One element is still missing however: the element of trust. As was discussed above, guerrillas stress the use of propaganda, civil disorders, selected terrorism, etc., as the basis to generate mistrust and discord. Balck emphasized the importance of trust for cohesion. And as both guerrillas and Blitz commanders work in a hostile environment (of menace and uncertainty), which naturally breeds mistrust, it is clear that moral effects must include this factor. This suggests that moral strength represents mental capacity to overcome menace, uncertainty and mistrust[108]. From these insights Boyd develops five notions related to moral conflict[109]:

- moral strength: mental capacity to overcome menace, uncertainty, and mistrust.
- Moral victory: triumph of courage, confidence, and esprit (de corps) over fear, anxiety, and alienation when confronted by menace, uncertainty, and mistrust.
- Moral defeat: triumph of fear, anxiety, and alienation over courage, confidence, and esprit when confronted by menace, uncertainty, and mistrust.
- Moral values: human values that permit one to carry on in the face of menace, uncertainty, and mistrust.
- Moral authority: person or body that can give one the courage, confidence, and esprit to overcome menace, uncertainty, and mistrust.

[107] Ibid, p.119.
[108] Ibid, p.120.
[109] ibid, p.121. Boyd explicitly refers to Clausewitz' concept of friction in the use of the words fear and anxiety.

This leads to two wrap-up slides on the essence of moral conflict. The first one amounts to a "what to do" summary. The second one improves upon this one, in similar fashion to the two slides on the essence of maneuver conflict.



So far it has become clear that courage, confidence and esprit the corps represent the positive counterweights to fear, anxiety and alienations. This does not reveal yet how to create, maintain and exploit moral strength among one's own troops. Positive counterweights to menace, uncertainty, and mistrust still need to be developed. These are not very obvious. Boyd makes the suggestion, admittedly based in no small part on his own intuition, that the answer lies in the elements of harmony, adaptability and initiative, offering the following explanation[111]:

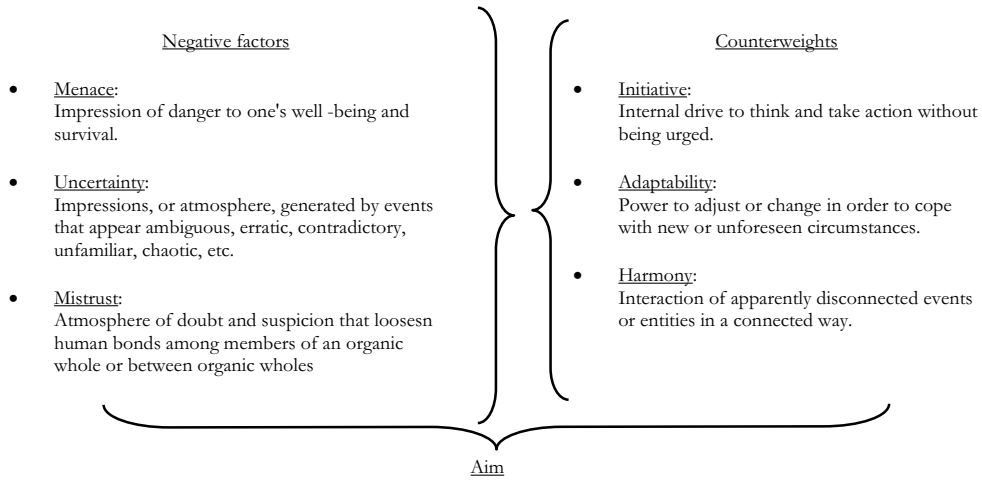
- The presence of mistrust implies that there is a rupture or loosening of the human bonds or connections that permit individuals to work as an organic whole in harmony with one another. This suggests that harmony itself represents an appropriate counterweight to mistrust.

- In dealing with uncertainty, adaptability seems to be the right counterweight. Otherwise, how can one adjust to the unforeseen or unpredictable nature of uncertainty?

- Finally, with respect to menace one cannot be passive. Instead, initiative is needed otherwise menace may obliterate the benefits associated with harmony and adaptability. Intuitively, this suggests that initiative is the right counterweight here.

[110] Ibid, p.122.
[111] Ibid, p.124.

This then leads to the second wrap-up of the essence of moral conflict, which combines the negative and the positive factors, the offensive as well as the defensive side[112].



- Pump-up friction via negative factors to breed fear, anxiety, and alienation in order to generate many non-cooperative centers of gravity, as well as subvert those that adversary depends upon, thereby sever moral bonds that permit adversary to exist as an organic whole.

- Build-up and play counterweights against negative factors to diminish internal friction, as well as surface courage, confidence, and esprit, thereby make possible the human interactions needed to create moral bonds that permit us, as an organic whole to shape and adapt to change

Synthesis: pattern for successful operations

A short look back. By now Boyd is ready to come slowly to his abstract synthesis of the dynamics and patterns of winning and losing. In the first pages of Patterns of Conflict he has laid out the aim of this presentation and a number of key themes and suggestions, offering in fact already the contours of his main argument. He has taken his audience through detailed discussions of the style of warfare as practiced by Sun Tzu, Alexander, Ghengis Khan and the early Bonaparte. He has argued that from the later Napoleonic battles to the First World War bloody and wasteful attrition warfare was tragically en vogue. The solution to the costly loss of flexibility, to the stalemate of the trenches, was provided by infiltration tactics. Together with the development of the Blitzkrieg concept, Lawrence's version of guerrilla warfare and communist revolutionary warfare, this period manifested a de facto rediscovery of the teachings of Sun Tzu. Boyd then gradually shifts to higher levels of abstraction in his compression of the different styles of warfare to the key elements and fundamental dynamics of each. Based on this favored maneuver and moral categories of conflict, he now moves on to get to the most general and abstract formulation of the essence of strategy. In twenty pages he brings it all together, from the tactical to the grand strategic level, coming full circle to the ideas he bluntly put forward in his introduction. But by now he has taken his audience through 2500 years of military history and strategic thought to argue his points.

[112] Ibid, p.125.

Towards a new conceptualization of strategy. Restating his first ideas, and based on propositions, findings and insights, including those of the essay, Boyd states that for any system the basic goal is to diminish the adversary's freedom of action, while improving our freedom-of-action so that we can cope with events while they unfold and he cannot[113]. This should also be the aim of any military commander. The plan for achieving this should incorporate the following eight steps (in which Sun Tzu and Liddell Hart can easily be recognized):

1. Probe and test the adversary to unmask strength, weaknesses, his maneuvers and intentions.
2. Employ a variety of measures that interweave menace, uncertainty and mistrust with tangles of ambiguity, deception and novelty as the basis to sever an adversary's moral ties and disorient or twist his mental images and thus mask, distort and magnify our presence and activities.
3. Select initiatives and responses that are least expected.
4. Planning should focus on a 'Schwerpunkt' with 'Nebenpunkte' and should have branches and sequels, and thus secure flexibility.
5. Threaten multiple and alternative objectives while,
6. Move along paths of least resistance to reinforce and exploit success.
7. Exploit, rather than disrupt or destroy those differences, frictions, obsessions, etc., of adversary organism that interfere with his ability to cope with unfolding circumstances.
8. Subvert, disorient, disrupt, overloading or seize vulnerable and critical connections, centers and activities that provide cohesion and permit a coherent OODA cycle in order to dismember the organism and isolate remnants for absorption or mop-up.

When it comes to action the thing is to:

> 'OODA' more inconspicuously, more quickly and with more irregularity as basis to keep or gain initiative as well as shape or shift main effort; to repeatedly and unexpectedly penetrate vulnerabilities and weaknesses exposed by that effort or other effort(s) that tie up, divert, or drain-away adversary attention (and strength) elsewhere.

The whole operation should be supported by a superior mobile communications structure. Only essential logistics should be used. The command concept should be highly decentralized in a tactical sense to allow tactical commanders initiative. It should be centralized at the strategic level to establish aims, match ambitions with means, to sketch plans, allocate resources and shape the focus of overall effort[114].

Up to this point Boyd's discussion concerned the elements of setting goals, planning, action, support and command. Although abstract in the way Boyd describes these elements, they still refer to the tactical level. He is still far removed from a general theory of winning and losing in which tactics (actions) are linked to strategy and the societal level. So, from this pattern of successful operations, Boyd proceeds to develop a set of hierarchically structured related definitions – or rather novel conceptualizations - of tactics, grand tactics (operational level in current parlance), strategy and grand strategy. Once more Boyd sets out to get to the essence of success in yet another higher level of abstraction to arrive first at the 'theme for disintegration and collapse' and then at the 'theme for vitality and growth'.

The first level to address is the grand tactical level. The pattern he sketched out before, suggests that the aim for any commander is to penetrate the adversary system and

[113] Ibid, p.128.
[114] Ibid, p.128.

mask one's own system against any such attempts by the opponent. One wants to create a variety of impressions of what is occurring and what is about to occur. One aims to generate mismatches between what seems to be and what is and to push the adversary beyond his ability to adapt. The intention formulated in the plan, requires the application of transients that make up the action part[115]. Boyd here wants to emphasize the element of uncertainty of combat and command, the relevance of mismatches and the value of creating a variety of impressions. These are enduring elements, indeed, vulnerabilities and weaknesses that commanders and subordinates alike must accept. To reinforce his point, Boyd returns to Napoleon who asserted that:

> "The art of land warfare is an art of genius, of inspiration…A general never knows anything with certainty, never sees his enemy clearly, never knows positively where he is. When armies are face to face, the least accident in the ground, the smallest wood, may conceal part of the enemy army. The most experienced eye cannot be sure whether it sees the whole of the enemy's army or only three-fourths. It is by the mind's eye, by the integration of all reasoning, by a kind of inspiration, that the general sees, knows, and judges."
>
> "The first quality for a commander in chief is a cool head which receives a just impression of things; he should not allow himself to be confused by either good or bad news; the impressions which he receives successively or simultaneously in the course of a day should classify themselves in his mind in such a way as to occupy the place which they merit; because reason and judgment are the result of the comparison of various impressions taken into just consideration."[116]

What are weaknesses and vulnerabilities can be exploited. If the element of judgment in the face of uncertainty is of such prime importance for a commander such as Napoleon, this should indeed feature prominently in the conceptualization of grand tactics. Subsequently Boyd formulates a "to do" definition of *grand tactics* which focuses in particular on the mind of the enemy commander, on the process of observation and orientation, while also containing by now familiar elements:

- Operate inside adversary's OODA-loops, or get inside his mind-time-space, to create a tangle of threatening and/or non-threatening events/efforts as well as repeatedly generate mismatches between those events/efforts adversary observes, or anticipates, and those he must react to, to survive;
  Thereby

- Enmesh adversary in an amorphous, menacing, and unpredictable world of uncertainty, doubt, mistrust, confusion, disorder, fear, panic, chaos,… and/or fold adversary back inside himself;

  Thereby

- Maneuver adversary beyond his moral-mental-physical capacity to adapt or endure so that he can neither divine our intentions nor focus his efforts to cope with the unfolding strategic design or related decisive strokes as they penetrate, splinter, isolate or envelop, and overwhelm him[117].

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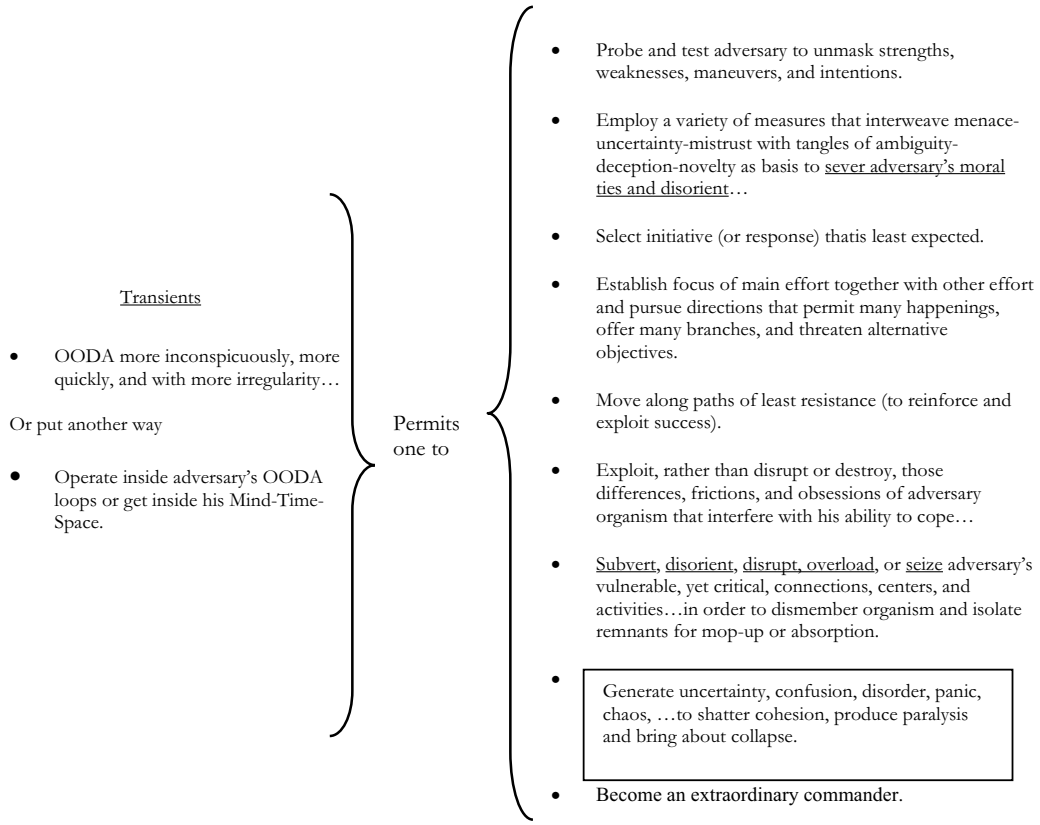
[115] Ibid, p.129.
[116] Ibid, p.130.
[117] Ibid, p.131.

Similar ideas are incorporated in Boyd's advice for the strategic level. To some extent the strategic level is similar to the grand tactical level in Boyd's view. However, for Boyd the strategic level has a higher level of aggregation and complexity, it features more enemy elements (quantity) and importantly a wider spectrum of options for compensation and adaptation. This offers also a wider theater (in both time and space) with more options for manipulating, confusing and invalidating the strategic calculations and maneuvers of the adversary. Although Boyd in a sense merely seems to restate his previous arguments, at the strategic level Boyd sees the enemy not anymore as tactical units, but as an organic whole, as an adaptive system composed of a variety of subsystems.

Another difference is that for Boyd, the cognitive element becomes more and more important at the strategic level. Boyd offers the following list of methods to influence the potential strategic behavior of the enemy[118]:



The strategic level commander is concerned with the entire enemy system. And as he will be more detached from the battlefield, a timely and correct information flow from the dynamic battlefield to the commander, and the ability to correctly assess events, become dominant factors of success. Although the cognitive side (here used as shorthand for morale, a sense of morality of one's actions as well as the element of judgement) is important for the behavior of each individual soldier, the impact of the moral aspect on the behavior of any commander has a greater impact on the whole operation. The impact of the cognitive

[118] Ibid, p.132.

dimension on the behavior of a strategic commander will subsequently have a direct impact on the strategic outcome.

This leads Boyd to the conclusion that in general terms the *strategic aim* is to:

> Penetrate moral-mental-physical being to dissolve his moral fiber, disorient his mental images, disrupt his operations, and overload his system, as well as subvert, shatter, seize or otherwise subdue those moral-mental-physical bastions, connections, or activities that he depends upon, in order to destroy internal harmony, produce paralysis, and collapse adversary's will to resist.[119]

This results in a synthesis of abstract formulations of prescriptions for actions and objectives of operations at the tactical, the grand tactical and strategic level. It is in a sense a list of things "to do". However, it is not a check list for commanders to follow, but a re-conceptualization of what one should be trying to achieve vis à vis the opponent's level of cohesion, his capability to observe and orient correctly, and his ability to respond in a timely and relevant way. In other words, Boyd offers ideas for affecting the opponent's capability to adapt, and he argues that it requires that any physical movement, as well as the hiding of movements, should relate directly to a cognitive effect one wants to achieve within the OODA process of the opponent[120]:

Tactics

- 'OODA' more inconspicuously, more quickly and with more irregularity as basis to keep or gain initiative as well as shape or shift main effort; to repeatedly and unexpectedly penetrate vulnerabilities and weaknesses exposed by that effort or other effort(s) that tie up, divert, or drain-away adversary attention (and strength) elsewhere.

Grand Tactics

- Operate inside adversary's OODA-loops, or get inside his mind-time-space, to create a tangle of threatening and/or non-threatening events/efforts as well as repeatedly generate mismatches between those events/efforts adversary observes, or anticipates, and those he must react to, to survive;

  Thereby

- Enmesh adversary in an amorphous, menacing, and unpredictable world of uncertainty, doubt, mistrust, confusion, disorder, fear, panic, chaos,… and/or fold adversary back inside himself;

[119] Ibid, p.133.
[120] Ibid, p.134.

Thereby

- Maneuver adversary beyond his moral-mental-physical capacity to adapt or endure so that he can neither divine our intentions nor focus his efforts to cope with the unfolding strategic design or related decisive strokes as they penetrate, splinter, isolate or envelop, and overwhelm him.

Strategy

- Penetrate moral-mental-physical being to dissolve his moral fiber, disorient his mental images, disrupt his operations, and overload his system, as well as subvert, shatter, seize or otherwise subdue those moral-mental-physical bastions, connections, or activities that he depends upon, in order to destroy internal harmony, produce paralysis, and collapse adversary's will to resist.

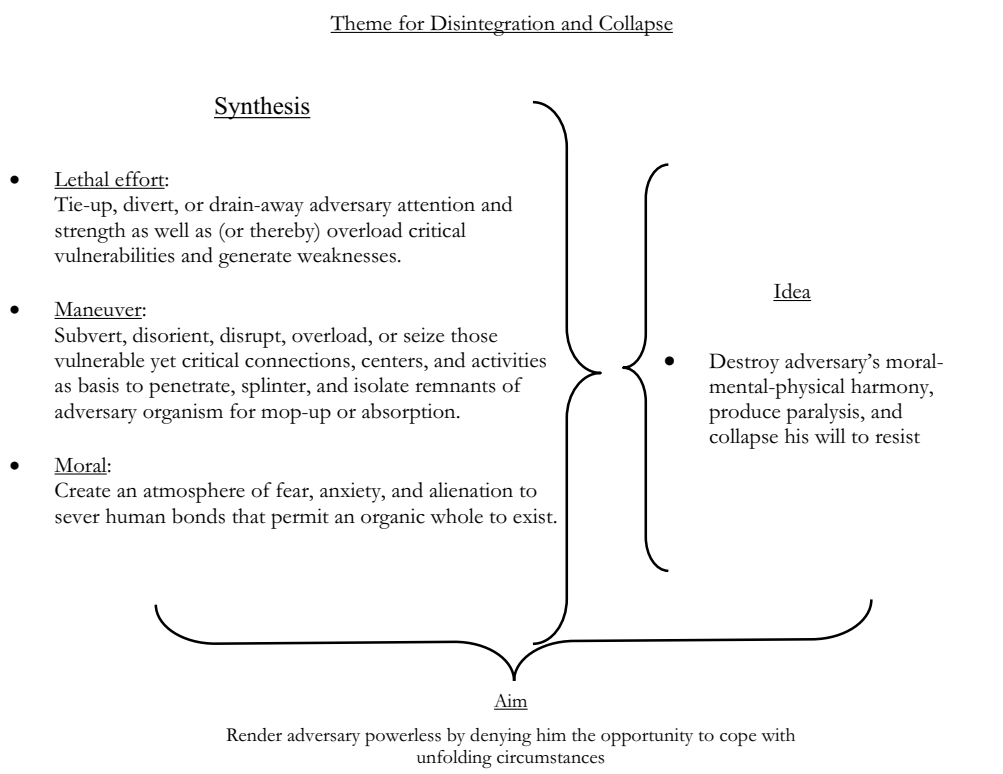
Strategic Aim

- Diminish adversary's capacity while improving our capacity to adapt as an organic whole, so that our adversary cannot cope while we can cope with events/efforts as they unfold.

Theme for disintegration and collapse

The name of the game. Boyd acknowledges that so far this exercise has not produced insights that are significantly different from the destructive attrition-maneuver-moral ideas played out in the synthesis of Categories of Conflict. More is required to lay bare the essence of winning and losing. Boyd subsequently recasts both Categories of Conflict and the list of ideas above in the following schematic, once more showing the deeper meaning of the rapid OODA loop idea, dispelling the notion that mere information superiority or superior speed in command and control is the essence of that idea. In the schematic Boyd has captured and combined elements of maneuver and moral conflict, as well as an element of the description of Grand Tactics. By now Boyd has worked his way towards a view on strategy, which focuses on those elements that allow complex social structures to exist and function in a purposeful way and to adapt to changes in the environment. Gradually his verbiage has become more abstract, general and conceptual in nature, and decreasingly recognizable as grounded in military history[121]:

[121] Ibid, p.135-136.



His holistic approach, and his view of the adversary as a complex adaptive system, becomes even more manifest in the subsequent slides, which lead him to formulate nothing less than the *Theme for Vitality and Growth*. Boyd continues to strip down and recombine his ideas, focusing in particular on the element of cohesion. Not the manifestation of force but the cohesion that produces it should be the focus of planning. For Boyd asserts that the "underlying insight" of the *Theme for Disintegration and Collapse*, is that[122]:

> unless one can penetrate adversary's moral-mental-physical being, and sever those interacting bonds that permit him to exist as an organic whole, by being able to subvert, shatter, seize, or otherwise subdue those moral-mental-physical bastions, connections, or activities that he depends upon, one will find it exceedingly difficult, if not impossible, to collapse adversary's will to resist.

Boyd then homes in on the meaning of the word "penetrate". Seen from a different angle, the observation above can be rephrased to produce the *name of the game* as[123]:

[122] Ibid, p.137.
[123] Ibid.

> Morally-mentally-physically isolate adversary from allies or any outside support as well as isolate elements of adversary or adversaries from one another and overwhelm them by being able to penetrate and splinter their moral-mental-physical being at any and all levels.

From this perspective the nexus of military strategy and grand strategy comes into view, which involves other sources of power, national public support, ideology, etc. Or put in the question Boyd asks his audience: 'How do we connect the tactical and strategic notions or the theme for disintegration and collapse with the national goal?' Again Boyd provides the answer: 'via a sensible *grand strategy* that will':

- Support national goal.
- Pump-up our resolve, drain away adversary resolve, and attract the uncommitted.
- End conflict on favorable terms.
- Ensure that conflict and peace terms do not provide seeds for (unfavorable) future conflict[124].

In Boyd's view grand strategy first and foremost must be an appealing idea, or set of objectives and interests, which inspires and unites the populace as well as allies and the uncommitted. Grand strategy is directly related to, and should be a function of, the prime national goal, which Boyd earlier regarded as a Darwinian drive to improve the fitness of the nation to survive in the dynamic environment. The *essence of grand strategy* for Boyd is to:

- Shape pursuit of national goal so that we not only amplify our spirit and strength (while undermining and isolating our adversaries) but also influence the uncommitted or potential adversaries so that they are drawn toward our philosophy and are empathetic toward our success.

Grand strategy should therefore be designed on the basis of:

- An appreciation for the underlying self-interests, critical differences of opinion, internal contradictions, frictions, obsessions, etc., that we as well as the uncommitted and any potential or real adversaries must contend with[125].

Strategy as a mode of behavior. Boyd then presents the combined set of prescriptions concerning the modes of behavior that favor success and survival on the various levels in a hierarchical order[126].

> *National Goal*
> Improve fitness, as an organic whole, to shape and cope with an everchanging environment.
>
> *Grand Strategy*
> Shape pursuit of national goal so that we not only amplify our spirit and strength (while undermining and isolating our adversaries) but also influence the uncommitted or potential adversaries so that they are drawn toward our philosophy and are empathetic toward our success.

[124] Ibid, p.138-39.
[125] Ibid, p.140.
[126] Ibid, p.141.

Strategic Aim
Diminish adversary's capacity while improving our capacity to adapt as an organic whole, so that our adversary cannot cope while we can cope with events/efforts as they unfold.

Strategy
Penetrate moral-mental-physical being to dissolve his moral fiber, disorient his mental images, disrupt his operations, and overload his system, as well as subvert, shatter, seize or otherwise subdue those moral-mental-physical bastions, connections, or activities that he depends upon, in order to destroy internal harmony, produce paralysis, and collapse adversary's will to resist.

Grand Tactics

- Operate inside adversary's OODA-loops, or get inside his mind-time-space, to create a tangle of threatening and/or non-threatening events/efforts as well as repeatedly generate mismatches between those events/efforts adversary observes, or anticipates, and those he must react to, to survive;

  Thereby

- Enmesh adversary in an amorphous, menacing, and unpredictable world of uncertainty, doubt, mistrust, confusion, disorder, fear, panic, chaos,… and/or fold adversary back inside himself;

  Thereby

- Maneuver adversary beyond his moral-mental-physical capacity to adapt or endure so that he can neither divine our intentions nor focus his efforts to cope with the unfolding strategic design or related decisive strokes as they penetrate, splinter, isolate or envelop, and overwhelm him.

Tactics

- 'OODA' more inconspicuously, more quickly and with more irregularity as basis to keep or gain initiative as well as shape or shift main effort; to repeatedly and unexpectedly penetrate vulnerabilities and weaknesses exposed by that effort or other effort(s) that tie up, divert, or drain-away adversary attention (and strength) elsewhere.

Boyd explains how the National Goal and Grand Strategy, which tend to be constructive in nature, are directly related and in harmony with Strategic Aim, Strategy, Grand Tactics and Tactics, despite the fact that these four are destructive in nature.

It is an important section, for it provides insight into Boyd's view of the main aim of warfare, and his close association with Sun Tzu, Fuller and Liddell Hart. Following naturally from his discussion of the flaws of attrition warfare and his praise for the alternatives of moral and maneuver conflict, Boyd explains that[127]:

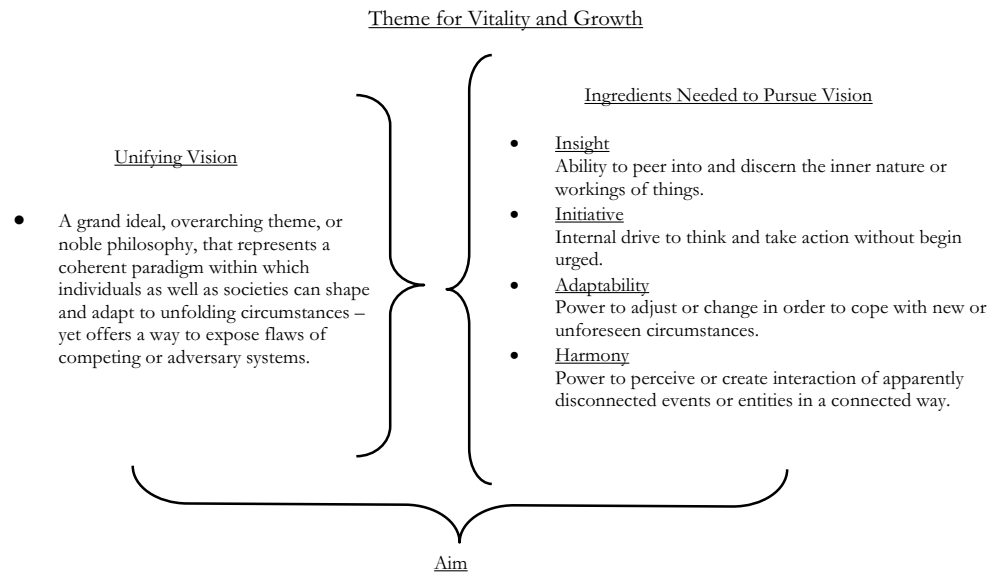
> …application of these latter four strategic and tactical notions permit real leadership to *avoid high attrition, avoid widespread destruction, and gain a quick victory*. This, combined with shattered cohesion, paralysis, and rapid collapse demonstrated by the existing adversary regime, makes it appear corrupt, incompetent, and unfit to govern. Under these circumstances, leaders and statesmen offering generous terms can form the basis for a viable peace. In this sense, the first two and the latter four notions can be in harmony with one another.

[127] Ibid, p.142.

Theme for vitality and growth

Boyd is still not satisfied because the destructive element is not sufficiently balanced by an awareness of the importance of a constructive element for national survival. In a slide with full prose Boyd asserts that 'up to this point – by repeatedly adding, stripping-away, and recombining many different, yet similar, ideas and thoughts – we have examined the nature of conflict, survival, and conquest in many different ways. A review and further manipulation of the ideas and thoughts that make-up these different ways suggest that, for success over the long whole and under the most difficult conditions, one needs some unifying vision that can be used to attract the uncommitted as well as pump-up friendly resolve and drive and drain-away or subvert adversary resolve and drive. In other words, what is needed is a vision rooted in human nature so noble, so attractive that it not only attracts the uncommitted and magnifies the spirit and strength of its adherents, but also undermines the dedication and determination of any competitors or adversaries. Moreover, such a unifying notion should be so compelling that it acts as a catalyst or beacon around which to evolve those qualities that permit a collective entity or organic whole to improve its stature in the scheme of things. Put another way, we are suggesting a need for a supra-orientation or center-of-gravity that permits leaders, and other authorities, to inspire their followers and members to enthusiastically take action toward confronting and conquering all obstacles that stand in the way'[128].

Enclosed in this section Boyd again, but now from yet another angle and now at the societal level, looks for and finds elements that foster initiative and harmony, two among four vital elements for survival he already introduced on page 12 of the presentation. The themes he regards as vital for success are conceptually quite similar. For instance, Boyd sees a unifying vision as yet another way to achieve implicit control. Indeed, Boyd comes full circle in his formulation of the:



[128] Ibid, p.143.

Application

Revisiting Sun Tzu, reinforcing key themes. In this section Boyd takes his audience on a tour through the early German military campaigns in Poland, the Low Countries and France and Russia. In that respect, this section resembles the previously discussed section titled 'Historical Snap-Shots'. The importance of this section however lies not so much in the historical analysis and illustrations. In stead, what makes this section relevant is the way Boyd shows how military success is the result of a dialectic process of adaptation and counter adaptation, of shaping and being shaped. He uses the Blitz-Counter Blitz dynamic to illustrate this. This seems merely an expansion of his earlier sections. However, now Boyd ties dynamic even more than before to the cognitive element of war. Boyd returns to Sun Tzu to explain and re-emphasis this key argument to which he has already frequently alluded.

On the one hand the discussion is thus a repetition of his earlier remarks on counter-blitz but now with the following central theme: what matters at all levels of command, is the cognitive impact of feints, maneuvers, attacks, retreats, threats, fire-engagements, etc. Collectively they constitute information and this information could reveal a pattern, and recognizing a pattern can lead the opponent to make predictions about the next steps. Consequently, the name of the game becomes one of consciously shaping the opponent's perception of the pattern of operations unfolding before him, while hiding the real picture.

Again here Boyd stresses the connection between physical events and cognitive impact, and now he takes this to the logical conclusion that cognitive impact needs to be a core rationale for designing tactics, grand tactics and strategy. Foreknowledge and judgment play central role here. And the influence of Sun Tzu is explicit not only because Boyd includes Sun Tzu in the titles of slides 146-156, but also because Boyd borrows heavily from the master. Ideas of Sun Tzu's *The Art of War,* such as *cheng/ch'i, the vacuous and substantial,* the idea of *formlessness and being unfathomable* echo through. As was discussed in chapter 8, the concept of *ch'i and cheng* is about conceptualizing, characterizing, manipulating forces within, and by exploiting an enemy's matrix of expectations.

The aim of Blitz and counter Blitz, according to Boyd, is to "blind side" the adversary regardless of the circumstances[129]. The 'human penchant for generating mental patterns' immediately suggests that it is important to shape the adversary's impression. Translated to the defense against a Blitz, shaping the opponent's impression is accomplished by arranging the elements of defense, as the basis to guide adversaries to form or project patterns on the environment they are facing. In other words, one should emphasize certain features so that the adversary's intelligence, recce, patrols, and other observation activity generate mental pictures of what we seem to be doing. In this sense, we cause the adversary to project or rhythm as well as a sense of for or gestalt upon the environment. Naturally, Boyd tells his audience, this raises the question: How do we want our posture to appear to an adversary, i.e., what kind of mental picture do we want to generate in his mind[130]?

Designing one's defense on this basis is obviously quite a departure from the regular determinants of tactics and grand tactics, which were generally related to terrain and enemy position and strength. After literally repeating the things to do for the counter Blitz of p.105[131], Boyd reveals that at the strategic level the game of Counter-Blitz is to:

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[129] Ibid, p.148.
[130] Ibid.
[131] Ibid, p.149.

- Shift from such an ambiguous or misleading posture into a gauntlet defense with alternative channels, sectors, or zones by thinning-out some sectors or zones in order to strengthen others.

The basic notion is to think in terms of channels, avenues, and gauntlets (instead of just belts, bands and fronts) so that ambush gauntlets will naturally evolve or be set-up to deal with forward as well as lateral (roll-out) thrusts of the adversary. In this way, ambush gauntlets can then be set-up at any level from platoon to theater[132].

At the tactical level one should use obstacles, delaying actions, hit-and-run attacks (note the inclusion of guerrilla tactics) and/or baited retreats in thinned-out sectors/zones together with "shaping" and "disruption" activities to disorient adversary as well as to pile-up or stretch-out his maneuver. These actions should be accompanied with fire and movement (coming from one's own strengthened adjacent sectors/zones) into the flanks and/or rear of the adversary. This will slow the opponent's momentum and 'blow adversary away', or alternatively, will channel the momentum. The thrust can then either be decapitated, or in case of stretch-out, the cohesion of the thrust can be broken[133].

The cognitive effects of these actions are what matters, and these cognitive effects will lead to an enemy response which is to some extend predictable. Thus shaping the enemy's actions can be effectuated. As Boyd explains:

Mental picture

- Think of obstacles, delay, hit-and-run, and baited retreats together with shaping and disruption activities as Cheng or Nebenpunkte to create gaps, exposed flanks, and vulnerable rears by the pile-up/congestion or stretch-out of adversary maneuver.
- Think of Ch'i or Schwerpunkt maneuver (fire and movement) hitting unexpectedly thru gaps into adversary flank/rear, or blind-side, as a decisive stroke to pull enemy apart and roll-up his isolated remnants[134].

A similar message lies in other related air and ground reconnaissance and offensive actions. They serve to harass and delay the enemy, to disorient him while at the same time providing information to one's own senior commanders to help them decide which sectors to thin-out and which to strengthen[135]. Multiple counterstrokes, the interplay of Nebenpunkte and Schwerpunkte disrupt the enemy offensive, force him to allow gaps and to stretch out his forces. Rapid shifts of forces can then reinforce a successful minor counter attack into a 'super-Schwerpunkt'. Such maneuvers are effective not only because of the delay in the advance they cause but also by forcing the opponent to become 'preoccupied in overcoming the challenge posed by the Super Nebenpunkte'. Such Counter-Blitz actions keep the pressure on the enemy who now is continually forced to adapt to many abrupt and irregular changes[136].

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[132] Ibid, p.150.
[133] Ibid, p.151. Anyone asserting that Boyd claims one can win by merely OODA looping faster has overlooked these deliberately chosen words.
[134] Ibid.
[135] Ibid, p.152.
[136] Ibid, pp.152-153.

The general underlying idea of Counter-Blitz, according to Boyd, is thus to:

> Pull adversary apart and bring about his collapse by causing him to generate or project mental images that agree neither with the faster tempo/rhythm nor with the hidden form of the transient maneuver patterns he must compete against[137].

After a 17 page discussion of the German Blitz campaigns, and the successful Russian Counter-Blitz, which serves to illustrate this underlying idea, Boyd arrives at the section of *Patterns of Conflict*, in which he ties the various key insights together in 5 pages and produces a conclusion of Boyd view on the art of success.

Wrap Up, or coming full circle

What 'getting inside the enemy's OODA loop means. The wrap-up is a highly conceptual synthesis and reformulation of all of his previous arguments, ideas and themes. It includes direct reference to his earliest intuitive remarks as well as his last argument concerning the importance of shaping the opponent's perception. Here Boyd abandons the division in tactical, grand tactical and strategic levels but combines them. He does not refer to attrition, maneuver or moral conflict anywhere, but merges the essence of the latter two. He attempts to strip away and recombine even further than before to arrive at the most concise formula for explaining success and failure in conflict. In a sense the wrap-up is Boyd's way of proving he has validated the assertions he made in the first section of *Patterns of Conflict*. On page 12 he had asserted that 'variety, rapidity, harmony and initiative seem to be the key qualities that permit one to shape and adapt to an ever-changing environment'. In the 'Wrap Up' he focuses on these four elements in particular to arrive at the most concise conceptualization of "The Art of Success". According to Boyd, the message thus far is that[138]:

- He who is willing and able to take the initiative to exploit variety, rapidity, and harmony – as basis to create as well as adapt to the more indistinct - more irregular – quicker changes of rhythm and pattern, yet shape focus and direction of effort – survives and dominates.

  or contrariwise

- He who is unwilling or unable to take the initiative to exploit variety, rapidity, and harmony…goes under or survives to be dominated.

The Game, Boyd has pointed at, is to:

- Create tangles of threatening and/or non-threatening events/efforts as well as repeatedly generate mismatches between those events/efforts adversary observes or imagines (Cheng/Nebenpunkte) and those he must react to (Ch'i/Schwerpunkt)

  as basis to

- Penetrate adversary organism to sever his moral bonds, disorient his mental images, disrupt his operations, and overload his system, as well as subvert, shatter, seize or otherwise

[137] Ibid, p.156.
[138] Ibid, p.174.

subdue those moral-mental-physical bastions, connections, or activities that he depends upon

thereby

- Pull adversary apart, produce paralysis, and collapse his will to resist.

The way to accomplish this, the how to, in most abstract terms is to:

- Get inside adversary observation-orientation-decision-action loops (at all levels) by being more subtle, more indistinct, more irregular, and quicker – yet appear to be otherwise[139].

Boyd then adds a short but new discussion on the implications of these observations, in particular how they relate to the four elements he had introduced at the beginning of *Patterns of Conflict*: variety, rapidity, harmony and initiative. In this discussion he inserts Sun Tzu's idea of fluidity, an important theme from his essay *Destruction and Creation*, the element of organizational complexity as well as the discussion above on pattern recognition. Boyd asserts that[140]:

- In a tactical sense, these multi-dimensional interactions suggest a spontaneous, synthetic/creative, and flowing action/counteraction operation, rather than a step-by-step, analytical/logical, and discrete move/countermove game.

    - in accepting this idea we must admit that increased unit complexity (with magnified mental and physical task loadings) does not enhance the spontaneous synthetic/creative operation. Rather, it constrains the opportunity for these timely actions/counteractions.

      or put in another way

    - Complexity (technical, organizational, operational, etc.) causes commanders and subordinates alike to be captured by their own internal dynamics or interactions – hence they cannot adapt to rapidly changing external (or even internal) circumstances.

- In a strategic sense, these interactions suggest we need a variety of possibilities as well as the rapidity to implement and shift among them. Why?

    - Ability to simultaneously and sequentially generate many different possibilities as well as rapidly implement and shift among them permits one to repeatedly generate mismatches between events/efforts adversary observes or imagines and those he must respond to (to survive).

    - Without a variety of possibilities adversary is given the opportunity to read as well as adapt to events and efforts as they unfold.

Recombining these (in particular the comment on organizational complexity, and other comments and insights (including the Clausewitzian concept of friction) related to the four elements of variety/rapidity/harmony/initiative, Boyd shows what and how they contribute

[139] Ibid, p.175.
[140] Ibid, p.176.

to victory by connecting them to the ability to adapt. Boyd asserts that 'Variety and rapidity allow one to magnify the adversary's friction, hence to stretch-out his time to respond. Harmony and initiative stand and work on the opposite side by diminishing one's own friction, hence compressing one's own time to exploit variety/rapidity in a directed way'. Altogether variety/rapidity/ harmony/initiative enable one to:

> Operate inside adversary's observation-orientation-decision-action loops to enmesh adversary in a world of uncertainty, doubt, mistrust, confusion, disorder, fear, panic, chaos, …and/or fold adversary back inside himself so that he cannot cope with events/efforts as they unfold.

Simultaneously, so Boyd continues, 'by repeatedly rolling-thru OODA loops while appealing to and making use of the ideas embodied in "Grand Strategy" and "Theme for Vitality and Growth", we can evolve and exploit variety/rapidity/ harmony/initiative as a basis to:

> Shape or influence events so that we not only amplify our spirit and strength (while isolating our adversaries and undermining their resolve and drive) but also influence the uncommitted or potential adversaries so that they are drawn toward our philosophy and are empathetic toward our success[141].

The Art of Success. Finally, Boyd arrives at his "nutshell" formulation of what constitutes "The Art of Success". The two sentences that convey this view do not make a convincing assertion when read in isolation. Indeed, they may sound simplistic. However, when read in the context of the discourse he has had so far with his audience, the various exercises in abstraction, in stripping away and recombining, this final effort at getting to the essence of things contains a world of meaning, theories, theorists, schools of thought and concepts. Every word has been discussed before and has become a signifier of a train of thought. And in these few words Boyd both concludes and captures a discussion which spans 2500 years of military history and strategic theory. In a few conceptually rich but very abstract words, he manages to combine in a logically connected way the "things to do" at the tactical, grand tactical, the strategic and grand strategic levels, themes from moral and maneuver conflict and the themes for vitality and growth and theme for disintegration and collapse. Boyd's advice for success is to[142]:

The Art of Success

- Appear to be an unsolvable cryptogram while operating in a directed way to penetrate adversary vulnerabilities and weaknesses in order to isolate him from his allies, pull him apart, and collapse his will to resist.

  yet

- Shape or influence events so that we not only magnify our spirit and strength but also influence potential adversaries as well as the uncommitted so that they are drawn toward our philosophy and are empathetic toward our success.

The first sentence is an advice to remain, in the words of Sun Tzu, unfathomable to the enemy, yet operate coherently in several levels of war and across different dimension. While

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[141] Ibid, p.177.
[142] Ibid, p.178.

this part includes physical actions, the second sentence exclusively refers to the moral, ideational and political aspects of strategy.

In the Epilogue Boyd compares his arguments with the familiar (but varying by country) principles of war. These principles suggest certainty and seem like a check-list for success. This makes them popular. To cater for those who favor a concise list of "to do's", Boyd offers a list that captures in a sufficient way his thoughts, yet cannot be construed as "principles". They span the physical, temporal and the cognitive dimensions. They deal with adaptiveness and include the view of the enemy as an adaptive organism. In stead of principles, Boyd refers to them as[143]:

Appropriate Bits and Pieces

- Compress own time and stretch-out adversary time.
- Generate unequal distributions as basis to focus moral-mental-physical efforts for local superiority and decisive leverage.
- Diminish own friction (or entropy) and magnify adversary friction (or entropy).
- Operate inside adversary's observation-orientation-decision-action loops or get inside his mind-time-space.
- Penetrate adversary organisms and bring about his collapse.
- Amplify our spirit and strength, drain-away adversaries' and attract the uncommitted.

The "Central Theme", Boyd concludes his massive search for the *Pattern of Conflict*, lies in these final words:

> Evolve and exploit insight/initiative/adaptability/harmony together with a unifying vision, via a grand ideal or an overarching theme or a noble philosophy, as basis to:
>
> - Shape or influence events so that we only amplify our spirit and strength but also influence the uncommitted or potential adversaries so that they are drawn toward our philosophy and are empathetic toward our success,
>
> Yet be able to
>
> - Operate inside adversary's observation-orientation-decision-action loops or get inside his mind-time-space as basis to:
>
> - Penetrate adversary's moral-mental-physical being in order to isolate him from his allies, pull him apart, and collapse his will to resist.

Concluding words

In *Patterns of Conflict* Boyd has thus offered his audience a new look at military history. With the conceptual lenses science offered him, with uncertainty as the key problem organisms and organizations have to surmount, he sheds new light on the dynamics of war. He has introduced familiar and some new case studies and theories. In particular in the second halve of the presentation Boyd makes a shift in level of abstraction. Applying the process of

[143] Ibid, p.184.

destruction and creation to his investigation, he uncovers underlying dynamics of each mode of warfare and expresses these in an increasingly abstract and conceptual way. It implicitly manifests an increasing application of systems-theoretical perspectives. Expressed within the context of adaptation, he shows conceptual similarities between very distinct modes of warfare. Gradually he unfolds a novel conceptualization of tactics, grand tactics, strategy and grand strategy that revolves around the process of adaptation in which open, complex adaptive systems are constantly engaged in. Already it has thus become evident that Boyd's work contains much more than "only" the rapid OODA loop idea. *Patterns* shows Boyd pays attention to the different levels of war and to different modes of warfare. It addresses the intimate connection between the physical, mental and moral dimensions of war. Moreover, it shows a constant focus on cohesion and highlights various methods to decrease enemy cohesion at the different levels of war. The following presentations will reinforce the impression that Boyd's work is indeed comprehensive and focussed on the theme of adaptation.

7. EXPLORATION AND REFINEMENT

Introduction

Before starting the detailed description of the five remaining presentations, a review of Boyd's own shorthand description of the essence of the various presentations helps positioning each of them. In *Destruction and Creation* Boyd lays out in abstract but graphic fashion the ways by which we evolve mental concepts to comprehend and cope with our environment. *Patterns of Conflict* represents a compendium of ideas and actions for winning and losing in a highly competitive world. In the following presentation titled *Organic Design for Command and Control* Boyd continues on the argument he laid out in *Patterns,* but now focussing on the implicit arrangements that permit cooperation in complex, competitive, fast moving situations. *The Strategic Game of ? and ?* emphasizes the mental twists and turns we undertake to surface appropriate schemes or designs for realizing our aims or purposes. It aims to uncover even more fundamental abstract dynamics than he has presented in *Patterns*. In *Revelation* Boyd makes visible the metaphorical message that flows from the *Discourse*. It is a restatement of the message of *Destruction and Creation*, which again he explores in detail and in less philosophical terms in *The Conceptual Spiral*. In the final presentation, *The Essence of Winning and Losing*, Boyd synthesizes for the last time in even more condenced form the core messages in a coherent comprehensive framework. In just few pages and a graphic rendering of the OODA loop, he manages to merge Polanyi, Kuhn, Popper, Gell-Mann, Sun Tzu, Liddell Hart. It shows once more and very clearly that the narrow interpretation of Boyd's work, equating the message of *A Discourse* with rapid OODA looping, is incomplete and inaccurate.

Organic Design for Command and Control

Introduction

Whereas isolation of the opponent from his environment (across all levels of organization) was the theme of the previous briefing, interaction is the theme of this one. As Boyd has already argued, only open systems can adapt adequately to change. An organism needs to maintain interaction with its environment if it is to survive. In military organizations this is responsibility of the command and control system. In *Organic Design for Command and Control* Boyd develops the parameters for an adequate command and control concept. It will come as no surprise that the briefing reflects insights of *Patterns of Conflict*, in particular from the sections on Blitzkrieg and maneuver conflict. It also reflects the influence of several studies on leadership, command and small unit cohesion Boyd had read. The bibliography of *Patterns of Conflict* of December 1986 lists studies on generals Bonaparte, Grant, Lee, Patton, Genghis Kahn, Guderian, the Prussian general staff system, German generalship during World War II, tactical genius, morale, several case studies on command and control and autobiographical works of generals Erwin Rommel and Heinz Guderian[1].

[1] Various sources have already been mentioned in footnotes in the previous chapter. Here it is worthwhile to note the following works that appear in Boyd's bibliography: David Downing, *The Devil's Virtuosos: German Generals at War 1940-1945* (1977); T.N. Dupuy, *The Military Life of Genghis,*

Boyd's inspiration also came in part from some fiasco's he had witnesses in the US armed forces exercises and operations, such as the failed evacuation operation Desert I in Iran. In his introduction he points out that normal, 'institutional responses to such failures is more and better sensors, more communications, more and better display devices, more satellites, more and better fusion centers, etc. – all tied into one giant fully informed, fully capable Command and Control system. This way of thinking emphasizes hardware as the solution[2].

Boyd's approach is process oriented, or in his words, 'I think there is a different way, a way that emphasizes the implicit nature of human beings. In this sense, the following discussion will uncover what we mean by both implicit nature and organic design'[3].

Criteria for command and control

He starts out with providing some guiding thoughts as the background for the rest of his argument, much as he had done in the first pages of *Patterns of Conflict*. In effect, he lays out a set of criteria around which a command and control philosophy must be designed. Boyd asserts that we:

- Need insight and vision to unveil adversary plans and actions as well as "foresee" own goals and appropriate plans and actions.
- Need focus and direction to achieve some goal or aim.
- Need adaptability, to cope with uncertain and everchanging circumstances.
- Need security, to remain unpredictable[4].

The rationale for these criteria is also offered and it is closely related to the two variants of the set of four elements Boyd had introduced in *Patterns of Conflict:*

- variety/rapidity/harmony/initiative (Patterns of Conflict, p.12);
- insight/initiative/adaptability/harmony (Patterns of Conflict, p.185).

As Boyd explains, 'without insight and vision there can be no orientation to deal with both present and future. Without focus and direction, implied or explicit, there can be neither harmony of effort nor initiative for vigorous effort. Adaptability implies variety and rapidity. Without variety and rapidity one can neither be unpredictable nor cope with changing and unforeseen circumstances. Without security one becomes predictable, hence one loses the benefits of the above'[5]. From this basis, Boyd sets out to develop a normative view on a design for command and control. Like Patterns of Conflict, he starts with some historical

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Khan of Khans (1969) and *A Genius for War* (1977); J.F.C. Fuller, *Grant ands Lee*, (1932); Richard Gabriel and Paul Savage, *Crisis in Command* (1978); Richard Gabriel and Reuven Gal, 'The IDF Officer: Linchpin in Unit Cohesion', *Army* (January 1984); John Gardner, *Morale* (1978); Simon Goodenough and Len Deighton, *Tactical Genius in Battle* (1979); Heinz Guderian, *Panzer Leader* (1952); Richard Humble, *Hitler's Generals* (1974); Albert Kesselring et al, *Manual for Command and Combat Employment of Smaller Units* (1952); Harold Lamb, *Genghis Khan* (1927); Kenneth Macksey, *Guderian, Creator of the Blitzkrieg* (1976); S.L.A. Marshall, *Men Against Fire* (1947); Erwin Rommel, *Infantery Attacks* (1937); Charles Whiting, *Patton* (1970); and importantly, Martin van Creveld, *Command in War* (1982).

[2] *Organic design for Command and Control*, p.2

[3] Ibid. It is not difficult to see the influence of *The Tacit Dimension* in this.

[4] Ibid, p.3.

[5] Ibid, p.4.

snapshots, or "samples from historical environment". He offers nine citations from nine practitioners (including himself)[6]:

Sun Tzu (around 400 BC)
Probe enemy strength to unmask his strengths, weaknesses, patterns of movement and intentions. Shape enemy's perception of world to maipulate/ undermine his plans and actions. Employ Cheng/Ch'I maneuvers to quickly and unexpectedly hurl strength against weaknesses.

Bourcet (1764-71)
A plan ought to have several branches…One should…mislead the enemy and make him imagine that the main effort is coming at some other part. And…one muist be ready to profit by a second or third branch of the plan without giving one's enemy time to consider it.

Napoleon (early 1800's)
Strategy is the art of making use of time and space. I am less chary of the latter than the former. Space we can recover, time never. I may lose a battle, but I shall never lose a minute. The whole art of war consists in a well reasoned and circumspect defensive, followed by rapid and audacious attack.

Clausewitz (1832)
Friction (which includes the interaction of many factors, such as uncertainty, psychological/moral forces and effects, etc.) impedes activity. Friction is the only concept that more or less corresponds to the factors that distinguish real war from war on paper. In this sense, friction represents the climate or atmosphere of war.

Jomini (1836)
By free and rapid movements carry bulk of the forces (successively) against fractions of the enemy.

N.B. Forrest (1860's)
Git thar the fustest with the mostest

Blumentritt (1947)
The entire operational and tactical leadership method hinged upon …rapid concise assessment of situations,…and quick decision and quick execution, on the principle: each minute ahead of the enemy is an advantage.

Balck (1980)
Emphasis upon creation of implicit connections or bonds based upon trust, not mistrust, that permit wide freedom for subordinates to exercise imagination and initiative--yet harmonize within intent of superior commanders. Benefit: internal simplicity that permits rapid adaptability.

Yours truly
Operate insde adversary's observation-orientation-decision-action loops to enmesh adversary in a world of uncertainty, doubt, mistrust, confusion, disorder, fear, panic, chaos,…and/or fold adversary back inside himself so that he cannot cope with events/efforts as they unfold.

The key points Boyd derives from these quotations are that (1) the atmosphere of war is friction; (2) friction is generated and magnified by menace, ambiguity, deception, rapidity, uncertainty, mistrust, etc.; (3) friction is diminished by implicit understanding, trust, cooperation, simplicity, focus, etc.; and (4) in this sense, variety and rapidity tend to magnify friction, while harmony and initiative tend to diminish friction[7]. In other words, without harmony and initiative, variety and rapidity lead to confusion and disorder. Harmony and initiative without variety and rapidity lead to rigid uniformity and predictability and ultimately to non-adaptability. The problem for any command concept then becomes to find an answer to the question how to generate harmony/initiative so that one can exploit variety/rapidity. Boyd comments on that question by suggesting that we must uncover those interactions that foster harmony and initiative yet do not destroy variety and rapidity[8].

[6] Ibid, pp.7-8.
[7] Ibid, p.8.
[8] Ibid, p. 9.

The Big O: Orientation.

The ensuing discussion is quintessential for understanding Boyd, for it leads him to the key concept of Orientation. Although Boyd does not explain it on paper explicitly, his focus on interactions lies in their function: interactions in various forms are the glue that binds the various nodes of a social system together. This becomes (albeit not self-) evident in the contrasting of positive and negative features of activities and linkages, which Boyd apparently introduces for their emotive and associative effect. Positively valued activities for instance are radio transmission *and* reception, conversation, writing and teamwork. Positively valued features of linkages are common frequencies, common language, correlation among multiple sources and harmony of different efforts[9]. If this may not immediately appear to lead to a deeper understanding of, or to the rationale for focusing on interactions, the list of *negatively valued features* does[10]:

Activities	Linkages
• Compartmentation	• Disconnected bits and pieces
• Non-cooperative centers of gravity	• Islands of disconnected effort
• Alienation	• Disconnected from other humans
• Non-adaptive	• Disconnected from environment
• Fixed recipe	• Disconnected from environment, but connected to some formality

Boyd derives from the first list of positively valued features the insight that 'interactions represent a many-sided implicit cross-referencing process of projection, empathy, correlation, and rejection'[11]. This is a deceptively simple description. The carefully chosen words, and the few examples which precedes it mask a spectrum of insights and theories. In the collision of ideas and hypothesis (projection) with reality contained within this description we find the Popperian process of conjecture and refutation. In its human elements, this description incorporates Polanyi's vision of knowing, while the aspect of the environment suggests systems theoretical and neo-Darwinist roots. All resurface in his next move.

This insight in the nature of interactions is the first step toward a definition of orientation. In his familiar way Boyd suggests to the audience that he suspects that this insight is in some way related to orientation, which (of course) leads to the question what we mean by orientation. So Boyd provides the second element for a definition:

> Orientation, seen as a result, represents images, views, or impressions of the world shaped by genetic heritage, cultural tradition, previous experiences, and unfolding circumstances.

Thus, in a few words, Boyd brings together synonyms for mental modules, schemata, memes, and tacit knowledge in a dynamic relation with the environment. He explains the sources of images, views or impressions, i.e., the conceptual lenses for observation. And the following step brings together interaction and this description of the result of orientation[12]:

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[9] Ibid, p.10.
[10] Ibid.
[11] Ibid, p.11.
[12] Ibid, p.15.

> Orientation is an interactive process of many sides implicit cross-referencing projections, empathies, correlations, and rejections that is shaped by and shapes the interplay of genetic heritage, cultural tradition, previous experiences and unfolding circumstances.

And it is this dynamic which Boyd later attempts to capture in a graphic rendering. Again Boyd is master of synthesis, but at first reading this description may also baffle a bit. So a short explanation is warranted. The description indicates that orientation is a dynamic process which results in views, images and impressions. This process is (and should be) continuous and is constituted by the development and maintenance of interactions of various kinds with the environment. The interactions are however also subject to modification, as much as the views, images and impressions. A long term and rather immutable formative factor shaping this process is genetic heritage. A medium term factor is culture, while a short term factor in shaping ideas and interactions is constituted by previous experiences. Boyd offers his own illumination[13]:

> Orientation is the Schwerpunkt. It shapes the way we interact with the environment - hence orientation shapes the way we observe, the way we decide, the way we act.
>
> In this sense
>
> Orientation shapes the character of present observation-orientation-decision-action loops - while these present loops shape the character of future orientation.

So from a discussion on the pervasive element of friction and the solution offered by harmony and initiative, from the stated need for adaptability, focus, direction, insight and vision, Boyd has developed the argument that orientation is the center of gravity for command and control. Orientation is the key factor - and variable - that enables or hinders generating harmony and initiative so that one can or cannot exploit variety/rapidity. From this point on, Boyd proceeds to explore the implications of this insight.

Implicit communication and organizational heat-death

By putting orientation central, the immediate implication is quite obvious, both for one's own command set up as for effects one wants to create to hinder the command process of the adversary. The obviousness of the implication (which sounds almost like a truism) however should not detract from the one new relevant element Boyd introduces: patterns (Boyd even suggests that patterns is equivalent to orientation). As Boyd asserts, 'we need to create mental images, views, or impressions, hence patterns that match with activity of [the] world'. The reference to the essay is obvious. However, his audience would most likely not be familiar with it. In this manner Boyd managed to introduce a epistemological theme in a very pragmatic setting.

Conversely, Boyd continues, 'we need to deny [the] adversary the possibility of uncovering or discerning patterns that match our activity, or other aspects of reality in the world'[14]. For 'patterns (hence orientation), right or wrong or lack thereof, suggest ability or inability to conduct many-sided implicit cross-references'. The next obvious issue is thus one of turning theory into practice: 'how do we set-up and take advantage of the many-sided

[13] Ibid, p.16.
[14] Ibid.

implicit cross-referencing process of projection, empathy, correlation, rejection that make appropriate orientation possible?'[15]

As alluded to before, it is tempting to suggest that the answer Boyd derived from the combination of Polanyi's *Knowing and Being,* Bronowski's *The Identity of Man* and various systems-theoretical works. Conceptually, Boyd asserts, it comes from ensuring variety in observation, i.e., variety in mental modules or schemata, within the organization, from conducting observation collectively and from communicating the perceptions. This will in turn lead to a shared, but enriched, understanding. Or in Boyd's words, the message is to

> expose individuals, with different skills and abilities, against a variety of situations - whereby each individual can observe and orient himself simultaneously to the others and to the variety of changing situations.

The reason is that 'in such an environment, a harmony, or focus and direction, in operations is created by the bonds of implicit communications and trust that evolve as a consequence of the similar mental images or impressions each individual creates and commits to memory by repeatedly sharing the same variety of experience in the same way'. The beneficial pay-offs of implicit communications and trust which is created lies in the temporal dimension; the command and control process will occur at an accelerated pace and, second, in increase in the level of initiative that can be generated now that lower level units can be given wide latitude. The payoff is 'a command and control system, whose secret lies in what's unstated or not communicated to one another (in an explicit sense) - in order to exploit lower-level initiative yet realize higher-level intent, thereby diminish friction and compress time, hence gain both quickness and security'[16].

To reinforce his point, Boyd addresses the consequences if one 'cannot establish these implicit connections or bonds- via similar mental images or impressions - as basis to cope with a many-sided uncertain and everchanging environment'[17]. For this exploration, Boyd explains that the previous discussion assumed interaction with both the external and internal environment. Rephrasing the question then becomes what would happen if a command and control system hinders interaction with the external world. According to Boyd, this implies a focus inward, rather than outward[18]. This brings him back to Darwin, Gödel, Heisenberg and the Second Law of Thermodynamics.

From Darwin, Boyd asserts once more, we observe that 'the environment selects', and this process is determined by the 'ability or inability to interact and adapt to exigencies of environment'. According to the Gödel Proof, the Heisenberg Uncertainty Principle and the Second Law of Thermodynamics, 'one cannot determine the character or nature of a system within itself, moreover, attempts to do so lead to confusion and disorder […]because in the real world the environment intrudes'. Marrying these ideas to Clausewitz, Boyd suggests that:

> He who can generate many non-cooperative centers of gravity magnifies friction. Why? Many non-cooperative centers of gravity within a system restrict interaction and adaptability

[15] Ibid, p.17. Boyd here seems to use the term patterns for two different things. In this first sentence of this paragraph, pattern seems to mean a visible consistence, cues in the enemy behavious which indicate a certain action or is afoot, i.e. pattern recognition. In this sense, pattern is associated with Sun Tzu. In the preceeding paragraph, pattern seemed to refer to mental modules and similar terms which allows one to observe cues for what they are in the first place.
[16] Ibid, p.18.
[17] Ibid, p.19.
[18] Ibid, p.20

> of system with its surroundings, thereby leading to a focus inward (i.e., within itself), which in turn generates confusion and disorder, which impedes vigorous or directed activity, hence, by definition, magnifies friction or entropy[19].

In effect, Boyd argues that restricting interaction, and loss of sub-system cohesion will lead to the organizational equivalent of the second law of thermodynamics. This key insight of this exercise is reinforced by Boyd in a sequence of statements[20]:

- Any command and control system that forces adherents to look inward, leads to dissolution/disintegration (i.e., system becomes unglued).

- Without the implicit bonds or connections, associated with similar images or impressions, there can be neither harmony nor individual initiative within a collective entity, therefore, no way that such an organic whole can stay together and cope with a many-sided uncertain and everchanging environment.

- Without implicit bonds or connections, we magnify friction, produce paralysis and get system collapse.

Having shown what can happen to an enemy organization when it cannot recognize patterns, when it cannot interact with the environment, when units become isolated from their environment and unglued from each other, when they lack shared images, Boyd returns to the meaning of all this for one's own organization. The first insight is that

> the key idea is to emphasize implicit over explicit in order to gain a favorable mismatch in friction and time (i.e., ours lower than any adversary) for superiority in shaping and adapting to circumstances[21].

Secondly, Boyd asserts that one should suppress the tendency to build-up explicit internal arrangements that hinder interaction with the external world. Instead, Boyd argues for arranging a setting and the circumstances so that leaders and subordinates alike are given the opportunity to continuously interact with the external environment, and with each other, in order to more quickly make many-sided implicit cross referencing projections, empathies, correlations, and rejections as well as create the similar images or impressions, hence a similar implicit orientation, needed to form and organic whole[22].

In effect, Boyd argues that all sub-systems of an organization should be open systems, that is, systems with sufficient ability and authority to observe and interact with their respective environment, while at the same time having lateral and vertical linkages with other sub-systems and higher directing entities. Such an arrangement is predicated upon the presence of a similar implicit orientation. The benefits of a similar implicit orientation for commander and subordinates alike, however, are obvious for Boyd for it will allow them to:

- Diminish their friction and reduce time, thereby permit them to:
- Exploit variety/rapidity while maintaining harmony/initiative, thereby permit them to:
- Get inside adversary's OODA loops, thereby:

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[19] Ibid.
[20] Ibid, p.21.
[21] Ibid, p.22.
[22] Ibid, p.23.

- Magnify adversary's friction and stretch-out his time (for a favorable mismatch in friction and time), thereby:
- Deny adversary the opportunity to cope with events/efforts as they unfold.

Circling back to the beginning, to the set of criteria Boyd had stipulated for a 'first rate command and control system', Boyd concludes that it is implicit orientation which shapes the character of insight and vision, focus and direction, adaptability, and security. Therefore, a command and control system, any design or related operational methods should play to and expand, not play down and diminish, implicit orientation[23]. As he states, 'up to this point we have shown orientation as being a critical element in command and control - implying that without orientation there is no command and control worthy of the name. Very nice, but simply stated, what does this comment and everything else we've discussed so far tell us about command and control?'[24] Boyd takes his audience by the hand by offering the following important illumination[25]:

- The process of observation-orientation-decision-action represents what takes place during the command and control process - which means that the OODA loop can be thought of as being the C&C loop.

- The second O, orientation - as the repository of our genetic heritage, cultural tradition, and previous experiences - is the most important part of the OODA loop since it shapes the way we observe, the way we decide, the way we act.

Implication

- Operating inside adversary's OODA loop means the same things as operating inside adversary's C&C loop.

Redefining command and control

Thus far one could argue that Boyd has addressed the organic part of the title of the presentation. He has developed several ideas about the command and control process by taking a systems view, or rather a complex adaptive systems view. Although clear and persuasive, these ideas are still rather conceptual and general. So Boyd now makes his way toward the practical side of effective command and control, which will lead him to a redefinition of command and control and a focus on the essence of leadership.

His starting point, and the normative framework, is clearly the previous discussion on the criteria for a first rate command and control system. Indeed, his views on effective command and control aim to effectuate such a system. And again, he seeks inspiration, if not substantiation, in some historical snapshots he had already used in *Patterns of Conflict*. He refers among others to Napoleon's use of staff officers for personal reconnaissance, von Moltke's message directives of few words, the contrasting British approach of tight control during the Battle of the Somme in 1916[26]. But he leans in particular, and explicitly, on Martin van Creveld's study *Command in War* to gain a "richer view". Boyd includes an entire page from van Creveld's book that deals with the Israeli command set up during the June 1967

[23] Ibid, p.24.
[24] Ibid, p.25.
[25] Ibid, p.26
[26] Ibid, p.28.

War, an example which according to Boyd reveals 'our old friend - the many sided implicit cross-referencing process of projection, empathy, correlation, and rejection'[27]. In the June 1967 War, Boyd cites van Creveld[28],

> General Yashayahu Gavish spent most of his time either "accompanying" units down to brigade level - by which, according to his own definition, he meant staying at that unit's command post and observing developments at first hand - or else helicoptering from one unit to another; again, in his own words, 'there is no alternative to looking into a subordinate's eyes, listening to his tone of voice'. Other sources of information at his disposal included the usual reporting systems; a radio network linking him with three divisional commanders, which also served to link those commanders with each other; a signal staff whose task it was to listen in to the divisional communications networks, working around the clock and reporting to Gavish in writing; messages passed from the rear, i.e., from General Headquarters in Tel Aviv, linked to Gavish by "private" radiotelephone circuit; and the results of air reconnaissance forwarded by the Air Force and processed by Rear Headquarters. Gavish did not depend on these sources exclusively, however; not only did he spend some time personally listening in to the radio networks of subordinate units (on one occasion, Gavish says, he was thereby able to correct an entirely false impression of the battle being formed at Brigadier Gonen's headquarters) but he also had a "directed telescope" in the form of elements of his staff, mounted on half tracks, following in the wake of the two northernmost divisions and constantly reporting on developments.

From this illustration, and from previous discussions here and in *Patterns of Conflict*, Boyd distills the Epitome of Command and Control, which is directly related to the key theme of adaptability[29]:

> Nature
>
> - Command and control must permit one to direct and shape what is to be done as well as permit one to modify that direction and shaping by assessing what is being done.
>
> What does this mean?
>
> - Command must give direction in terms of what is to be done in a clear unambiguous way. In this sense, command must interact with system to shape the character of nature of that system in order to realize what is to be done;
>
> Whereas
>
> - Control must provide assessment of what is being done also in a clear unambiguous way. In this sense, control must not interact nor interfere with system but must ascertain (not shape) the character/nature of what is being done.
>
> Implication
>
> - Direction and shaping, hence "command", should be evident while assessment and ascertainment, hence 'control', should be invisible and should not interfere - otherwise "command and control" does not exist as an effective means to improve our fitness to shape and cope with unfolding circumstances.

[27] Ibid, p.30.
[28] Ibid, p.29.
[29] Ibid, p.31.

This differs from traditional views on the meaning of command and control (C&C), and Boyd wants to emphasize just that (and here he is referring to his opening statements of the presentation on the reigning command and control philosophy and associated problems within the US armed forces at the time). In fact, he continues to reconceptualize C&C and exposes his audience to a subtle word game to arrive at a description of C&C with a much higher emotive and cognitive association.

The traditional definitions, Boyd explains, means to direct, order, or compel while control means to regulate, restrain, or hold to a certain standard as well as to direct or command. Thus, the description offered above is different than the kind that is being applied. In this sense, the C&C Boyd is speaking of seems, in his words, 'more closely aligned to leadership (rather than command) and to some kind of monitoring ability (rather than control) that permits leadership to be effective'. In other word, Boyd continues, 'leadership with monitoring, rather than C&C, seems to be a better way to cope with the multi-faceted aspects of uncertainty, change, and stress. On the other hand, monitoring, per se, does not appear to be an adequate substitute for control. Instead, after some sorting and reflection, the idea of appreciation seems better.[…] First of all, appreciation includes the recognition of worth or value and the idea of clear perception as well as the ability to monitor. Moreover, next, it is difficult to believe that leadership can even exist without appreciation. Pulling these threads together suggests appreciation and leadership offer more appropriate and richer means than C&C for shaping and adapting to circumstances'[30].

This discussion sheds another light on the epitome of command and control, laid out before. In a new set of definitions Boyd not only replaces command and control with appreciation and leadership, he also subtly inserts some words which emphasize the cognitive character of the process (below those words are printed in italics to show the differences clearly). These changes and additions are quite relevant for they also lead to a description which is much less directive in nature and much more in line with Boyd's argument about the value of trust, implicit control, shared orientation, etc, he developed here and in *Patterns of Conflict*. Underlying this change is the idea that initiative will not be fostered by top down, directive command and control system. Indeed, after the new conceptualization of C&C, Boyd states that C&C represents a top-down mentality applied in a rigid or mechanical (or electrical way) that ignored as well as stifles the implicit nature of human beings to deal with uncertainty, change, and stress (examples: The Battle of the Somme, Evacuation of Saigon, Mayaguez Affair, Desert I, Nifty-Nugget […])[31].

Appreciation and Leadership[32]:

Nature

- *Appreciation and leadership* permit one to *discern,* direct and shape what is to be done as well as permit one to modify that direction and shaping by assessing what is being done *or about to be done (by friendlies as well as adversaries).*

What does this mean?

- *Leadership* must give direction in terms of what is to be done in a clear unambiguous way. In this sense, leadership must interact with system to shape the character or nature of that system in order to realize what is to be done.

[30] Ibid, p.32.
[31] Ibid, p.35.
[32] Ibid, p.34.

whereas

- *Appreciation*, as part of leadership, must provide assessment of what is being done in a clear unambiguous way. In this sense, appreciation must not interact nor interfere with system but must *discern* (not shape) the character/nature of what is being done or about to be done;

Implication

- Assessment and discernment should be invisible and should not interfere with operations while direction and shaping should be evident to system - otherwise appreciation and leadership do not exist as an effective means to improve our fitness to shape and cope with unfolding circumstances.

To show the difference between C&C and Appreciation and Leadership once more and quite clearly, Boyd finalizes his presentation with a new set of definitions, which reflects the differing themes discussed in the presentation[33]:

- Command
  Refers to the ability to direct, order, compel with or without authority or power
- Control
  Means to have power or authrity to regulate, restrain, verify, (usually against some standard) direct or command. Comes from medieval latin contrarotulus, a 'counter roll' or checklist (contra, against plus rotulus, list)
- Understanding
  Means to comprehend the import or meaning of something.
- Monitoring
  Refers to the process that permits one to oversee, listen, observe, or keep track of as well as to advise, warn, or admonish.
- Appreciation
  Refers to the recognition of worth or value, clear perception, understanding, comprehension, or discernment, etc.
- Leadership
  Implies the art of inspiring people to cooperate and enthusiastically take action toward the achievement of uncommon goals.

Subsequently Boyd concludes that the title 'organic design for command and control is not appropriate'. Instead, 'the following title more clearly reflects the spirit and content of this presentation: Appreciation and Leadership'[34].

The Strategic Game of ? and ?

Introduction

Although at places highly conceptual, *Patterns of Conflict* and *Organic Design for Command and Control* in essence are about military matters at the operational level. The historical examples he uses and the concepts he develops find their basis in operational art. He looks for

[33] Ibid, p.37. The definitions of command and control are here contrasted deliberately against those of understanding, monitoring, appreciation and leadership. Boyd actually listed them together in one sequence.
[34] Ibid, p.36.

patterns that produced success in military operations and he tries to distill some suggestions for future application. Boyd aims to develop and teach ideas with which a commander can improve his operational art. In particular in *Organic Design for Command and Control* Boyd stays close to German Blitz doctrine.

In his last briefing of *The Green Book -The Strategic Game of ? and ?* - he draws several of his findings in the other briefings together and applies it to the (grand-) strategic level, or rather, Boyd here develops a general strategic principle. He climbs one step higher in the level of decision-making. But perhaps more importantly, he climbs to yet another higher level of abstraction. In this briefing he aims to formulate in even more general terms what lies at the heart of a strategic encounter with an opponent. What is the activity that one should be engaged in exactly in this "dialectic of wills" as Beaufre calls it[35]? This briefing contains a search for what strategy is about, that is what the question marks stand for in the title[36].

It is in a sense a similar exercise as the previous two presentations, and he develops quite similar arguments, but now coming from somewhat different angles with a more specific focus on one specific question. Even more than the other two, this presentation bear the stamp of his widening frame of reference. Here we hardly see any military history, and all the more reference to brain research, complexity theory, anthropology and systems theory (in a way the entire presentation forms yet another expose on the nature of open systems and the need for interaction with the environment). We find here an elaboration in particular on the set of definitions - or rather the list of "to do's" he developed in *Patterns of Conflict* about tactics, grand tactics, strategy and grand strategy. He adds also several themes and arguments from *Organic Design* (and this makes it imperative to follow Boyd's order of the presentations). He also revisits a theme from the essay *Destruction and Creation*, highlighting again the importance of the combination of analysis and synthesis as a mode of thinking.

But this presentation is not merely a restatement of earlier arguments. It builds upon them – indeed, without the previous presentations, this one would be quite hard to follow - but then Boyd carries them to their logical abstract and general conclusion and makes previous themes and arguments more explicit. This presentation is important for it highlights what Boyd really considers the essence of strategy and strategic behavior. Moreover, this presentation makes more evident than *Patterns of Conflict* the three components of war: the moral, the mental and the physical component.

It consists of 59 pages divided in four sections. The first 10 pages dwell on the importance of obtaining and applying multiple perspectives, and the powers of synthesis. This forms the argument that to understand strategy (as in military strategy in which his prime audience is most interested in) we need to look beyond familiar categorizations, theories, interpretations, and instead must look at strategic behavior in general. Boyd applies this in the second section in which he addresses again the question of the survival. The answer comes from a 16 page, broad survey of insights from various sources, derived from studies of a variety of organisms. The survey leads to a short 'condensation to essential elements'. These generic elements are then put in a 'strategic context'. This constitutes a repeating rhetorical pas de deux of question and illumination, and climaxes after 30 pages in yet another formulation of 'the art of success', one that differs in some important ways from the formulation he offered in *Patterns of Conflict*. Not yet content, Boyd applies the message

[35] André Beaufre, *Introduction to Strategy* (London 1965) p. 22.
[36] *Stratregic Game of ? and ?*, p.1.

he wants to get across in an example. He concludes with a slide which answers the four questions he offers as his outline at the beginning of *Strategic Game of ? and ?*[37].

Approach, or building snowmobiles

The outline is as follows[38]:

- What is Strategy?
- What is the aim of purpose of strategy?
- What is the central theme and what are the key ideas that underlie strategy?
- How doe we play to this theme and activate these ideas?

Boyd wants to reminds his audience of the importance of combining both analysis *and* synthesis and the relevance of continuously generating mental images. This has two reasons, one of which was discussed before in his essay. Here it also serves different purpose. Without a conviction that this combination is indeed a useful approach for increasing knowledge, the following sections - the broad survey - of this presentation does not make much sense. But if you *are* convinced, the broad survey will lead you to novel and valuable insights, and the argument Boyd builds upon the broad survey will be considered valid, even when Boyd links the study of strategy to the study of Alzheimer's disease.

This time he asks his audience to join him in a mental exercise. As Boyd states, 'Image that you are on a ski slope with other skiers[…]. Imagine that your are in Florida riding in an outboard motorboat, maybe even towing waterskiers. Imagine that you are riding a bicycle on a nice spring day. Image that you are a parent taking your son to a department store and that you notice he is fascinated by the toy tractors or tanks with rubber caterpillar treads'[39].

'Now imagine that you pull the ski's off but you are still on the ski slope. Imagine also that you remove the outboard motor from the motor boat, and you are not longer in Florida. And from the bicycle you remove the handlebar and discard the rest of the bike. Finally, you take off the rubber threads from the toy tractor or tanks. This leaves only the following separate pieces: skis, outboard motor, handlebars and rubber threads'. However, Boyd challenges his audience, what emerges when you pull all this together[40]?:

SNOWMOBILE

So Boyd moves from Polanyi to snowmobiles. The message is obvious and a restatement of the one he also advanced in *Organic Design*: 'To discern what is going on we must interact in a variety of ways with our environment. We must be able to examine the world from a number of perspectives so that we can generate mental images or impressions that correspond to that world'. This serves as the introduction to the general survey, for Boyd 'will use this scheme of pulling things apart (analysis) and putting them back together (synthesis) in new combinations to find how apparently unrelated ideas and actions can be related to one another'[41]. And indeed, he does.

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[37] The "approach" Boyd takes in this presentation and described here is on p. 4.
[38] Ibid, p.3.
[39] Ibid, p.6.
[40] Ibid, pp.7-9.
[41] Ibid, p.10.

General Survey

In this section his interest in science becomes readily apparent. According to Boyd the answer about the nature of the question marks (i.e. the essence of strategy) comes from examining seven different disciplines or activities[42]:

- Mathematical Logic
- Physics
- Thermodynamics
- Biology
- Psychology
- Anthropology
- Conflict

For starters, Boyd very briefly restates the point of departure he began *Patterns of Conflict* with[43]:

Human Nature

Goal

- Survive, survive on own terms, or improve our capacity for independent action.

The competition for limited
resources to satisfy these
desires may force one to

- Diminish adversary's capacity for independent action, or deny him the opportunity to survive on his terms, or make it impossible for him to survive at all.

A selection from newspaper articles, sections from books, his own presentations, a speech and a number of quotations follows to address the question Boyd posits: 'in a most fundamental way, how do we realize this goal or make it difficult for others to realize this goal'[44]? Despite the fact that these quotations concern different types of organisms -animal, human, social, bio-chemical - they are all related, as Boyd, reveals 13 pages later: all deal with the key issue Boyd addressed also in *Organic Design*: *interaction*. But at first the audience must have been puzzled, for the first three quotations are clips from newspaper articles on recent brain research while the fourth article deals with the loss of muscle tissue in rats during space flight, not quite familiar territory for most strategists or military practitioners:

> "Nerve Cells Redo Wiring…" by Boyce Rensberger (from the Washington Post)
> "Dale Purvis and Robert D. Hadley….have discovered that a neuron's fibers can change significantly in a few days or weeks, presumably in response to changing demands on the nervous system. …research has shown neurons continually rewire their own circuitry, sprouting new fibers that reach out to make contact with new groups of other neurons and

[42] Ibid, p. 12. Note that most of these fields are generally not in the curriculum of military higher eduction programs.
[43] Ibid, p.14.
[44] Ibid, p.15.

withdrawing old fibers from previous contacts…This rewiring process may account for how the brain improves ones abilities such as becoming proficient in a sport or learning to play a musical instrument. Some scientists have suggested that the brain may use this method to store facts….The research was on adult mice, but since all mammalian nervous systems appear to behave in similar ways, the researchers assume that the findings also apply to human beings."

" The Soul of the Machine", by Richard M. Restak (Review of "Neuronal Man", by Jean Pierre Chaneux) (The Washington Post Book World)
"Changeux suggests that the complexity of the human brain is dependent upon the vast number of synapses (connections) between brain cells. … these synaptic connections are established or fall by the wayside according to how frequent they're used. Those synapses which are in frequent use tend to endure ('are stabilized') while others are eliminated…In other words, …interactions with the environment"…[exert]…"tremendous influence on the way the human brain works and how it has evolved."[45]

"Brain Cells Try To Battle Alzheimer's…", by Jan Ziegler (The Washington Post)
"A post mortem study of brains of Alzheimer's victims", (reported on by Dr.Carl Cotman and colleagues) "showed that cells tried to repair connections destroyed by the disease by sprouting new branches,…A progressive, degenerative disease, it can cause memory loss, confusion, difficulty in speech and movement, inability to recognize even family members…A characteristic of the disease is the death of neurons, or nerve cells, that connect to each other by long fibers, which forces the brain to live with fewer and fewer connections. Analyzing cells from the hippocampus of six deceased Alzheimer's patients, Cotman and colleagues, found that axons - the output fibers of nerve cells, responsible for transmitting signals through the nervous systems - start to sprout, reforming the connections between remaining cells…Ultimately however, the sprouting process cannot keep up with destruction. Either the sprouting stops, or too many nerve cells die…"

"Rats Lost Muscle, Bone Strength in Space Flight", by Paul Recer (Erie Daily Times)
"Space rats that spent seven days in orbit suffered massive losses of muscle and bone strength, suggesting that astronauts on long voyages must be protected from debilitating effects of zero gravity…The young rats experienced a bone strength loss of up to 45 percent and a muscle tissue loss of up to 40 percent…older rats…suffered bone and muscle strength losses of about 15 percent…Soviet space scientists reported a similar amount of muscle and bone loss in rats that were in space for more than 20 days…" [46]

Next Boyd presents five sections from books. The first two concern the work on dissipative structures by Prigogine[47]:

"Order out of chaos", by Ilya Prigogine and Isabella Stengers
"Equilibrium thermodynamics provides a satisfactory explanation for a vast number of physicochemical phenomena. Yet it may be asked whether the concept of equilibrium structures encompasses the different structures we encounter in nature. Obviously the answer is no."

"Equilibrium structures can be seen as the result of statistical compensation for the activity of microscopic elements (molecules or atoms). By definition they are inert at the global level…Once they have been formed they may be isolated and maintained indefinitely without further interaction with their environment. When we examine a biological cell or a

[45] Ibid, p.16. Quotations are presented here as in the presentation.
[46] Ibid, p.17. Erie was Boyd's former hometown.
[47] Ibid, pp.18-19.

city, however, the situation is quite different: not only are these systems open, but also they exist only because they are open. They feed on the flux of matter and energy coming to them from the outside world. We can isolate a crystal, but cities and cells die when cut off from their environment. They form an integral part of the world from which they can draw sustenance, they cannot be separated from the fluxes that they incessantly transform."

"Looking Glass Universe", by John P.Briggs and F. David Peat
"Prigogine called far-from-equilibrium forms like the vortex, 'dissipative structures'. The name comes from the fact that to keep their shape these structures must constantly dissipate entropy so it won't build up inside the entity and 'kill' it with equilibrium….[These dissipative structures] can survive only by remaining open to a flowing matter and energy exchange with then environment…The structure is stabilized by its flowing. It is stable but only relatively stable - relative to the constant energy flow required to maintain its shape. Its very stability is also paradoxically an instability because of its total dependence on its environment. The dissipative structure is autonomous (separate) but only relatively separate. It is a flow within a flow."

And from here on Boyd enters the social realm with a long piece on guerrilla warfare, on the relation between social order and strategy and one on the nature of culture (all of which re-emphasize the innate, tacit nature of culture and the importance the moral dimension, in short, the glue of social structures) besides several quotations with an explicit military content:

"The War of the Flea", by Robert Taber
"Almost all modern governments are highly conscious of what journalism calls 'world opinion'. For sound reasons, mostly of an economic nature, they cannot afford to be condemned in the United Nations, they do not like to be visited by Human Rights Commissions of Freedom of the Press Committees; their need of foreign investment, foreign loans, foreign markets, satisfactory trade relationships, and so on, requires that they be members in more or less good standing of a larger community of interests. Often, too, they are members of military alliances. Consequently, they must maintain some appearance of stability, in order to assure the other members of the community or of the alliance that contracts will continue to be honored, that treaties will be upheld, that loans will be repaid with interest, that investments will continue to produce profits and be safe."

"Protracted internal war threatens all of this…no ally wishes to treat with a government that is on the point of eviction."

"It follows, that it must be the business of the guerrilla, and of his clandestine political organization in the cities, to destroy the stable image of the government, and so to deny its credits, to dry up its source of revenues, and to create dissension within the frightened owning classes, within the government bureaucracy (whose payrolls will be pinched), and within the military itself."

"Isolation, military and political, is the great enemy of guerrilla movements. It is the task of the urban organization to prevent this isolation, to provide diversions and provocations when needed, to maintain contact, to keep the world aware of a revolution in progress even when there is no progress to report."[48]

[48] Ibid, p.20.

"Social Order and the General Theory of Strategy", Alexander Atkinson
"Moral fibre is the "great dam that denies the flood of social relations their natural route of decline towards violence and anarchy"…In this sense, "moral order at the center of social life literally saves society from itself."

"Strategists must grasp this fact that social order is, at once, a moral order…If the moral order on which rests a fabric of social and power relations is compromised, then the fabric (of social order) it upholds goes with it".

In other words, "the one great hurdle in the strategic combination (moral and social order) is the moral order. If this remains untouched the formation of new social relations and social ranking in status and power either never gets off the ground or faces the perennial specter of backsliding towards the moral attractions of established social and power relations."

The strategic imperative, then, becomes one of trying to "achieve relative security of social resources by subverting and reweaving those of the opponent into the fabric of one's own social order"[49].

"Beyond Culture", by Edward T. Hall
"Everything man is and does is modified by learning and is therefore malleable. But once learned, these behavior patterns, these habitual responses, these ways of interacting gradually sink below the surface of the mind and, like the admiral of a submerged submarine fleet, control from the depths. The hidden controls are usually experienced as though they were innate simply because they are not only ubiquitous but habitual as well."

"…The only time one is aware of the control system is when things don't follow the hidden program. This is most frequent in intercultural encounters. Therefore, the great gift that the members of the human race have for each other is not exotic experiences but an opportunity to achieve awareness of the structure of their own system, which can be accomplished only by interacting with others who do not share that system…"[50]

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[49] Ibid, p.21.

[50] Ibid, p.22. This is an important quotation from Hall's work (to be found on p.42 and p.44.). Considered a classic, it is (with Clifford Geertz' work) one of the few works in the bibliography of *Patterns of Conflict* that has culture as its main subject. A very brief summary of Hall's view of culture is as follows: culture = models/templates. Culture is the medium we live in, like the air we breathe. Culture is innate but learned (i.e. we are born with the physical necessity and capacity to specialize our bodies, brains, hearts in line with cultural patterns). Culture is living, interlocking system(s) - touch one part, the rest moves. Culture is shared; it is created and maintained through *relationship*. It is also a highly selective screen between man and the outside world. Culture designates what we pay attention to and what we ignore. It is easy to see how this book could fuel Boyd's belief in shared orientation, and the importance of obtaining a variety of perspectives. Another section (p.43) later also underlines the importance of novelty in this context. Normally one is not aware of one's patterns for 'man's nervous system is structured in such asway that the patterns that govern behavior and perception come into consciousness only when there is a deviation from plan'. In addition, Hall discusses 'monochromatic organizations and argues that, as they grow larger, they turn inward, becoming blind to their own structure; they grow rigid and are even apt to lose sight of their original purpose (p.24). Another topic frequently advanced is the fact that 'we have been taught to think linearly rather than comprehensively' (p.11), a 'compartimentalized way of thinking' (p.12). Interestingly, Hall also included a quote from J. Bronowski that was close to Boyd's heart: 'There is no absolute knowledge, and those who claim it, whether they are scientists or dogmatists, open the door to tragedy' (p.71).

"Destruction and Creation", by Yours Truly (selection from an unpublished essay)
According to Gödel's Incompleteness Theorems, Heisenberg's Uncertainty Principle, and the Second Law of Thermodynamics one cannot determine the character or nature of a system within itself. Moreover, attempts to do so lead to confusion and disorder[51].

"A Model of Soviet Mentality", by Dmitry Mikheyev (selection from a speech)
"Interaction between the individual and his environment starts with his perception of himself as a separate entity and the environment as everything outside of self. He learns his physical limits and desires, and how to fulfill them through interaction with the physical and social environment. …I maintain that the way the individual perceives the environment is crucial for his orientation and interaction with it."

"Man's orientation will involve perceptions of self as both a physical and a psychological entity, as well as an understanding of the environment and of the possibilities for achieving his goals (Fromm, 1947). Society, meanwhile, has goals of its own - preservation of its physical integrity and spiritual identity. Pursuing these goals involves mobilizing and organizing its inner resources and interaction with the outside environment of other societies and nations. …An individual becomes a member of the society when he learns to act within its limits in a way that is beneficial to it"[52].

Nearing the end of the sequence of illustrations, Boyd concludes with some short quotes. From Sun Tzu he borrows the famous lines 'know your enemy and know yourself; in one hundred battles you will never be in peril' as well as the one which forms the heart of the indirect approach: 'seize that which your adversary holds dear or values most highly; then he will conform to your desires'. Jomini's oft criticized emphasis on geographical disposition and logistics is brought along to support the importance of interactions: 'the great art, then, of properly directing lines of operations, is so to establish them in reference to the bases and to the marches of the army as to seize the communications of the enemy without imperiling one's own, and is the most important and most difficult problem in strategy'. Finally, Boyd repeats his definition of leadership as yet another element in which interaction is key: 'the art of inspiring people to cooperate and enthusiastically take action toward the achievement of uncommon goals'[53].

Condensation to Essential Elements

For Boyd there is a clear and united message in all of these illustrations, illustrations which moreover span also both previous presentations as well as the essay. Boyd captures the essential elements of the illustrations as follows[54]:

Compression

- Physical as well as electrical and chemical connections in the brain are shaped by interacting with the environment. Point: without these interactions we do not have the mental wherewithal to deal or cope with that environment.

- Gödel's Incompleteness Theorems, Heisenberg's Uncertainty Principle, and the Second Law of Thermodynamics, all taken together, show that we cannot determine the

[51] Ibid, p.23.
[52] Ibid, p.24.
[53] Ibid, p.25.
[54] Ibid, p.28.

character or nature of a system within itself. Moreover, attempts to do so lead to confusion and disorder -- mental as well as physical. Point: We need an external environment, or outside world, to define ourselves and maintain organic integrity, otherwise we experience dissolution/disintegration--i.e., we come unglued.

- Moral fibre or moral order is the glue that holds society together and makes social direction and interaction possible. Point: without the glue social order pulls apart towards anarchy and chaos leaving no possibility for social direction and interaction.

- Living systems are open systems; closed systems are non-living systems. Point: If we don't communicate with outside world -- to gain information for knowledge and understanding as well as matter and energy for sustenance -- we die out to become a non-discerning and uninteresting part of that world.

In one form or another, in various scales and in different realms, these illustrations reveal that 'as human beings, we cannot exist without an external or surrounding environment from which we can draw sustenance, nourishment, or support. Reaching back to two themes from Patterns of Conflict, Boyd recasts this insight as the message that '*interaction permits vitality and growth while isolation leads to decay and disintegration*'[55].

And with that, Boyd has come to the core, the most barren essence, the shortest yet deepest principle of strategy. Indeed, Boyd now states, *'The theme associated with the essay D&C and the presentations 'Patterns of Conflict' and 'Organic Design' is one of Interaction and Isolation'*. While *Organic Design* emphasizes interaction, *Patterns of Conflict* emphasizes isolation. The essay *Destruction and Creation* is balanced between interaction and isolation[56]. Now Boyd is ready to put this in a strategic perspective.

Strategic Perspective

Boyd has thus answered the question in the title: *'The Strategic Game is one of Interaction and Isolation'*. That is what strategy is about: it is *'a game in which we must be able to diminish an adversary's ability to communicate or interact with his environment while sustaining or improving ours'*[57].

The obvious question then is again the pragmatic side of it: how does one do that. Again following J.F.C. Fuller's dimensions of control, he lists the three components - or here rather dimensions - he already introduced in *Patterns of Conflict*: the mental, moral and physical dimension, to analytically break up the enemy system and look for ways to apply the strategic principle and achieve isolation[58]. Although already employed before, also in their interrelationship, Boyd now thinks it appropriate to define the three dimensions and explain why we should use these[59]:

- Physical represents the world of matter-energy-information all of us are a part of, live in, and feed upon.
- Mental represents the emotional/intellectual activity we generate to adjust to, or cope with, that physical world.
- Moral represents the cultural codes of conduct or standards of behavior that constrain, as well as sustain and focus, our emotional/intellectual responses.

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[55] Ibid, p.29. Italics are mine.
[56] Ibid, p.30.
[57] Ibid, p.33. Italics are mine.
[58] Ibid, p.34.
[59] Ibid, p.35.

So Boyd discerns within the adversary system a physical, a mental and a moral dimension. Subsequently, isolation can occur - or be aimed for - in these different dimensions: 'Physical isolation occurs when we fail to gain support in the form of matter-energy-information from others outside ourselves. Mental isolation occurs when we fail to discern, perceive, or make sense out of what's going on around ourselves. Moral isolation occurs when we fail to abide by codes of conduct or standards of behavior in a manner deemed acceptable or essential by others outside ourselves'[60].

Interaction ensures the opposite: 'Physical interaction occurs when we freely exchange matter-energy-information with others outside ourselves. Mental interaction occurs when we generate images or impressions that match up with the events or happenings that unfold around ourselves. Moral interaction occurs when we live by the code of conduct or standards of behavior that we profess, and others expect us, to uphold'[61].

The question then becomes how to isolate the opponent while maintaining interaction oneself: 'How do we physically isolate our adversaries yet interact with others outside ourselves? How do we mentally isolate our adversaries yet keep in touch hence interact with unfolding events? How do we morally isolate our adversaries yet maintain the trust/confidence of others thereby interact with them?'[62] But before Boyd arrives at these questions, let alone the answers, Boyd takes a pause and plays the familiar game of question, illumination, suggestion and question again. He connects this discussion with several themes and insights from the previous presentations, even from the first pages of *Patterns of Conflict* that deal with air-to-air combat and the essay *Destruction and Creation*. This way the audience itself discovers the answers through applying the conceptual framework Boyd had constructed up to this point, or at least internalizes the issues and way of thinking instead of merely listening to the solution. It is after all *A Discourse*. So Boyd asks[63]: 'how do we play to this theme and exploit these ideas?'

Hints

- Recall how we mentally constructed a snowmobile.
- Remember how we looked at ideas in mathematical logic, physics, thermodynamics, biology, psychology, anthropology, and conflict to surface a central theme.
- Remember our whole approach has been one of pulling things apart and putting them back together until something new and different is created.

Illuminating example[64]

? - What does the Second Law of Thermodynamics say - ?
All natural processes generate entropy.

? - What did Heisenberg say - ?
One cannot simultaneously fix or determine precisely
the momentum and position of a particle.

? -What did Gödel say -?
One cannot determine the consistency of a system within itself

[60] Ibid, p.36
[61] Ibid, p.37.
[62] Ibid, p.46.
[63] Ibid, p.38.
[64] Ibid, p.39.

The point of these questions is that 'as they appear, these statements and the ideas they embody seems unrelated to one another'. However, Boyd repeats, 'taken together Gödel, Heisenberg and the Second Law of Thermodynamics say that one cannot determine the character or nature of a system within itself. Moreover, attempts to do so lead to confusion and disorder'.

Then Boyd asks another question: 'What do the tests of the YF-16 and the YF-17 say?' The message is that 'the ability to shift or transition from one maneuver to another more rapidly than an adversary enables one to win in air to air combat'. Again, this example does not seem related in any sense with the statements of Gödel et al[65]. However, taken together, the overall message is that[66]:

- The ability to operate at a faster tempo or rhythm than an adversary enables one to fold adversary back inside himself so that he can neither appreciate not keep-up with what's going on. He will become disoriented or confused;

which suggests that

- Unless such menacing pressure is relieved, adversary will experience various combinations of uncertainty, doubt, confusion, self-deception, indecision, fear, panic, discouragement, despair, etc., which will further:

Disorient or twist his mental images/impression of what's happening;
thereby
Disrupt his mental/physical maneuvers for dealing with such a menace;
thereby
Overload his mental/physical capacity to adapt or endure;
thereby
Collapse his ability to carry one.

These statements point to the idea he advanced also in *Destruction and Creation* that 'we can't just look at our own personal experiences or use the same mental recipes over and over again; we've got to look at other disciplines and activities and relate or connect them to what we know from our experiences and the strategic world we live in. If we can do this we will be able to surface new repertoires and (hopefully) develop a fingerspitzengefuhl for folding our adversaries back inside themselves, morally-mentally-physically - so that they can neither appreciate nor cope with what's happening - without suffering the same fate ourselves'[67].

Again Boyd has touched a familiar theme. Superior orientation is key. In a way he has merely elaborated on the insights from page 36. However, he has reminded the audience which path led to these insights. And in bringing several insights from different sources and different discussions from separate presentations together and succeeding in showing the conceptual linkages, he has also applied his own argument concerning the necessity of looking beyond one's familiar frames of reference. Moreover, page 36 dealt with one's own side rather than the enemy's. And now Boyd feels his audience is ready to tackle the issue how to fold the 'adversary back inside themselves, morally-mentally-physically, …without suffering the same fate ourselves?'[68].

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[65] Ibid, p.40-43.
[66] Ibid, p.44.
[67] Ibid, p.45.
[68] Ibid, p.46.

On isolation and interaction

Physically, Boyd argues, 'we can isolate our adversaries by severing their communications with the outside world as well as by severing their internal communications to one another. We can accomplish this by cutting them off from their allies and the uncommitted via diplomatic, psychological and other efforts. To cut them off from one another we should penetrate their system by being unpredictable, otherwise they can counter our efforts. Mentally we can isolate our adversaries by presenting them with ambiguous, deceptive or novel situations, as well as by operating at a tempo or rhythm they can neither make out nor keep up with. Operating inside their OODA loops will accomplish just this by disorienting or twisting their mental images so that they can neither appreciate nor cope with what's really going on. Morally our adversaries isolate themselves [!] when they visibly improve their well being to the detriment of others (allies, the uncommitted), by violating codes of conduct or behavior patterns that they profess to uphold or others expect them to uphold'[69]. The expected payoff is

> disintegration and collapse, unless adversaries change their behavior patterns to conform to what is deemed acceptable by others outside themselves[70].

Again, this is only a slight alteration by elaboration of page 36. However, in these slight alterations Boyd did generate new clues concerning isolation. And in a logical response Boyd now explores what this means for maintaining interaction on one's own side to avoid this fate flowing from isolation. By exploring one side, Boyd immediately sheds light - or as Boyd calls it, "illumination" - on the opposite. If the previous analysis of isolation is valid, the consequence for the analysis of interaction lies in the following new description[71]:

'Physically we interact by opening-up and maintaining many channels of communication with the outside world, hence with others out there, that we depend upon for sustenance, nourishment, or support. Mentally we interact by selecting information from a variety of sources or channels in order to generate mental images or impressions that match-up with the world of events or happenings that we are trying to understand and cope with. Morally we interact with others by avoiding mismatches between what we say we are, what we are, and the world we have to deal with, as well as by abiding by those other cultural codes or standards that we are expected to uphold'. Here the expected pay-off is[72]:

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[69] Ibid, p.47. By now it will have become evident that rapid OODA looping, or getting inside the enemy decision cycle involves more than merely accomplishing this process faster. It also has a qualitative meaning, which relates to images, views, etc, in short, orientation. For instance, we can overload the enemy system by presenting him with a wealth of data that may or may not be in accordance with reality. The data may or may not be consistent or could present contradicting images. If we know his value system or set of expectations, we can feed data that reinforce those beliefs while in reality doing something else. He may still proceed as rapidly through the process, but the process has become qualitatively dysfunctional. Note too that isolation can occur not only in the mental, but also in the physical and moral, dimensions often forgotten in critiques and summaries. Moreover, not everything related to isolation comes from our actions, but is the result from the opponent's actions, as Boyd shows in his discussion on moral isolation.

[70] Ibid, p.48.

[71] Ibid, p.49.

[72] Ibid, p.50.

vitality and growth, with the opportunity to shape and adapt to unfolding events thereby influence the ideas and actions of others.

The following comparison shows that the latter discussion on isolation and interaction flows logically from the first one and forms a response to it:

Boyd's first take on isolation	Boyd's second view on isolation
Physical isolation occurs when we fail to gain support in the form of matter-energy-information from others outside ourselves.	Physically we can isolate our adversaries by severing their communications with the outside world as well as by severing their internal communications to one another. We can accomplish this by cutting them off from their allies and the uncommitted via diplomatic, psychological and other efforts. To cut them off from one another we should penetrate their system by being unpredictable, otherwise they can counter our efforts.
Mental isolation occurs when we fail to discern, perceive, or make sense out of what's going on around ourselves.	Mentally we can isolate our adversaries by presenting them with ambiguous, deceptive or novel situations, as well as by operating at a tempo or rhythm they can neither make out nor keep up with. Operating inside their OODA loops will accomplish just this by disorienting or twisting their mental images so that they can neither appreciate nor cope with what's really going on.
Moral isolation occurs when we fail to abide by codes of conduct or standards of behavior in a manner deemed acceptable or essential by others outside ourselves	Morally our adversaries isolate themselves [!] when they visibly improve their well being to the detriment of others (allies, the uncommitted), by violating codes of conduct or behavior patterns that they profess to uphold or others expect them to uphold.
Boyd's first take on interaction	**Boyd's second view on interaction**
Physical interaction occurs when we freely exchange matter-energy-information with others outside ourselves.	Physically we interact by opening-up and maintaining many channels of communication with the outside world, hence with others out there, that we depend upon for sustenance, nourishment, or support.
Mental interaction occurs when we generate images or impressions that match up with the events or happenings that unfold around ourselved.	Mentally we interact by selecting information from a variety of sources or channels in order to generate mental images or impressions that match-up with the world of events or happenings that we are trying to understand and cope with.
Moral interaction occurs when we live by the code of conduct or standards of behavior that we profess, and others expect us, to uphold.	Morally we interact with others by avoiding mismatches between what we say we are, what we are, and the world we have to deal with, as well as by abiding by tose other cultural codes or standards that we are expected to uphold.

So, far from seemingly similar and perhaps somewhat superfluous, the latter discussion on isolation and interaction puts into practice what the first take merely describes. The first take is "a what", the second constitutes "a how to", and with that Boyd answers the questions he set out for himself and the audience. Concluding the section ('Putting in Strategic Perspective'), Boyd pulls these discussions together to reveal another description of[73]:

[73] Ibid, p.51.

The Art of Success:

- Shape or influence the moral-mental-physical atmosphere that we are part of, live in, and feed upon, so that we not only magnify our inner spirit and strength, but also influence potential adversaries and current adversaries as well as the uncommitted so that they are drawn toward our philosophy and are empathetic toward our success;

yet be able to

- Morally-mentally-physically isolate adversaries from their allies and outside support as well as isolate them from one another, in order to: magnify their internal friction, produce paralysis, bring about their collapse; and/or bring about a change in their political/economic/social philosophy so that they can no longer inhibit our vitality and growth.

Here too, comparison with an earlier description of the art of success (from *Patterns of Conflict*, p.178) will show the added value of the discussions in *The Strategic Game of ? and ?*.

The Art of Success (PoC)	The Art of Success (Strategic Game)
Appear to be an unsolvable cryptogram while operating in a directed way to penetrate adversary vulnerabilities and weaknesses in order to isolate him from his allies, pull him apart, and collapse his will to resist.	Shape or influence the moral-mental-physical atmosphere that we are part of, live in, and feed upon, so that we not only magnify our inner spirit and strength, but also influence potential adversaries and current adversaries as well as the uncommitted so that they are drawn toward our philosophy and are empathetic toward our success;
yet	yet be able to
Shape or influence events so that we not only magnify our spirit and strength but also influence potential adversaries as well as the uncommitted so that they are drawn toward our philosophy and are empathetic toward our success.	Morally-mentally-physically isolate adversaries from their allies and outside support as well as isolate them from one another, in order to: magnify their internal friction, produce paralysis, bring about their collapse; and/or bring about a change in their political/economic/social philosophy so that they can no longer inhibit our vitality and growth.

It is interesting to note that he expands on this theme of moral isolation in the last few slides of the presentation. Here Boyd's concern with the moral high ground of our actions again emerges clearly, as it did in *Organic Design*. There it pertained to the operational or military strategic level leadership. This time he addresses the moral dimension at the nation-state or societal level, and "the moral" should be read to signify national culture, ideology and/or political aspirations, i.e., statecraft and grand strategy, much like Sun Tzu did. Boyd regards the moral from the perspective of a complex adaptive system. It is a dimension of an organism that it needs to shape and evolve if it wants to survive and prosper. From a different perspective, one can comment that the way Boyd describes (or better prescribes) the moral, it becomes a very functional and instrumental property. This comment is given weight by the following section in which Boyd implements his arguments in an example.

A Moral Design for Grand Strategy

If the previous argument is accepted, it follows that for designing grand strategy the name of the game is to 'use moral leverage to amplify our spirit and strength as well as expose the flaws of competing or adversary systems, all the while influencing the uncommitted, potential adversaries and current adversaries so that they are drawn toward our success'. Put another way, 'one should preserve or build-up moral authority while compromising that of our adversaries' in order to pump-up our resolve, drain away adversaries' resolve, and attract them as well as others to our cause and way of life'. If this is the challenge, Boyd follows in his familiar way with the question how to accomplish that: 'how do we evolve this moral leverage to realize the benefits cited above?'[74] The answer comes in two parts; one concerns ourselves, one concerns the adversary, and Boyd prescribes both defensive as well as somewhat offensive measures for statecraft.

In a typical Boydian passage, he stresses that, 'with respect to ourselves, we must surface, as well as find ways to overcome or *eliminate* those blemishes, flaws, or contradictions that generate mistrust and discord, so that these negative qualities either alienate us from one another or set us against one another, thereby destroy our internal harmony, paralyze us, and make it difficult to cope with an uncertain, ever-changing world at large. *In opposite fashion* we must *emphasize* those cultural traditions, previous experiences and unfolding events that build up harmony and trust, thereby create those implicit bonds that permit us as individuals and as a society, or as an organic whole, to shape as well as adapt to the course of events in the world[75].

'With respect to adversaries we should reveal those harsh statements that adversaries make about us – particularly those that denigrate our culture, our achievements, our fitness to exist, etc. – as basis to show that our survival and place in the scheme of things is not necessarily a birthright, but is always at risk'. This has an internally oriented focus evidently to avoid complacency among one's own people. But Boyd does not shun the offensive in the moral domain. As Boyd continues, 'we should reveal those mismatches in terms of what adversaries profess to be, what they are, and the world they have to deal with in order to surface to the world, to their citizens, and to ourselves the ineptness and corruption as well as the sub-rosa designs that they have upon their citizens, ourselves, and the world at large'.

At the same time one should engage in dialogue to convince the adversary of one's own benevolent nature and the benefits of cooperation: 'we should acquaint adversaries with our philosophy and way of life to show them that such destructive behavior works against, and is not in accord with, our (or any) social values based upon the dignity and needs of the individual as well as the security and well-being of society as a whole'[76]. We should 'respect their culture and achievements, show them we bear them no harm, and help them adjust to an unfolding world, as well as provide additional benefits and more favorable treatment for those who support our philosophy and way of doing things'. This accommodating attitude must be coupled to a show of resolve to guard one's interest if necessary. We should 'demonstrate that we neither tolerate nor support those ideas and interactions that undermine or work against our culture and our philosophy hence our interests and fitness to cope with a changing world'[77].

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[74] Ibid, p.54.
[75] Ibid, p.55.
[76] Ibid, p.56.
[77] Ibid, p.57.

The meaning of strategy and the art of success

Extrapolating from the previous set of propositions, Boyd develops a new notion of what strategy is at its most fundamental level, in its most abstract form. It brings to the fore again the theme of adaptation. Boyd answers the four questions he listed at the beginning of *Strategic Game of ? and ?*[78]:

? – What Is Strategy - ?

A mental tapestry of changing intentions for harmonizing and focusing our efforts, as a basis for realizing some aim or purpose in an unfolding and often unforeseen world of many bewildering events and many contending interests.

? – What Is the Aim or Purpose of Strategy - ?

To improve our ability to shape and adapt to unfolding circumstances, so that we (as individuals or as groups or as a culture or as a nation-state) can survive on our own terms.

? – What Is the Central Theme and What Are the Key Ideas that Underlie Strategy - ?

The central theme is one of interaction/isolation while the key ideas are the moral-mental-physical means towards realizing this interaction/ isolation.

? – How Do We Play to this Theme and Activate these Ideas - ?

By an instinctive see-saw of analysis and synthesis across a variety of domains, or across competing independent channels of information, in order to spontaneously generate new mental images or impressions that match-up with an unfolding world of uncertainty and change.

In these propositions we can discern themes that have appeared in the essay and the presentation: *adaptation, multiple perspectives, analysis/synthesis, interaction/isolation.* Although the presentation evidently addresses the societal level, the previous discussion must be considered to apply to any organism and to all levels and sub-entities of any organization, for at each level of organization, in principle, one can discern strategic behavior; it is that behavior which deals with the way to survive as an organizational entity, with its own purpose, functions and characteristics. That behavior might be tactical when looked upon from a higher level in the larger parent organization, but for the unit it may be strategic. The definitions he develops here contain some elements of insights he has developed in *Patterns of Conflict* and *Organic Design*, but with a slight difference. Moreover, *Patterns of Conflict* cumulated in a definition of strategy after a tour through military history, and those definitions must to some extend still be understood within the context of the behavior of armed forces. Here the definitions refer to organizations in general. The definitions he presents here have no predecessors in military strategic theory, it is unique, and at the time must have appeared definitely so. They are evidently pregnant with influences of neo-Darwinist literature, chaoplexity studies and systems theoretical themes. With this novel abstract

[78] Ibid, p.58.

conceptualization of the essence of strategy and strategic success, Boyd has come to the climax of his presentation, and has almost arrived at the most condenced essence of *A Discourse*.

Revelation

With only one slide following the slide with the title, this is the shortest of all presentations. Referring back to "the snowmobile", it cannot be understood without the previous presentation, and must really be considered an epilogue of it. Yet it reveals (hence the title) in emblematic form a core argument Boyd wanted to get across:

- A loser is someone (individual or group) who cannot build snowmobiles when facing uncertainty and unpredictable change;

whereas

- A winner is someone (individual or group) who can build snowmobiles, and employ them in appropriate fashion, when facing uncertainty and unpredictable change.

In stark language it argues for the requirement to have the capacity for both analysis *and* synthesis. In these very brief lines Boyd thus once more explains that this is the 'metaphorical message' of *Strategic Game*: It thus builds on, and reinforces the argument of *Strategic Game* as well as the essay. It also precedes the discussion contained in *Conceptual Spiral*, which is much longer, but in some ways also again an elaboration of the same argument, but now from yet again a different perspective.

The Conceptual Spiral

Introduction

Two statements of Michael Polanyi can nicely serve as an introduction for *The Conceptual Spiral:*

> A free society may be seen to be bent in its entirety on exploring self-improvement- every kind of self improvement. This suggests a generalization of the principles governing the Republic of Science[79].
>
> I have shown that all engineering and technology, comprising operational principles lies logically beyond the range of Laplacian knowledge and that the same is true for the operational principles established by physiology as the functions of living things[80].

The Conceptual Spiral was completed in July/August 1992, 16 years after the first versions of *Patterns of Conflict*. It consists of 38 pages. It is the result of seven years of additional reading and distillation. Even more than the other presentations, it reflects Boyd's wide interest in subjects far beyond the traditional focus of military history or strategic studies. The message

[79] Polanyi, *Knowing and Being,* p. 70.
[80] Ibid, p.177.

however is not much different, but even more in focus. In fact, Boyd re-visits his essay, reformulating the same argument, confirming the findings once more, but now employing illustrations from science, engineering and technology, all of which Boyd conceptualizes as self-correcting mechanisms (or systems, or OODA loops indeed). These fields and the illustrations Boyd derived from them, would be much more familiar to the general audience (although Boyd expressly included sections to convince his audience they were actually quite ignorant) than the philosophical essay. Indeed, *The Conceptual Spiral* must be considered the equivalent of the essay, but now offered in a more easily accessible format, and in appearance less philophical. The themes are familiar too:

- pervasive uncertainty as prime characteristic of life,
- the essence of combining analysis with synthesis, marrying induction and deduction,
- the importance of novelty, mismatches and creativity,
- and the requirement to combine multiple perspectives to form adequate orientation patterns.

The title itself hints at the core argument, which in part can be traced back to the work of Piaget: survival mandates reveling in a continuous conceptual spiral of induction and deduction, of creation and destruction.

Focus

Boyd starts with the familiar move. First he states the prime focus of the presentation:

> To make evident how science, engineering, and technology influence our ability to interact and cope with an unfolding reality that we are part of, live in, and feed upon[81].

And the answer will come, he suggests, from revisiting and exploring the following key passage from the 'Abstract'[82]:

> …the theme that weaves its way through this 'Discourse on Winning and Losing' is not so much contained within each of the five sections, per se, that make up this 'Discourse', rather, it is the kind of thinking that both lies behind and makes-up its very essence. For the interested, a careful examination will reveal that the increasingly abstract discussion surfaces a process of reaching across many perspectives; pulling each and every one apart (analysis), all the while intuitively looking for those parts of the disassembled perspectives which naturally interconnect with one another to form a higher order, more general elaboration (synthesis) of what is taking place. As a result, the process not only creates the 'Discourse' but it also represents the key to evolve the tactics, strategies, goals, unifying themes, etc., that permit us to actively shape and adapt to the unfolding world we are a part of, live-in, and feed-upon.

The reason for including this section, Boyd says, is 'it suggests a general way by which we can deal with the world around us'. It is tempting to see the echo of Piaget in Boyd's words when he next asserts that he will show that[83]:

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[81] Boyd, *The Conceptual Spiral*, p.2.
[82] Ibid, p.4.
[83] Ibid, p.5.

By exploiting the theme contained within this passage and by examining the practice of science/engineering and the pursuit of technology we can evolve a conceptual spiral for comprehending, shaping, and adapting to that world.

Simple minded message

The subsequent section aims to illustrate and substantiate this hunch. The first step is offering the audience a new view on the nature of science, engineering and technology. Boyd gives three preliminary definitions in the terms that makes them conceptually comparable to each other:

- Science can be viewed as a self-correcting process of observation, hypothesis, and test.

- Engineering can be viewed as a self-correcting process of observation, design and test.
- Technology can be viewed as the wherewithal or state of the art produced by the practice of science and engineering.

Illustrations

This raises the question, according to Boyd, what the practice of science, engineering and the pursuit of technology has given us or done for us. The answer lies in four slides Boyd shows the audience with a total of 57 entries of persons, teams or companies and their specific contributions to science, engineering and technology. Once more manifesting a remarkable erudition, as well as substantiating the idea that Boyd was aware of the scientific changes of his time, the purpose of this list is to show how all are related through a most pervasive element both Piaget, Polanyi and deBono had discussed: *novelty through mismatches*[84]:

Examples from Engineering

Some Outstanding Contributors	Contributions
Wright Brothers (1903)	Gasoline powered airplane
Christian Hulmeyer (1904)	Radar
V. Paulsen/R.A. Fessenden (1904/1906)	Wireless telephone
John A. Fleming/Lee De Forest (1904/1907)	Vacuum tube
Tri Ergon/Lee de Forest (1919/1923)	Sound motion picture
USA – Pittsburgh (1920)	Public radio broadcasting
American Car Locomotive (1925)	Diesel – electric locomotive
J.L. Baird (1926)	Television
Warner Brothers (1927)	Jazz singer/sound motion picture
Germany/USA (1932/1934)	Diesel-electric railway
Britain/USA/Germany (1935-1939)	Operational radar
Germany/Britain/USA (1935/1936/1939)	Television broadcasting
Hans von Ohain/Germany (1939/1939)	Jet engine/jet airplane
Eckert & Mauchly (1946)	Electronic computer
Bardeen & Brattain & Shockley (1947)	Transistor
Ampex (1955)	Video recorder
J. Kilby/R.Noyce (1958/1959)	Integrated electric circuit
T.H. Maiman (1960)	Laser
Philips (1970)	Video cassette recorder
Sony (1980)	Video camcorder

[84] Ibid, pp. 9-12.

Examples from Engineering

Some Outstanding Contributors	Contributions
Savery/Newcomen/Watt (1698/1705/1769)	Steam engine
George Stephenson (1825)	Steam railway
H.Pixii/M.H. von Jacobi (1832/1838)	AC generator/AC motor
Samuel Morse (1837)	Telegraph
J.N. Nieqce/J.M. Daguerre/Fox Talbot (1839)	Photography
Gaston Plante (1859)	Rechargeble battery
Z. Gramme/H. Fontaine (1869/1873)	DC Generator/DC motor
Nicholas Otto (1876)	4-cycle gasoline engine
Alexander G. Belle (1876)	Telephone
Thomas A. Edison (1877)	Phonograph
Thomas A. Edison (1879)	Electric light bulb
Werner von Siemans (1879)	Electric locomotive
Germany (1881)	Electric metropolitan railway
Charles Parsons (1884)	Steam turbine
Benz/Daimler (1885/1886)	Gasoline automobile
T.A. Edison/J.LeRoy/T.Armat/et al (1890-1896)	Motion-picture camera/projector
N.Tesla/G.Marconi (1893/1895)	Wireless telegraph
Rudolf Diesel (1897)	Diesel locomotive
Italy (1902)	Electric railway

Examples from science

Some outstanding Contributors	Contributions
Isaac Newton (1687)	'Exactness'/predictability via laws of motion/ gravitation
Adam Smith (1776)	Foundation of modern capitalism
A.M. Ampere/C.F.Gauss (1820's/1830's)	Exactness/predictability via electric/magnetic laws
Carnot/Kelvin /Clausius/Bolzmann (1824/1852/1865/1870's)	Decay/disintegration via second law of thermodynamics
Faraday/Maxwell/Herz (1831/1865/1888)	Union of electricity & magnetism via field theory
Darwin & Wallace (1838/1858)	Evolution via theory of natural selection
Marx & Engels (1848 – 1895)	Basis for modern 'scientific socialism'
Gregory Mendel (1866)	Inherited traits via his laws of genetics
Henri Poincare (1890's)	Inexactness/unpredictability via gravitational influence of three bodies
Max Planck	Discreteness/discontinuity via his quantum theory
Albert Einstein	Exactness/predictability via his special & general relativity theories
Bohr/de Broglie/Heisenberg/Schrodinger/Dirac/ et al (1913/1920's…)	Uncertainty/indeterminism in quantum physics
L.Lowenheim & T. Skolem (1915-1933)	Unconfinement (non-categoricalness) in mathematics & logic
Claude Shannon (1948)	Information theory as basis for communication
Crick & Watson (1953)	DNA spiral helix as the genetically coded information of life
Lorenz/Prigogine/Mandelbrot/Feigenbaum/et al (1963/1970's.)	Irregularity/unpredictability in non-linear dynamics
G.Chaitin/C. Bennett (1965/1985)	Incompleteness/incomprehensibility in information theory

Grand Message

This long list of past contributions by these people suggests a 'Grand Message' for now and for the future, Boyd continues[85]. And this grand message is an elaborate restatement of the ideas of Gödel and Heisenberg first introduced in the essay, but now (almost) in layman's language. In the mathematical/logical sense, Boyd asserts, the theorems associated with Gödel, Lowenheim & Skolem, Tarski, Church, Turing, Chaitin, and others reveal that not only do the statements representing a theoretical system for explaining some aspect of reality explain that reality inadequately or incompletely but, like it or not, these statements spill out beyond any one system and do so in unpredictable ways. Or, conversely, these theorems reveal that we can neither predict the future migration and evolution of these statements nor just confine them to any one system nor suggest that they fully embrace any such system.

If we extend these ideas and build upon them in a scientific/engineering sense, we can say, according to Boyd, that any coherent intellectual or physical systems we evolve to represent or deal with large portions of reality will at best represent or deal with that reality incompletely or imperfectly. Moreover, we neither have nor can we create beforehand a supersystem that can forecast or predict the kind of systems we will evolve in the future to represent or deal with that reality more completely or more perfectly. Furthermore, such a supersystem can neither forecast nor predict the consequences that flow from those systems that we create later on. Going even further, we cannot determine or discern the character or nature of such systems (super or otherwise) within themselves. These findings imply that:

> People using theories or systems evolved from a variety of information will find it increasingly difficult and ultimately impossible to interact with and comprehend phenomena or systems that move increasingly beyond and away from that variety – that is, they will become more and more isolated from that which they are trying to observe or deal with, unless they exploit the new variety to modify their theories/systems or create new theories/systems.

This reveals that, 'while we can comprehend and predict some portions of the everchanging world that unfolds before us, other portions seem forever indistinct and unpredictable'[86].

Underlying dynamics

After reading his previous work it is obvious Boyd has reformulated here one of his earliest statements that we must constantly make sure we develop adequate mental models to make up for the ever present and unavoidable level of uncertainty. For his present audience he keeps this insight hidden until later. Instead he raises the question 'what all this have to do with our ability to thrive and grow in such a world that is seemingly orderly and predictable yet disorderly and unpredictable?[87]

To get at this question, he suggests 'to take a closer and more general look at what science, engineering, and the pursuit of technology produce and how this is accomplished. Furthermore, suspecting that these practices and pursuit are not wholly accidental nor obvious and that they seem to change us in some ways, he also suggests to examine what keeps the whole enterprise going and how this enterprise affects us personally[88]. In other

[85] Ibid, p.14. The next section almost literally follows Boyd's text on p.14..
[86] Ibid, p.16.
[87] Ibid, p.17.
[88] Ibid, p.18.

words, in order to gain a richer image of science, engineering, and technology, the following questions need to be addressed. What do science, engineering and technology produce? How is this accomplished? What is the driving mechanism that keeps the process alive and ongoing, or put another way, what phenomena sustains or nourishes the whole enterprise? Finally, how does this enterprise of science, engineering, and technology affect us personally as individuals, as groups, or as societies?'[89]

In typical Boydian fashion, the answer he offers to the first question – what do science, engineering and technology produce – comes from a conceptual comparison of the three. The similarity lies not in anything tangible but in an intangible common element. As Boyd states, 'if we examine the contributions from the practice of science and engineering and generalize from these individual contributions what do we see? We see new ideas, new systems, new processes, new materials, new etc. In other words, science, engineering, and technology produce change via novelty'[90].

The second question – how is novelty produced - also brings a familiar argument, but instead of arriving at it from the avenue of uncertainty, now he arrives at it from the avenue of novelty. To examine novelty, Boyd explains, 'we speak of it in terms of those features that seem to be part of that novelty. In other words, we reduce a novel pattern down to some features that make up that pattern. Different people in examining such a pattern may see differing features that make it up. In other words, there are different ways by which a pattern can be reduced hence the possibility for differing features or parts. Regardless of how it comes out, we call this process of reduction: analysis.

Pushing this process even further we can reduce many different patterns (analyses) to parts that make up each pattern and use these parts, or variations thereof, to make a new pattern. This is done by finding some common features that interconnect some or many of these parts so that a new pattern – whether it be a new concept, new system, new process, new etc. – can be created. We call this process of connection: synthesis. Now if we test the result of this process with the world we're dealing with, we have an analytical/synthetic feedback loop for comprehending, shaping, and adapting to that world[91]. And pulling all this together we can say that[92]:

> Novelty is produced by a mental/physical feedback process of analysis and synthesis that permits us to interact with the world so that we can comprehend, cope with, and shape that world as well as be shaped by it.

This leads to the third question: 'what is the driving mechanism that keeps the process alive and ongoing[93]. What phenomena sustain or nourish the whole enterprise? One thing is clear, Boyd tells his audience, 'if our ideas and thoughts matched perfectly with what goes on in the world; and if the systems or processes we designed performed perfectly and matched with whatever we wanted them to do, what would be the basis for evolving or creating new ideas, new systems, new processes, new etc.? The answer: There wouldn't be any! In other words:

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[89] Ibid, p.19.
[90] Ibid, p.20.
[91] Ibid, p.21.
[92] Ibid, p.22.
[93] Ibid, p.23.

> The presence and production of mismatches are what sustain and nourish the enterprise of science, engineering, and technology, hence keep it alive and ongoing – otherwise there would be no basis for it to continue.

Boyd then sets out to explain how this enterprise of science, engineering, and technology affects us personally as individuals, as groups, or as societies[94]. The previous discussion had shown that 'the practice of science/engineering and the pursuit of technology not only change the physical world we interact with – via new systems, new processes, new etc. – but they also change the mental/physical ways by which we think about and act upon that world. In this sense the practice of science/engineering and the pursuit of technology permit us to continually rematch our mental/physical orientation with that changing world so that we can continue to thrive and grow in it. Put simply:

> The enterprise of science, engineering, and technology affects us personally as individuals, as groups, or as societies by changing our orientation to match with a changing world that we in fact help shape.

To Boyd the discussion up to this point has revealed that 'without the intuitive interplay of analysis and synthesis we have no basic process for generating novelty, no basic process for addressing mismatches between our mental images/impressions and the reality it is supposed to represent; and no basic process for reshaping our orientation toward that reality as it undergoes change. Put simply:

> Without the interplay of analysis and synthesis we have no basis for the practice of science/engineering and the pursuit of technology – since novelty, mismatches, and reorientation as the life blood ingredients that naturally arise out of such practice and pursuit can longer do so[95].

These findings mandate a modification of the definitions of science and engineering offered earlier, showing how Boyd himself had applied the spiral model for getting closer to the truth. The earlier definition of science regarded it as a 'self-correcting process of observation, hypothesis, and test'. The amended definition Boyd now suggests, regards science as a 'self-correcting process of observation*s*, *analysis/synthesis*, hypothesis and test'. Note that Boyd has changed observation into observations to indicate the fact that it is a continuous process, and not merely a one-time event. The same holds true for engineering, which had been defined earlier as 'a self-correcting process of observation, design and test'. This now must be changed to read 'a self-correcting process of observation*s*, *analysis/synthesis*, design, and test'. The reason for this change of view is that 'without the interplay of analysis and synthesis one can evolve neither the hypothesis or design and follow-on test nor the original 'simple-minded message' nor this presentation itself[96].

Final step: why novelty matters

Still, Boyd acknowledges, it is not obvious what bearing all this have on winning and losing[97]. The next slide illuminates this issue, without fully providing the answer yet. It suggests that

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[94] Ibid, p.24.
[95] Ibid, p.25.
[96] Ibid, p.26, italics are mine.
[97] Ibid, p.27.

what applies to science and engineering also applies to life in general. Novelty, Boyd asserts, 'is not only produced by the practice of science/engineering and the pursuit of technology, it is also produced by the forces of nature, by our own thinking and doing as well as by others. Furthermore, novelty is produced continuously, if somewhat erratically or haphazardly. Now, in order to thrive and grow in such a world we must match our thinking and doing, hence our orientation, with that emerging novelty. Yet, any orientation constrained by experiences before that novelty emerges (as well as by the Grand Message discussed earlier) introduces mismatches that confuse or disorient us. However, the analytical/synthetic process, previously described, permits us to address these mismatches so that we can rematch thereby reorient our thinking and action with that novelty. Over and over this continuing whirl of reorientation, mismatches, analysis/synthesis enables us to comprehend, cope with, and shape as well as be shaped by novelty that literally flows around and over us'[98].

So, Boyd has established the link between the dynamics of science and engineering and life, which makes the foregoing discussion interesting also for its pragmatic insights. But he has not addressed yet how this relates with winning and losing. As Boyd states: Yet, upon reflection, we still have a puzzle: why does our world continue to unfold in an irregular, disorderly, unpredictable manner even though some of our best minds try to represent it as being more regular, orderly, and predictable?[99] More pointedly, with so much effort over such a long period by so many people to comprehend, shape, and adapt to a world that we depend upon for vitality and growth, why does such a world, although richer and more robust, continue to remain uncertain, everchanging, and unpredictable?[100]

The answer, and the final piece of the argument comes from connecting novelty with uncertainty. Very simply, Boyd says, 'review of *Destruction and Creation*, this presentation, and our own experiences reveal that the various theories, systems, processes, etc. that we employ to make sense of that world contain features that generate mismatches that, in turn, keep such a world uncertain, everchanging, and unpredictable[101]. Then Boyd produces a list with entries drawn from a variety of scientific disciplines, all describing features that induce uncertainty:

- Uncertainty associated with the unconfinement, undecidability, incompleteness theorems of mathematics and logic.
- Numerical imprecision associated with using the rational and irrational numbers in the calculation and measurement processes.
- Quantum uncertainty associated with Planck's Constant and Heisenberg's Uncertainty Principle.
- Entropy increase associated with the Second Law of Thermodynamics.
- Irregular and erratic behavior associated with far from equilibrium open nonlinear processes or systems with feedback
- Incomprehensibility associated with the inability to completely screen, filter, or otherwise consider the spaghetti-like influences from a plethora of everchanging, erratic, or unknown outside events.
- Mutations associated with environmental pressure, replication errors, or unknown influences in molecular and evolutionary biology.
- Ambiguity associated with natural languages as they are used and interact with one another.

[98] Ibid, p.28.
[99] Ibid, p.29.
[100] Ibid, p.30.
[101] Ibid, p.31.

- Novelty generated by the thinking and actions of unique individuals and their many-sided interactions with each other[102].

Deeper Message

There then is the underlying message: There is no way out, unless we can eliminate the features just cited, Boyd asserts. Since we don't now how to do this we must continue the whirl of reorientation, mismatches, analysis/synthesis over and over again ad infinitum as a basis to comprehend, shape, and adapt to an unfolding, evolving reality that remains uncertain, everchanging, unpredictable[103]. And if we connect this continuing whirl of reorientation, mismatches, analysis/synthesis and the novelty that arises out of it with the previous discussion, Boyd tells his audience, we can see that we have 'a Conceptual Spiral for'[104]

• Exploration	-	Discovery	-	Innovation
• Thinking	-	Doing	-	Achieving
• Learning	-	Unlearning	-	Relearning
• Comprehending	-	Shaping	-	Adapting

Hence a Conceptual Spiral for Generating

• Insight	-	Imagination	-	Initiative

Just to make his point very clear once more, Boyd asks the rhetorical question: Can we survive and grow without these abilities?[105] And of course the answer is a wholeheartedly ! NO ![106]. This suggests then, that the conceptual spiral just formulated and derived from the previous explorations also represents[107]:

A
Paradigm
For Survival and Growth

The point, according to Boyd, of all this is that:

> Since survival and growth are directly connected with the uncertain, everchanging, unpredictable world of winning and losing, we will exploit this whirling (conceptual) spiral of orientation, mismatches, analyses/synthesis, reorientation, mismatches, analyses/synthesis...so that we can comprehend, cope with, and shape, as well as be shaped by that world and the novelty that arises out of it[108].

Boyd has thus explained the essence of these somewhat cryptic slides once more, and now in unambiguous terms. He shows how the enterprise of science, engineering and the pursuit of

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[102] Ibid, p.32.
[103] Ibid, p.33.
[104] Ibid, p.34.
[105] Ibid, p.35.
[106] Ibid, p.36.
[107] Ibid, p.37.
[108] Ibid, p.38.

technology, is connected to the game of winning and losing, and how insight into the dynamics of science and engineering is useful for strategy. They are all self-correcting and evolving systems. He has shown a new parallel once more between dynamics in disparate fields, substantiating not only that the ideas developed in the essay and subsequent presentations are relevant for strategy, but also that strategic thinking should be infused with these ideas and these dynamics. The hidden message for his audience is that, if organizations want to survive in a highly dynamic environment, in peace-time as much as in war, they need to embrace uncertainty and novelty.

The Essence of Winning and Losing

Introduction

On 28 June 1995, two years before his death, Boyd finished the last addition to *A Discourse*. As the title suggests, it contains what Boyd considered at that moment the essence of his opus. It is extremely brief, covering only five slides, including the title slide which depicts a mounted knight. Yet it is also extremely important, for it contains the only graphic representation of the OODA loop that up to this point Boyd has only described in words in various sections of different presentations. And as Hammond concludes (referring to his own involvement in Boyd's 'big squeeze') it is a synthesis of all of Boyd's work, from *Aerial Attack Study* and OODA loops to his most recent interests in coevolution, socio-biology, genetic engineering, chaos theory, complexity, and non-linearity[109]. Boyd's simple model belies its sophistication, Robert Polk noted in his short but eloquent assessment[110].

Indeed, in the five "key statements" of this presentation, Boyd manages to capture – and go back to – the arguments of some of the earliest literature he had studied in the early seventies, such as Piaget, Popper, Polanyi, Monod, Bronowski and Conant, while directly marrying these once more to several of his key arguments and definitions he developed in *Patterns*, *Strategic Game* and *Organic Design*. He shows how the insights derived mainly from looking at military history, but inductively informed by the OODA loop idea and the themes from the essay, are conceptually related to the insights from *Strategic Game* and *Organic Design*, which find their basis much more in the sciences. These key statements also constitute both an explanation as well as a justification for the expanded OODA loop model that follows the statements[111]:

Key statements

- **Without our genetic heritage, cultural traditions, and previous experiences**, we do not possess an **implicit** repertoire of psychological skills shaped by environments and changes that have been previously experienced.

- Without **analysis and synthesis**, across a variety of domains or across a variety of competing/independent channels of information, we cannot evolve new repertoires to deal with unfamiliar phenomena or unforeseen change.

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[109] Hammond (2001), p.188.
[110] Robert Polk, 'A Critique of the Boyd Theory – Is it Relevant to the Army?', *Defense Analysis,* Vol.16, No.3, p.259.
[111] *The Essence of Winning and Losing*, p.2.

- **Without a many-sided implicit cross-referencing process of projection, empathy, correlation**, and **rejection** (across these many different domains or channels of information), we cannot even do **analysis** and **synthesis**.

- **Without OODA loops** we can neither sense, hence observe, thereby collect a variety of information for the above processes, nor decide as well as implement actions in accord with those processes.

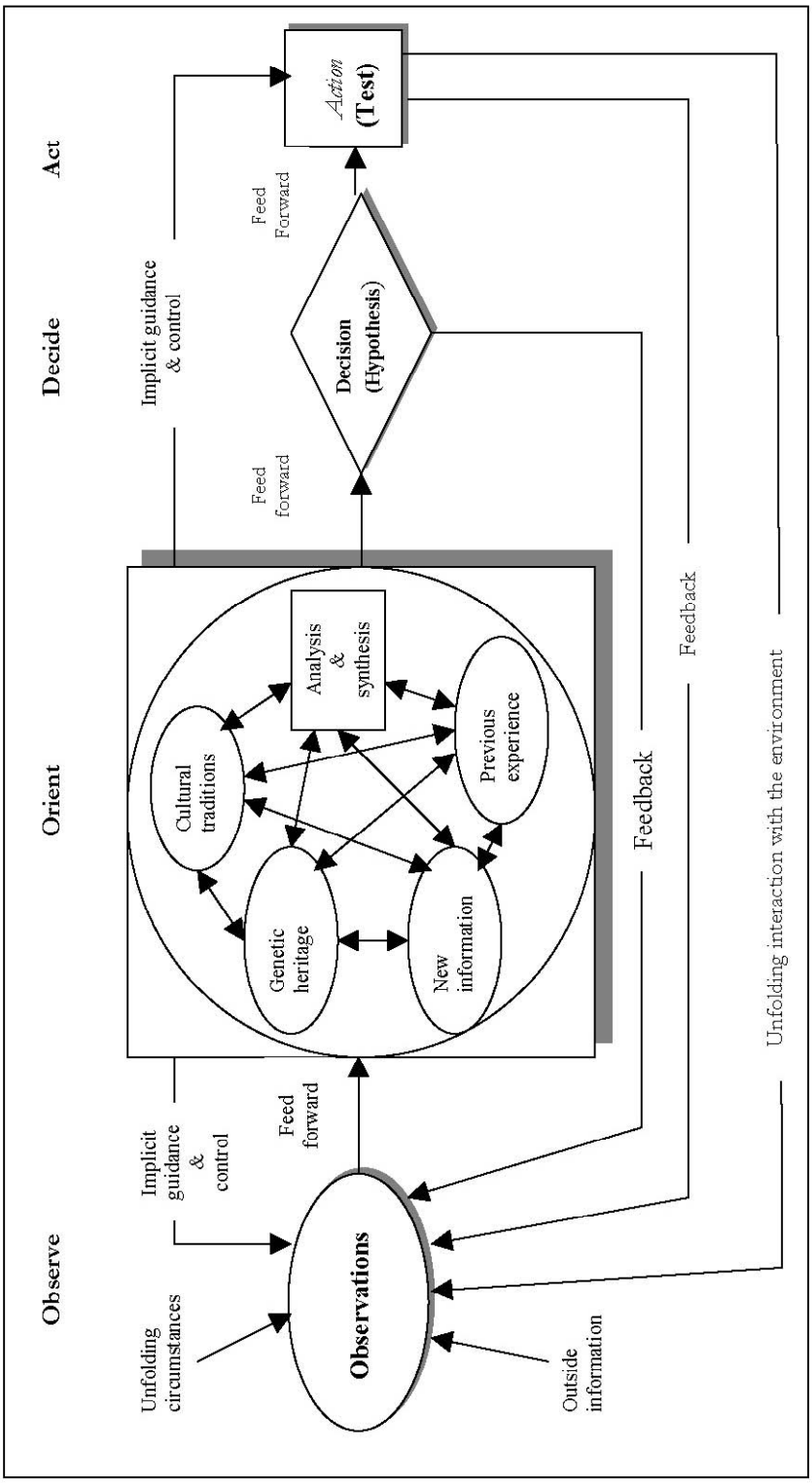
Or put another way

- **Without OODA loops** embracing all the above and **without the ability to get inside other OODA loops** (or other environments), we will find it impossible to comprehend, shape, adapt to, and in turn be shaped by an unfolding, evolving reality that is uncertain, everchanging, unpredictable.

It is only a slight stretch of imagination to suggest that in the last statement Boyd connects grand tactics with epistemology. The next slide then offers the full graphic rendering of the cybernetic double-loop decision-making model. A comparison with the simplified but most frequently used model of the OODA loop process and the picture below shows a much more complicated, more comprehensive, richer and deeper process, one which clearly suggests that there is more to Boyd's theory than the idea of rapid OODA looping. In Boyd's hands, the model gains a much wider application and more profound meaning[112]:

[112] Ibid, p.4.

The real OODA loop



Observation is the task that detects events within an individual's, or group's, environment. It is the method by which people identify change, or lack of change, in the world around them. While it is not the sole basis for Action, it is a primary source of new information in the behavioral process.

Note, Boyd stresses however, 'how orientation shapes observation, shapes decision, shapes action, and in turn is shaped by the feedback and other phenomena coming into our sensing or observing window. Without the context of Orientation, most Observations would be meaningless. Boyd is particularly detailed about Orientation. To survive and grow within a complex, ever changing world of conflict it is necessary to have insight and vision, focus and direction, he had stated earlier. To that end, Boyd posits, we must effectively and efficiently orient ourselves; that is, we must quickly and accurately develop mental images, or schema, to help comprehend and cope with the vast array of threatening and non-threatening events we face. This image construction, or orientation, is nothing more than the process of destruction (analysis) and creation (synthesis) he discussed in his briefings. It is how we evolve.

Also note how the entire 'loop' (not just orientation) is an ongoing many-sided implicit cross-referencing process of projection, correlation, and rejection'. It is the process of examining the world from a number of perspectives so that we can generate mental images or impressions that correspond to that world. Done well, it is the key to winning instead of losing. Very illuminating is Boyd's expansion on the nature of Orientation. It shows why "the big O" is indeed central and what elements constitute this filter and the dynamic at play. Indeed, in "the big O", we find represented the first three of the five key statements. The mental images we construct are shaped by our personal experience, genetic heritage, and cultural traditions, but they are also measured up against incoming new information to validate existing schemata. The entire OODA loop is a double-loop learning process, but the Orientation element itself thus also contains such a double loop feature.

Observations that match up with certain mental schema call for certain decisions and actions. Significantly, whereas the D and A of the OODA loop generally are seen to stand for Decision and Action, in this model Boyd offers his own view on the meaning of both words by tying Decision to Hypothesis and Action to Test. Decision is the component in which actors decide among action alternatives that are generated in the Orientation phase. Boyd discusses actions more than he does with the decision component. Actions, according to Boyd, should be rapid, surprising, ambiguous, menacing and varied. Translated into action, decisions thus feedback into the systems as validity checks on the correctness and adequacy of the existing orientation patterns.

The OODA loop model as presented by Boyd therefore represents Boyd's view on the process of individual and organizational adaptation in general, rather than to a military specific command and control decision making proces it is generally understood to depict. It refers to the conceptual spiral as discussed in the previous presentation, to the process of learning, to doctrine development, to command and control processes and to the Popperian/Kuhnian ideas of scientific advance. The (neo-)Darwinists have their place, as do Piaget, Conant, Monod, Polanyi, and Hall, and the non-linearists such as Murray Gell-Mann are incorporated through Boyd's final key statement in the final slide that follows the OODA loop picture[113]:

> The key statements of this presentation, the OODA Loop Sketch and related insights represent an evolving, open-ended, far from equilibrium process of self-organization, emergence and natural selection.

[113] Ibid, p.5.

This relates the OODA loop clearly to Complex Adaptive Systems, the role of schemata and to the process of evolution and adaption. Once again it shows that where the aim is "to survive and prosper" in a non-linear world dominated by change, novelty and uncertainty, adaptation is the important overarching theme in Boyd's strategic theory.

Beyond the rapid OODA loop idea

Correcting the narrow interpretation

As an abstract model, the OODA loop can be used as a framework to explain Boyd's thoughts. The OODA construct runs through all the levels of military operations and aggregation levels of social systems. Going through the slides Boyd tries to catch more and more aspects of behavior in a decreasing number of overarching terms. Yet, the common view that this abstract model, interpreted as an argument that victory goes to the side that can decide most efficiently, sufficiently captures the meaning and breath of Boyd's work falls short of the mark. The OODA loop represents and means more than a decision process and in Boyd's hands the model contains more elements for victory than information superiority and speed.

The first misconception concerns the element of speed. The rapid OODA looping idea suggests a focus on speed of decision making, and "out-looping" the opponent by going through consecutive OODA cycles faster, but Boyd equally addresses the other aspect of tempo; altering the tempo. Tempo makes it hard for the opponent to adequately adapt to the fast *changing* situation. It is not absolute speed that counts; it is the relative tempo or a variety in rhythm that counts. The OODA speed is a parameter to vary with for it is also a pattern one can give away. This does not really imply that one should make up one's mind slower, but it may imply that, when it comes to the action part of the OODA loop, one may want to alter the times of executing actions so as to foster the impression of unpredictability. Changing OODA speed becomes part of denying a pattern to recognized.

Secondly, and related to the previous observation, rapid OODA looping should not be equated with merely going through the decision cycle faster than the opponent and/or accomplishing this process with more information, for such a view ignores the close interrelationship between physical action and the mental component. One can have a distinct advantage in timely and accurate information, but if this cannot be translated into meaningful action, this "information superiority" is useless. Boyd instead argues that the aim is to create and perpetuate a highly fluid and menacing state of affairs for the enemy, and to disrupt or incapacitate his ability to adapt to such an environment. Thus the psychological (mental/moral) and temporal mechanisms come into play only if and when the physical and spatial dimensions are also adequately manipulated. Physical lethal and threatening actions interact with mental and moral effects. Although it is perception and thus the psychological dimension that is the heart of the theory, this does not mean physical aspects are less important. Boyd shows how they are closely related and he highlights the effectiveness of the synthesis of actions in the physical, mental and moral dimensions.

A third misconception concerns again the focus on speed/tempo. While tempo is incredibly important, it is also just one dimension among a significant number of other control dimensions in this theme. And it is probably most important at the tactical level as a factor directly influencing chances of success. At the grand tactical level he is more concerned with 'operating inside adversary's mind-time-space', and with 'generating mismatches between those events he observes, or anticipates and those he must react to'. At

this level, as well as at the strategic and the grand-strategic other dimensions that can be manipulated span the spectrum of leverage points for manipulating a Complex Adaptive System that were described at the end of chapter 5.

This also surfaces when Boyd discusses the three categories of conflicts, which must be positioned at the strategic level. Negating time and information is perhaps the necessary mechanism that leads to inadequate reactions, but not sufficient. Other factors need to combine with lack of time to induce a moral, mental and physical incapability to react. Schwerpunkte, physical and non-physical, need to be attacked as well as Nebenpunkte. Physical as well as non-physical connections, moral bonds, must be severed through the game of isolation and interaction. Conspicuous and varied actions are necessary and it is these, combined with the menacing aspect of those actions and impressions that produce paralysis, disintegration and non-cooperative centers of gravity, and that shatter cohesion. The aim of the theme of disintegration and collapse is rendering the adversary powerless by denying him the opportunity to cope with unfolding circumstances. The temporal dimension plays a large role here too, but rather within the context of the organism's ability to adapt, and it plays a much less prominent role than at the tactical level.

The abstract aim of Boyd's method is to render the enemy powerless by denying him the time to mentally cope with the rapidly unfolding, and naturally uncertain, circumstances of war, and only in the most simplified way, or at the tactical level, can this be equated with the narrow rapid OODA loop idea. Indeed, it is only at the tactical level that Boyd actually refers to 'OODA more inconspicuously, more quickly and with more irregularity'. So, the view that the rapid OODA loop idea captures Boyd's work is valid only if one confines oneself to the tactical level, but it leaves unaddressed the fact that Boyd also dealt with the other levels of war, that he dealt with other subjects such as organizational culture, as well as the fact that at the other levels of war Boyd focussed on other factors relevant for adaption.

The larger theme: Adaptability

If the previous presentations did not do so already, the comprehensive drawing of the OODA loop Boyd developed in his last presentation suggests indeed that there is much more to the OODA loop idea than only the (important) insight of "rapid OODA looping" and after a complete reading of his work, it is evident that the theme of adaptation is actually the one which is at the heart of Boyd's work. *Maintaining the ability to adapt while negating that to the opponent* is the single all-embracing theme connecting the various parts of *A Discourse*. 'Adaptability is the power to adjust or change in order to cope with new and unforeseen circumstances', Boyd noted in *Patterns*, and 'in dealing with uncertainty it seems to be the right counterweight'. The dominant and overarching theme in Boyd's work is not the narrow interpretation of rapid OODA looping, or "decision superiority", but rather the ability to adapt to the unfolding, multidimensional events, which occur at different time scales. The "rapid OODA looping idea" in the narrow sense fits in the larger theme of adaptation, and even this narrow view on Boyd's work gains meaning if it is expressed within the context of organizational adaptation.

Boyd regards the contestants, the armies, their headquarters and societies in terms of living systems, as organisms, that aim to survive and prosper. To that end they – individuals, platoons, brigades, divisions, army corps, nations, and any other type of social system - observe, learn and adapt. Boyd's theory is about interacting *processes* of thought, about anticipation and feedback loops, about learning and adaptation and about the fatal consequences of not learning or being constrained in one's efforts. The OODA loop stands

for a process of learning, of evolving. Using this construct, the crux of winning vice losing becomes the relational movement of opponents through their respective OODA loops, i.e., their organizational learning and adaptation processes.

Adaptation naturally follows from Boyd's view of war as being about survival. The strategic aim, he asserts in *Patterns*, is 'to diminish adversary's capacity to adapt while improving our capacity to adapt as an organic whole, so that our adversary cannot cope while we can cope with events/efforts as they unfold'. He deliberately adopts a Neo-Darwinist/CAS perspective, hence the centrality of the theme of adaptation. Boyd seeks to create organizations that are adaptive. The themes of interaction-isolation, novelty, uncertainty, the dynamic in war of doctrine-counter doctrine, the existence of several categories of conflict, each with their own logic, and their logical responses, must be seen within the context of organisms that aim to survive and therefore need to adapt within a dynamic environment.

Boyd argues that adaptation occurs across various timescales, not unlike the ones proposed by Gell-Mann, and he develops a view on what adaptability means and requires at each level. Each level knows its specific "name of the game". At the *tactical level and operational level* actions, movements, attacks, feints, threats, etc, disrupt the enemy's organizational processes, confuse commanders and personnel, attrit his forces and dislocate his units. Confusion, fear and lack of information or the ability to react upon correct perception of the threats degrade trust, cohesion, and courage, and thus the ability to cohere and respond collectively and to take the the initiative, i.e., to adapt adequately as an organization. Adaptation is rather direct.

At the *strategic level* adaptation is more indirect and takes longer time intervals. It revolves around adjusting doctrines and force structures and disorienting the opponent's orientation patterns, or mental images.

At the *grand-strategic level* it revolves around shaping the political and societal environment, and selecting a form of warfare. The theme for vitality and growth lists as the aim improving fitness as an organic whole to shape and expand influence or power over the course of events in the world. This also surfaces as the national goal. Here, Boyd moves away from the OODA loop, in any case it is less pervasive. Instead the emphasis is on the effective combination of isolation and preservation strategies in all the dimensions, the mental-moral and the physical. Another major issue is the absence of emphasis on the temporal aspect because success here is not (only) overloading the opponent's OODA system but derives comes from the interplay of leveraging across multiple dimensions. Success is the result of playing the game of interaction and isolation well.

So, Boyd's theory is comprehensive, suggesting key factors for victory at each level. The OODA loop as an abstract model is still relevant but the narrow interpretation of going through the OODA loop more rapidly than the opponent less so. Beyond the tactical level, the other features embedded within the OODA loop surface as more important.

A new synopsis

His work shows a strong consistency and logic when viewed from the perspective of general organizational adaptation, as the following synopsis of his work shows. In abstract and general terms, an ability to adapt requires maintaining a minimum level of freedom of action for each level of an organization as well as maintaining a range of options for future action. It requires a variety of organization levels and in subsystems, orientation patterns and in response options. It requires subsystems sufficient latitude so as to enable them to respond in a timely manner to the events in their immediate environment with the means at their

disposal. They should however operate with the overall systemic fitness and goals in mind wich requires the maintenance of cohesion, i.e., the maintenance of sufficient connections between the subsystems and layers. Moreover, the system will need operate on explicit and implicit guidance. This way can a system hope to survive and prosper in the face of complex change and uncertainty.

To adapt means to create and maintain a fit with the environment and that is exactly what one wants to deny one's opponents, whether it is through conventional warfare or through guerrilla warfare. Based upon the analysis of ancient and modern military history, Boyd identifies four key qualities of successful operations-- *initiative, harmony, variety, and rapidity*. Collectively, these characteristics allow one to adapt to and to shape the uncertain, friction-filled environment of war. That same set of qualities enables one to create *friction, uncertainty and ambiguity,* and to exploit *mismatches*, thus disabling the opponent's capability to adapt. Friction, uncertainty and ambiguity, are closely related in Boyd's work. All are threats and potential weapons. Although related, intertwined even, each performs a specific role to achieve specific effects. Friction is directly connected to Boyd's insistence on tempo. Tempo works on the OODA loop and the adequacy of reactions through friction, that Clausewitzian term that denotes the myriad factors that cause real war always to proceed differently than we expected or planned for. A high tempo will increase the friction in the opponent's organization that needs to react constantly.

While not a novel term of course Boyd adds to Clausewitz' idea the notion of Sun Tzu that friction can be used to shape the conflict in one's favor by creating and exploiting the frictions faced by one's opponent. Friction is a tool in the hands of an able commander. The military commander can manipulate friction in two supplementary ways. First, he must minimize his own friction through initiative and harmony of response. Boyd relates this idea of minimizing friendly friction and maximizing enemy friction to his key qualities of initiative, harmony, variety, and rapidity. To minimize friendly friction, one must act and react quicker than one's opponent. This is best accomplished by the exercise of initiative at the lower levels within a chain-of-command. This decrease in friendly friction acts to tighten his own loop (i.e., to speed up his own decision-action cycle time). Another key to attaining a favorable edge in OODA loop speed and accuracy (and, hence, to winning instead of losing) is efficient and effective orientation.

Second, he must maximize his opponent's friction through variety and rapidity of response. This increase in enemy friction acts to loosen the adversary's loop (i.e., to slow down his decision-action cycle time). To maximize enemy friction, one should plan to attack with a variety of actions, executed with the greatest possible rapidity in a variety of tempo's. Variety in one's actions and strategy in terms of dimensions, areas, forces, tactics, method, in timing or in rhythm, precludes the opponent from recognizing a pattern in one's actions. Getting inside the opponent's loop requires that you remain fluid, that, like water, you follow the path of least resistance and least expectation, flow through the environment and use strength against weakness. Make your opponent react. Be menacing and threaten what he values most. This lethal combination of varied, rapid actions (which can be physical, mental and/or moral), serves to overload the adversary's capacity to properly identify and address those events which are most threatening. Together, these "friction manipulations" assure one's continuous operation within the enemy's OODA loop in menacing and unpredictable ways. Initially, this produces confusion and disorder within the enemy camp. It dissolves cohesion. Ultimately, it produces panic and fear, which manifest themselves in a simultaneous paralysis of the ability to cope and willingness to resist.

Friction is thus a crucial concept for Boyd. It is a weapon as well as a threat. The idea of friction as a weapon flows directly from the recognition of uncertainty as the one

thing any system is constantly facing and trying to reduce. As Boyd argues in the opening piece of *A Discourse*, for Boyd uncertainty prevails and is inherent in any system. It is unavoidable and insurmountable. This insight led Boyd to make uncertainty the nucleus for developing theories about conflict. He turns uncertainty into a weapon. Besides the fact that the opponent probably experiences uncertainty because of a time lag between observation, analysis and action, through lack of time to digest all available information or through less than optimal sensors, uncertainty can also be magnified deliberately by creating ambiguity. Contradictory information, feints and deception are familiar tools for achieving this. Boyd restated them, adding that multiple and various actions simultaneously or during non-standard intervals (in addition to security and deception) prevent one to become predictable. That way, as just stated, there is no pattern in one's behavior (across the physical, mental and moral dimensions) to recognize and if there are patterns, one changes them or alternates between them. Variety with uncertainty thus causes ambiguity.

This ties in with Boyd's conviction that we should create *mismatches*. Time, rhythm and tempo are merely levers for creating mismatches. At the operational level, Boyd speaks of severely disrupting the adversary's combat operation process used to develop and execute his initial and subsequent campaign plans. This disruption occurs by rapidly and repeatedly presenting the enemy with a combination of ambiguous, but threatening events and deceptive, but non-threatening ones. This "out-looping" of the opponent, these multiple events, compressed in time, this manipulation of friction, creating uncertainty and promoting ambiguity, it all leads to the emergence of mismatches or anomalies, between those actions the opponent believes to threaten his survival and those which actually do. Going into the OODA-loop these mismatches feed back into the system to create an increase in mismatch in the next OODA cycle. Repeated and reinforced mismatches lead to a yawning gap between perception and reality of the strategic environment. The opponent has become isolated. This can also be effectuated by manipulating the social environment the opponent operates in. Isolation also occurs if the social environment becomes hostile to the aims and actions of the opponent, negating him support he may be dependent upon.

The enemy must eliminate these mismatches between perception and reality if his reactions are to remain relevant-- that is, if he is to survive. He must attempt to re-establish interaction with the environment. One's operational aim should be to ensure the opponent cannot rid himself of these menacing anomalies by hampering his ability to process information, make decisions, and take appropriate action. In consequence, he can no longer determine what is being done to him and how he should respond. Ultimately, the adversary's initial confusion will degenerate into paralyzing panic, and his ability and/or willingness to resist will cease. Alternatively, he his rendered powerless because he is splintered and unable to cohere. His system has become a closed one in stead of an open system, and closed systems are incapable of adaptation. At the strategic and grand strategic levels other elements are added, such as shaping the political and societal environment through creating a unifying vision, dissolving the opponent's moral fiber, destroying internal harmony, disorienting his mental images, attracting the uncommitted and weakening the abonds between the opponent and his allies, etc. *Interaction and isolation* are the key terms Boyd coins for this dynamic at the most abstract level.

The narrow interpretation of the OODA loop also deemphasizes another essential feature of Boyd's theory: *developing, maintaining and reshaping one's orientation*, the box around which the loop graphically revolves. *First* of all, speed, or rather tempo, is not very useful if one cannot adequately react on incoming information or one's interpretation of events is flawed. Orientation shapes the way we interact with the environment. It determines how and what we observe, decide and act. It determines the character of the present OODA loops

while the present OODA loops shape the character of future orientation. It feeds forward and backward. Orientation is the key phase in the OODA loop. Brave decisions and heroic actions are pointless if the observation was inaccurate because of our inadequate orientation. Orientation is made up of genetic heritage, cultural tradition, experience, and unfolding circumstances. Orientation is shaped by the interplay of these factors. It is the "genetic code" of an organism or organization. For any command concept, then, orientation is the "Schwerpunkt".

Second, in order to avoid predictability and ensuring adaptability to a variety of challenges, just having one common orientation, one thought pattern, one belief systems or one military doctrine to solve all operational contingencies will not suffice. It is essential to have a repertoire of orientation patterns and the ability to select the correct one according to the situation at hand while denying the opponent the latter capability. In order to maintain variety in response one should have variety built into the making of orientation patterns. The way to do this is to involve people with varying backgrounds and experience and confront them as a group with varying situations. This will built trust and variety in response and communication about each other's way of looking at situations. Boyd is very much aware that one needs to take care when selecting people in command but also in operational headquarters. This concept in turn requires a common outlook and doctrine, otherwise units may respond in totally unexpected ways.

At the same time one wants to keep the opponent in the dark or bewildered. This will make it hard for him to read the strategic environment correctly thus making any selection of orientation pattern and subsequent set of responses guesswork. Here again the idea we saw earlier of creating many non-cooperative centers makes good sense. Without the ability of proper communication, the isolated and/or disoriented units sent contradicting, incomplete, inconsistent, outdated or no information at all. This denies a commander the capability to form a balanced judgment that is based on various looks at the same situation. Boyd calls this a situation in which a command and control system is turned inward. Such a situation will always lead to dissolution and disintegration (the system becomes unglued).

The *third* aspect Boyd argues for in relation to orientation is the insistence to have a repertoire of relevant schemata *combined with* a capability to validate the schemata before and during operations and the capability to devise and incorporate new ones, if one is to survive in a rapidly changing environment. Indeed, learning is essential for adaptation. One may react very fast to unfolding events, but if one is constantly surprised nevertheless, apparently one has not been able to turn the findings of repeated observations and actions into a better appreciation of the opponent, i.e., one has not learned but instead continued to operate on existing orientation patterns. Verifying existing beliefs and expectations, and if necessary modifying these in a timely manner, is crucial. The way to play the game of interaction and isolation is to spontaneously generate new mental images that match-up with an unfolding world of uncertainy and change, Boyd asserted in *The Strategic Game*. So, indeed, a major theme throughout, for all levels of organization and war is the capability to evolve, to adapt, to learn, or what one author recently labeled as 'organizational learning dominance'[114].

Boyd's advice for organizational culture and structure are entirely consistent with his emphasis on adaptability. Boyd stresses that setting up and maintaining connections are vital. External explicit connections are however prone to interruption, and when the command system is based on them, it will generally be slower than a concept which is based on implicit communication. The latter can make do with less information, less external

[114] R. Evan Ellis, 'Organizational Learning Dominance, The Emerging Key to Success in the New Era of Warfare', *Comparative Strategy,* 18:191-202, 1999.

communication and explicit direction, which will reduce response times. As stated before, higher commands must shape the 'decision space' of subordinate commanders and, connected by a common frame of reference and direction in the form of a goal or focus, these commanders will remain connected to the entire system.

Survival of military units depend on having a very specific kind of command arrangement with both explicit control mechanisms and feedback loops, as well as implicit ones formed by common frames of reference, shared ideas, shared experiences, trust, etc. Trust is the glue of Boyd's command system. It is the basis for social cohesion. Through trust, you gain respect, loyalty, and common purpose, without it you need detailed orders to run things. By giving units and subordinate commanders trust and freedom of action they can ensure the optimum conditions for the actions, they can adapt as necessary. This leaves room for initiative. Combined with a common outlook and a common doctrine all one really needs is a goal. If everyone understands clearly and is attuned to the organization's purpose or the commander's intent, explicit communication beyond the objective is superfluous for a unit. Because of the shared outlook one knows what to do and what one can expect of others, be it supporting units, higher commands etc. Implicit communication will suffice.

This rendering of mission type orders or Auftragstaktik is derived from Blitzkrieg. Auftragstaktik builds on, and requires trust among and across all levels. It requires initiative, flexibility and freedom of action for the lower levels. Relying on implicit communication and common outlook saves time in the OODA cycle and makes detailed supervision unnecessary. This ensures the timely and suitable adaptation of the system as a whole. It allows lower units to read their environment and respond adequately within the overall framework of the larger system and towards the goals of that larger system. The higher levels can set the boundaries and the direction. That defines the latitude for lower level units. It shouldn't go beyond that.

Command, Boyd indicates, is a wrong term, as is control. Basically Boyd advocates lateral relations and avoiding a top down hierarchical system. It must be a top down, a lateral as well as a bottom up process. There must be continuous open two-way communication. Higher command levels must restrain themselves in their desire to want to know all that is going on at lower levels as well as their desire to interfere. They must trust and coach. They must encourage cooperation and consultation among lower levels. They must accept bad news and be open for suggestions, lower level initiatives and critique. It is thus more a question of leadership and monitoring where monitoring involves an appreciation of what is going on and comparing this to what is expected. At the strategic an grand strategic levels an equivalent dynamic is argued. Leaders should develop attractive and inspiring national goals and philosophies that unite the nation.

Boyd thus developed an internally consistent command philosophy that can also be related to his ideas on operational art and organizational survival. He is able to tie it to the OODA loop and explain it in those terms. It also fits hand in glove with his proposition that, if one wants to survive and prosper, one must be able to adapt, evolve and learn better and faster then the opponent. Boyd's command philosophy is essential for the Boydian operational art to succeed. Boyd in fact re-invents and reformulates Auftragstaktik. The concept of Auftragstaktik is the organic way of ensuring that all levels within an organization (which should be decentralized) can adapt to their environments while as a unified entity they still head in a common direction. And its success is self-reinforcing. The strategic and operational levels set the overall direction and make sure there is variety of action and rapidity and keep the opponent guessing. This will translate into tactical advantage for lower levels, for the tactical units of the opponent will be misguided by their confused higher command level. Strategic mismatches create tactical mismatches which in turn, in the next

OODA loop of the opponent will lead to another strategic mismatch. According to Boyd this command and control philosophy ensures that units at all levels can maintain a sufficient degree of interaction with their environment. In the abstract sense it is a self-correcting mechanism much as the way science, technology and engineering are driven by self-correcting mechanisms.

Conclusion

This discussion has indicated, first, that the popular notion of the 'rapid OODA loop' idea does not adequately capture what Boyd meant with it, and, secondly, that Boyd must be remembered for more than only the idea that one can gain military victory by more rapidly OODA looping than the opponent. Boyd's work is more comprehensive and subtle than the one thing with which Boyd is normally associated with, namely the rapid OODA-loop idea, and it contains various other very valuable insights. The rapid OODA idea is fine for tactics and the operational level combat. It is a very important idea, one that had an important impetus in rediscovering and expanding maneuver warfare theory and doctrine. However, Boyd's relevance for strategic theory lies more in pointing to the need for systemic isolation, the need to have a variety of orientation patterns and the requirement to maintain organizational adaptability through a variety of methods. Moreover, as argued in previous chapters it lies in his approach for thinking strategically and the metaphors to examine war and conflict he offers.

8. CONCLUSION

The history of science demonstrates beyond a doubt that the really revolutionary and significant advances come not from empiricism.

James B. Conant[1]

To think theoretically one must be ready to appreciate and accept the need to sacrifice detailed descriptions for broad observations.

James N. Rosenau[2]

Summary

This study aimed to improve our understanding of Boyd's work as embodied in *A Discourse on Winning and Losing*. To that end in chapters 3, 4 an 5, the formative factors have been described in some detail. This discussion offered insight into reasons why Boyd developed his theory, and the professional environment his ideas landed in, and in response to which he in no small measure developed his ideas. In addition it showed a number of key themes, concepts and metaphors he derived from his background as fighter pilot, designer of fighter aircraft, his involvement in the Military Reform Movement, his reading of military history, and in particular from his study of scientific literature. Chapters 6 and 7 provided a very comprehensive account of Boyd's work, demonstrating that Boyd's work constitutes a theory of considerable sophistication, consistency and persuasiveness. It is also more comprehensive, subtle and complex than the common rendering and the general perception of what Boyd argues. It addresses the grand strategic, strategic, operational and the tactical level, developing specific advise (or the name of the game) for action at each level, but all in logical relation to one another. Additionally it develops suggestions for command and control and organizational culture that are conceptually consistent with the overall thrust of his arguments on the nature of strategy and the essence of winning and losing. All are geared toward one aim which is to examine the dynamics of winning and losing, and each presentation as well as the essay contributes to that aim, offering variations, elaborations and new conceptualizations of the essence of success, winning, or rather in its most abstract, the name of the game of organizational survival.

The detailed discussion strongly indicates the importance of Boyd's work. Alexander George has indicated that research that could improve conceptual and generic knowledge is deemed very valuable, while Holsti states that studies linking variables from different levels are few and any model of explanation that emphasizes dynamics and the interplay of variables at different levels over time is a distinct step forward[3]. Boyd's work succeeds on

[1] Cited in Kaplan, p. 303.
[2] James N. Rosenau, *The Scientific Study of Foreign Policy* (2nd edition, New York, 1980), p.26.
[3] Cited in Dennis J.D. Sandole (1999), p.12.

both accounts. Also on the question of *the value of a theory* in the academic sense does Boyd's work qualify as a substantial contribution to strategic theory. Because a theory can be both commendable sound and disappointingly banal, it must be evaluated not only in terms of its epistemological virtues, but also by the value of the increment in knowledge it seeks to provide. This is determined by the scope of the phenomena it accounts for and the significance of the phenomena it addresses. A theory of great scope is one from which whose premises many implications may be drawn. Theories that correctly account for many phenomena that had previously been poorly understood, or that adumbrate new paths to explanation, are obviously better than those that illuminate a very narrow range of questions, or questions to which we already have satisfactory answers[4]. On most accounts Boyd's work must be considered important. Boyd's work qualifies to a large extent as a general theory of war, addressing various kinds, levels and dimensions of war. Moreover, it offers a novel synthesis of strategic theories, as well as new approaches to studying and thinking about war and strategy. Its importance thus lies in much more than the rapid OODA loop idea.

A new synthesis

There is much familiar territory in Boyd's work. I have argued that Boyd to some extent repackaged familiar ideas and arguments. Boyd's work follows closely the ideas advanced by Sun Tzu, Julian Corbett, Basil Liddell Hart, J.F.C. Fuller and T.E. Lawrence, and various others. Despite Boyd's critique on Clausewitz, Boyd does borrow concepts from him too. Furthermore Boyd discusses theorists of revolutionary warfare such as Lenin and Marx. Boyd did not aim to be novel per se, in fact, Boyd recognized that there is essential continuity in strategic experience. Knowledge grows not only by accretion and the replacement of dubious elements by more sound ones, but also by digestions, the remaking of the old cognitive materials into the substance of a new theory. The problem was, according to Boyd, that there are times we loose sight of those factors. Boyd's work explicitly builds on this continuity. It is the foundation of his argument. And in this there are strong similarities, for instance between Boyd's concept and those of Sun Tzu and Liddell Hart. The similarity with Liddell Hart even goes beyond the similarities in concepts. Like Liddell Hart, Boyd wrote to convince people that the military doctrine and practice of his day was fundamentally flawed. Like Liddell Hart Boyd opposed attrition type warfare and favored paralysis through maneuver. Like Liddell Hart (as well as Sun Tzu, Clausewitz and J.F.C Fuller), Boyd's stressed the moral and cognitive aspects of war. The work of both men followed a traumatic era of warfare, and like Liddell Hart Boyd too sees the answer (in lage measure) in maneuver warfare theory.

Neither is his constant reminder of the necessity to observe the opponent and the wider environment of combat and act accordingly a novel idea. This is directly from Sun Tzu, as are his ideas about shaping the environment and the opponent before actually engaging in combat. Sun Tzu too emphasized using superior judgment capability and constant adaptation as a weapon. He advocated variety, rapidity, surprise, creating uncertainty and multi-dimensional warfare and a host of other concepts and ideas we recognize in Boyd's work, and indeed, Boyd literally incorporated various concepts from Sun Tzu's work.

But while many of the insights that he provided can be traced back to the work of Sun Tzu of 2500 years ago, Boyd's did make an important contribution by rediscovering, translating and updating the concepts of Sun Tzu and the other strategists to suit the era he

[4] See Nincic, pp. 25-26.

found himself in. To Sun Tzu Boyd adds the Blitzkrieg concept which re-combines, according to Boyd, the elements that have historically produced success using the new tools of this century; the tank, the aircraft and modern communication equipment. To some extent one could also consider his rediscovery of operational art a novelty in his day.

The view of Boyd as a "great synthesizer" is however actually not quite valid for it fails to acknowledge genuine novel elements he added to this synthesis. First of all, to his audience in the seventies and eighties, Boyd's insistence on tempo, maneuver, the importance of the moral, organizing in semi-autonomous units, etc., was novel, and his rediscovery of the classical strategists timely. Moreover, while Boyd's ideas do indeed resemble those of classical theorists of the maneuvrists school of strategic thought, Boyd transcends them in a number of ways, delving deeper into the essence of victory underlying various schools of thought.

Moreover, although the presentation *Patterns of Conflict* initially does suggest that Boyd had been merely looking for confirmation of his hunch about the general validity of the rapid OODA loop idea, his study was not so selective, nor pre-conceived, and although Boyd did favor the maneuvrist style of combat when he discusses conventional warfare (a preference which is understandable in light of his environment), when he shifted his attention to the essence of strategy, he sees the maneuvrist style of warfare just as one of three possible "categories of conflict".

His work incorporates and integrates different strategic theories. In an abstract sense, Boyd regards them as alternative modes of behavior, and the theories as orientation patterns. He regards strategic theories and strategic concepts, like doctrines, as part of the repertoire of a strategist's orientation pattern, integrating them in the cognitive dimension and in the discovery of fundamental similarities when he strips the theories to their bare essentials and expresses them in systems-theoretical/neo-Darwinist terms. In particular after his general overview of military history the synthetic character of his work becomes prevalent. Boyd's genius lies in recognizing the similarity in the principle factors and processes that produced success in the different categories of conflict. This integrative feature of Boyd's work is a remarkable performance and strength of his work. This feature is related to the following important contribution of Boyd.

Science and strategic theory: uncertainty and adaptability

A very important novelty in Boyd's work lies in his entire approach to the study of military history, operational art and strategic theory, as chapters 4 and 5 have demonstrated. He married military history with science, building his theory around the epistemological debates of the 1960s and 1970s, informed by Gödel, Heisenberg, Popper, Kuhn, Piaget, and Polanyi, which highlighted the unavoidable feature of uncertainty in any system of thought (as well as the limits of the Newtonian paradigm). It also offered him the themes of the combination of analysis-synthesis as well as the Second Law of Thermodynamics and entropy. He was the first strategist to introduce the epistemological debates of the sixties and seventies into strategic thought and to see the value and consequences of these debates for strategy, leading strategic thought away from the Newtonian, mechanistic, reductionist and deterministic approach.

Cybernetics and Systems theory offered him the concept of feedback, the distinction between open and closed systems, the importance of interactions and relations, and the need for a holistic approach. The cognitive revolution emanating from these developments showed him the role of schemata formed by genetics, culture and experience. Chaos theory highlighted non-linear behavior. These ideas returned in various guises in evolution theory

and complexity theory, and emphasized the theme of adaptation. In short, it lead him to focus on the cognitive dimension of war, and the role of uncertainty, and on the answer to it: adaptability.

Such an eclectic multi-dimensional and holistic approach was essential to understand the complex behavior of complex systems. This mode of thinking became an argument in itself. He wanted to inculcate his audience not so much with a doctrine as with an understanding of the dynamics of war and strategy and a style of thinking about that dynamic that differed from the deterministic mindset that prevailed in the strategic discourse of the sixties and seventies. Applying his argument in practice, constantly showing the dynamic of move and countermove, constantly stripping bare – analyzing - the essence of certain strategies, and then recombining them with new insights and hypotheses, allowed him to expand and go "deeper" into the essence of strategy and war than previous strategists such as Corbett, Fuller and Liddell Hart. It showed him similarities and parallels between, as well as distinct features unique to different modes of warfare, or categories of conflict. He thus single-handedly transformed the way one can and perhaps even should think about war and strategy and developed a unique set of terms and concepts, a new language, to express those thoughts.

Not only did he argue that a multidisciplinary approach informed by insights from a variety of scientific fields is a prerequisite for sound strategic thinking, science also helped Boyd explain and connect in a novel way and lead him to new perspectives, hypothesis and insights. It gave him new metaphors, or rather, new orientation patterns and ways to conceptualize strategy and war. It lead him to focus on the process of adaptation. The aim and purspose of strategy is, according to Boyd, to improve our ability to shape and adapt to unfolding circumstances, so that we (as individuals or as groups or as a culture or as a nation state) can survive on our own terms. Boyd introduced the open complex adaptive system struggling to survive in a contested dynamic non-linear world pregnant with uncertainty into strategic theory, constantly attempting to improve and update its schemata and repertoire of actions and its position in the ecology of the organization.

Boyd is the first to make the processes of thinking, learning and adaptation key military concepts. Sun Tzu, using different terms, preceded him in some ways but no one before Boyd made these concepts, which center on the cognitive dimension in particular, the heart of a comprehensive military theory. Adaptation is the key word in particular in the second halve of *Patterns*, and comes increasingly to the fore in subsequent presentations. This idea also lies at the heart of the simple, clear and logical yet comprehensive OODA loop, which is, as a synthesis and without Boyd's tempo-proposition, a novel idea in military theory. A proper understanding of the OODA loop starts with viewing it within the context of the process of adaptation.

The essay had highlighted that uncertainty is the pervasive element of human endeavor, indeed, it is the prime characteristic of life, he repeated in *The Conceptual Spiral,* and it surfaces frequently across the presentations, as well as the insistence that thinking strategically under such a condition requires a continuous combination of analysis and synthesis, and a multidisciplinary and multispectral approach. In *Patterns,* which starts as a critique of the attritionist mindset, he develops the three categories of conflict, describing in detail the dynamics at play in each mode of warfare. He emphasizes the dynamic of move and counter-move, the cycle of alternating phases of dominance by either the offense or defense, and the interplay of the physical, mental and the moral dimensions. While constituting an argument against the attritionist mindset, Boyd moves on and beyond this argument, distilling in increasingly abstract form the essence of each warform, which in the end allows him to compare the different warforms and to formulate new definitions of

strategy. He elaborates on several aspects of *Patterns*, disclosing what lies at the heart of the strategic game between open systems – interaction and isolation- what type of organizational structure and culture is required – flexibility, network, autonomy, open and trust are keywords here - returning in the end to the message of the essay, translated in digestible form, showing that what lies at the heart of succesful strategic behavior is similar to the dynamic at play in science, engineering, and technology. Then, in a last exercise of synthesis, Boyd draws the comprehensive OODA loop graphic, accompanied by the five statements, showing what constitutes the OODA loop and what it means. It showed that the OODA loop is much less a model of decisionmaking than a model of individual and organizational learning and adaptation in which the element of orientation – made up of genetics, experience, culture - and plays the dominant role in the game of hypothesis and test, of analysis and synthesis, destruction and creation.

The focus on adaptability also shows in Boyd's discussion on modes of conflict. Even when Boyd acknowledges his preference, he still is much less dogmatic then, for instance, Liddell Hart. Liddell Hart was much more in the tradition of Jomini than Clausewitz, Luvaas has argued[5]. Where Liddell Hart asserted that all victories could in the end be attributed to the application of the indirect approach, Boyd included an elaborate discussion of cases and causes in which the indirect approach (or Blitzkrieg concept) succeeded or failed. Indeed, each mode of warfare is joined by a discussion of the counter move to that mode. His eye was trained upon the dialectic, the paradoxical and evolutionary character of strategy. Where Liddell Hart saw victory always accruing from the application of the indirect approach, Boyd saw the process of action-reaction, of learning, anticipation, invention, and counter-movements. Thus Boyd took his audience to insights that he considered more important: a balanced, broad and critical view in stead of the doctrinaire.

Boyd searched not for one particular optimum, but instead acknowledged the contingent nature of war, and focused on the universal processes and features that characterize war, strategy, and the game of winning and losing. Boyd argues that one should respond with an appropriate frame to analyze the situation at hand. Depending on the kind of war, this argues that the strategist would select that partial strategic theory that fits with the specific situation. Several modes of warfare are part of the repertoire for war, a menu of moves and ideas, a general must be able to choose from and a society must be prepared to wage, depending on the circumstances, and each category knows its specific opposite an opponent may use to negate the benefits of that approach.

Sun Tzu, Clausewitz, J.F.C. Fuller, T.E. Lawrence, Basil Liddell Hart, John Wylie and Andre Beaufre, to name but a few familiar strategists[98], preceded him in recognizing that war and strategy involve learning and revolve around the mind, although few equal Boyd in his focus on the cognitive dimension of man and social systems. But no modern strategist and certainly no contemporary one, developed a theory based on the scientific concepts he discovered due to his deliberate and broad study of scientific literature.

A general theory of organizational survival

The comprehensive OODA loop model can be applied to almost all levels as an explanatory tool. Boyd is persuasive in showing the relevance and the applicability of it at the individual,

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[5] Jay Luvaas, 'Clausewitz: Fuller and Liddell Hart', *Journal of Strategic Studies,* 9 (1986), p.207.

[98] *In Introduction to Strategy* (London, 1965) on p. 45 and p. 136 Beaufre states that 'strategy must be a continuous process of original thinking, based upon hypotheses which must be proved true or false as action proceeds'. Furthermore Beaufre recognizes that initiative and freedom of action are essential (p. 36).

tactical, operational, strategic and, the grand strategic level. It applies to regular warfare and guerrilla warfare. As Colin Gray has stated, Boyd's OODA loop is a grand theory in the sense that the model has an elegant simplicity, an extensive domain of application, and contains a high quality of insight about strategic essentials[6].

This can be extended to Boyd's entire work in which he discusses various kinds of war and conflicts and attempts to develop recurring patterns of behavior in those conflicts. His theory can with some justification be claimed to apply to all types of warfare. In fact Boyd's work should not be regarded solely as a very valuable study of patterns in human conflict, although that is the nature of his work he started out with. As we have seen, in particular during his later period Boyd approached and explained those patterns from a more abstract point of view and drew parallels between evolution theory, complexity theory and military history. This suggested even more general patterns of the way organisms and organizations behave when confronted with threats and challenges. He introduces the 'theme for vitality and growth', suggesting that Boyd transcends the tactical and operational levels of war, connecting different forms of warfare, uncovering hidden similarities, and indeed, transcends the arena of war. This strongly suggests *A Discourse* is a general theory of organizations in conflict. *A Discourse* not only contains suggestions for winning battles, but also for maintaining organizational fitness, for organizational learning and change.

Boyd moved beyond military history and warfare and shifted his focus to a number of similar, deep, underlying processes that unite various modes of survival and evolution. He examines also organizational and species evolution, growth and survival and highlighting the essential similarity of the processes and factors that are at play when such complex adaptive systems face challenges to their existence. He extends it to economies, societies and even to science and technology, showing how in these fields too self-correcting processes, the discovery of novelties, mismatches and anomalies, the continuous interplay of destruction and creation and the dialectic of analysis and synthesis keep the process going. Therefore one could perhaps better describe *A Discourse* not as a general theory of war but as a general theory of the strategic behavior of complex adaptive systems in adversarial conditions.

Beyond rapid OODA looping

It has thus been demonstrated that the narrow interpretation of Boyd's work is inaccurate and incomplete. Not only has Boyd addressed a multitude of topics, besides the rapid OODA loop idea, offering new conceptualizations of strategy, and introducing new concepts for thinking about the interactions at the different levels of war, it is moreover only either in the most abstract and short-hand rendering, or at the tactical level, that the rapid OODA loop idea in its narrow interpretation mirrors Boyd's work to some extent. And even at the tactical level Boyd argues for a more comprehensive approach, focussing on the interplay of actions and threats as they manifest themselves in the physical, moral and mental dimensions. Instead of a focus on information, he displays a focus on the myriad factors that produce the internal cohesion required for a system to survive, and the multi-dimensional connections a system needs to maintain with the outside environment.

Importantly, this study has shown that the larger theme of Boyd's work, which is also embedded within the comprehensive OODA loop graphic, is multidimensional organizational adaptation in a dynamic non-linear environment. Moreover, it was shown what scientific literature he surveyed, and how that eclectic approach, which was normative according to Boyd for the study of war, offered him new ways to view war and strategic

[6] Gray, *Modern Strategy*, p. 91.

behavior, demonstrating the value of examining the formative factors of strategic theories. An awareness of the scientific *Zeitgeist* which Boyd deliberately followed, provided metaphors and concepts that helped explain and understand Boyd's arguments, and demonstrated that the scientific *Zeitgeist*, which has since then been labelled as the postmodernism era, offered Boyd new modes of conceptualizing strategy and war.

Boyd as the first post-modern strategist?

The name of Boyd's *Zeitgeist*

Boyd can be considered the first post-modern strategist both in content and in his approach to making strategy and strategic theory, in light of the similarities of his work with moderate post-modern social theorists, with developments in post-modern security and strategic studies, and because of the economic or technologist interpretation of post-modernism, which has spawned correlating views of post-modern war and post-modern warfare. In line with previous attention for the formative factors of strategic thought, it is certainly warranted to address the broader cultural and academic *Zeitgeist* in which Boyd operated when developing *A Discourse*. It will furthermore indicate that the influence and therefore usefulness of Boyd's work did not end with the doctrinal innovations in the eighties.

Boyd's particular concern with, and take on epistemology, and the centrality in Boyd's work of the factor of uncertainty, as well as the need for a multitude ideas and perspectives for understanding and shaping action (multispectrality), and his deconstructive method of pulling perspectives apart and look for new possible connections and meaning, is shared with post-modern theorists of the social sciences such as constructivism, deconstructionism and structuration theory. Moreover, Boyd advocates a pluralist methodology for thinking about strategy, for analyzing change in history, and for deriving insight from military history, which is consistent with post-modern analysis.

This connection should not be surprising as many works Boyd had studied also feature in studies on postmodernism, and key figures of postmodernism found inspiration in the same works, findings and developments Boyd paid close attention to. Indeed, as a recent history of postmodernism asserts, in the 1970s and 1980s, after a long and complex movement through various aesthetic and theoretical discourses, the "postmodern turn" emerged on the scene of science and social theory as a break from the mechanistic, reductionist, naive realist, and determinist worldview of Newtonian physics. Advocates of postmodern science claim that the modern scientific paradigm is giving way in the 20th century to a new mode of scientific thinking based on concepts such as entropy, evolution, organism, indeterminacy, probability, relativity, complementarity, interpretation, chaos, complexity and self-organization. Five major sources of influence are listed, all of which appear on Boyd's reading list and in his work: evolutionary biology and ecology, quantum mechanics and relativity theory, cybernetics and information theory, and chaos and complexity theory[7].

Developments in security and strategic studies mirror Boydian notions too about the role of theory, of frames of reference, of ideas and language as systems of meaning. His adoption of chaos and complexity theory to understand and express ideas concerning social

[7] Best and Kellner, pp.195-196. Interestingly, they find the historical foundation for post-modern ideas in Kierkegaard, Marx, and in particular Nietsche. The fact that Boyd read Marx was already stated, the fact that Nietsche's works *Beyond Good and Evil, Thus Spoke Zarathustra* and *Twilight of the Idols* are listed in his bibliography was not.

life are also in tune with post-modern images of social systems. Finally, the very title of Boyd's work; *A Discourse* suggests a post-modern view on how he developed his ideas and what his work stands for: a dynamic vehicle to convey and develop meaning. And at the heart of it all lies *knowledge*, a theme shared with numerous studies on war and warfare in the post-modern era, such as Information War, Cyberwar, Netwar, and Network Centric Warfare, all part of a discourse on a Revolution in Military Affairs. These concepts lean heavily on Boydian concepts and also find inspiration in the new sciences. In this sense Boyd's contribution to strategic theory and military thought is nicely described by Richard Dawkins, who said:

> Often the most important contribution a scientist can make is to discover a new way of seeing old theories or facts. A change of vision can usher in a whole climate of thinking in which many exciting and testable theories are born, and unimagined facts laid bare[8].

The following observations on post-modernity highlight the various similarities between post-modern notions in social and IR theory and Boyd's work, allowing Boyd to be positioned within a larger theoretical framework, and providing an additional angle on Boyd's arguments as well as on their validity.

Post-modernism arose to prominence in cultural and scientific life during the eighties, when key figures such as Lyotard, Derrida, Habermas, Foucault, Bauman and Giddens published widely discussed studies on the "post-modern condition". Christopher Coker notes that 'in the run up to the end of the Cold War (December 1989), post-modernity became a leading school of thought in Europe'[9]. 'Post-modernism is the social, cultural and political air we breath. It permeates virtually all facets of contemporary life in the West', another author noted[10].

Post-modernism has gained several meanings. Pauline Rosenau notes that 'there are as many forms of post-modernism as there are post-modernists'[11]. Darryl Jarvis observes that there is no single definition and it 'remains a curious lexeme of essentially contested concepts, disparate ideas, obtuse meanings, and political agendas[12]. Indeed, there are many ways to describe what is meant by post-modernism. It is an epochal change following modernism, the term used to describe the cultural styles and movements of the first half of the 20th Century. And there are some common themes in the various interpretations of this epochal change. Disturbance, disruption, re-inscription, and the penchant to "rethink" knowledge are common to its sense of self. And few disciplines since the 1970s have been untouched by the temerity of post-modern writings and readings. Philosophy, politics, music,

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[8] Richard Dawkins, *The Selfish Gene*, p.xi.

[9] Christopher Coker, 'Post-modernity and the end of the Cold War: has war been disinvented?', *Review of International Studies*, 1992, Vol. 18, p.189. See also Bradford Booth, Meyer Kestnbaum, and David R. Segal, 'Are Post-Cold War Militaries Postmodern?', *Armed Forces & Society*, Vol.27, No.3, Spring 2001, pp.319, where they assert that 'the theoretical perspective of postmodernism has become commonplace in sociology'. See for an introduction into modernity and postmodernity also Kenneth Thompson, 'Social Pluralism and Post-Modernity', and Gregor McLennan, 'The enlightenment Project Revisited', both in Stuart Hall, David Held and Tony McGrew, *Modernity and its Futures*, Polity Press, Blackwells, Oxford, 1992.

[10] Peter van Ham, *European Integration and the Postmodern Condition*, Routlegde, London, 2001, p. 7.

[11] Pauline Rosenau, *Post-Modernism and the Social Sciences,* Princeton, 1992, p.15. The first chapter provides a concise overview of both various interpretations and meanings of post-modernism as its intellectual lineage and history.

[12] Darryl Jarvis, 'Postmodernism: A Critical Typology', *Politics and Society*, Vol.26, No.1, March 1998, p.98.

film, sociology, geography, literary criticism, development studies, and international relations all display postmodern intrusions[13].

In cultural life it has come to indicate, for instance in architecture and art, a re-valuation of classical art and architecture resulting in a novel incorporation of classical elements in contemporary art, as a counterpoint to modern, sterile functionalist and minimalist art and architecture[14]. In the social and ethical dimension one can discern also a nihilist or extreme relativist position, that claims that either anything goes in terms of truth and values, that there is no progress, and that certainly the modern western society is not the exponent of progress. This interpretation considers the modern ideals of western consumerism lying at the heart of a wealth of world problems such as poverty, pollution, north-south inequalities, and in general a failing of the "Enlightenment project". Such post-modernism in the extreme – or subversive post-modernism – means an absolute relativism towards claims or paradigms for understanding reality. Anyone's truth is as valid as another man's[15]. Somewhat less dismissive is the description that 'knowledge is located in the fact of discourse and dialogism'[16].

This brings it sometimes close to a more moderate view so called 'affirmative' post-modernists[17], or critical post-modernists[18], who consider the positivistic method with its claims of objectivity or limited subjectivity as invalid. They do not deny the existence of a phenomenal world, external to thought. They do oppose however that phenomena can constitute themselves as objects of knowledge independently of discursive practices. It challenges language independent observation. What counts as a socially meaningful object or event is always the result of an interpretive construction of the world out there. Our interpretations are based on a shared system of codes and symbols, of languages, life worlds and social practices. The knowledge of reality is socially constructed. Concepts of rational argumentation, and especially the rational or scientific validation of hypotheses, are seen as fundamentally flawed. Reality and knowledge about it, are subjective and contextual[19]. But not all views are equal, some are more privileged by offering a better, more plausible, more explanatory narrative.

Another and related interpretation – technological post-modernism - is moderate in that it sees post-modernism as an awareness of the aspects that define 'modern' life, an awareness that allows to reflect on the modern institutions and alter them if needed, creating the post-modern condition[20]. In this sense it is a "periodizing" category in which the pre-modern leads via the modern to the late- or post-modern era[21]. With this position can also be associated the economic view that the modern condition is associated with industrial society, or Second Wave economy, while the current post-modern condition is symbolized by the "information society". Castell observed the organizational transition from industrialism to informationalism and the Tofflers have coined the term "Third Wave"

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[13] Jarvis, p.98.
[14] See for instance Charles Jencks, *Post-Modernism, the New Classicism in Art and Architecture*, Academy Editions, London, 1987.
[15] Jarvis, p.126.
[16] Ibid, p.107.
[17] Pauline Rosenau, p.15.
[18] Jarvis, pp.108, 114-115.
[19] See for instance Jean-Paul Lyotard, *The Postmodern Condition: A Report on Knowledge*, (Manchester, 1984), K.R. Dark, *The Waves of Time*, (London, 1998) and Paul Cilliers, *Complexity and Postmodernism*, (London, 1998) for similar observations.
[20] Jarvis, pp.108 and 127.
[21] Ibid, p.101.

economy to describe how economic wealth is now mostly dependent on informational resources and on a countries "knowledge base"[22].

Combined, these various schools agree on a multi-theoretical perspectivism. And this eclecticism in theoretical approaches and ideas itself constitutes a post-modern sensibility: the notion that things are too complex to be grasped by any one theoretical account. The post-modern world is now understood to be composed of interpenetrating and multiple realities, where complexity in social, economic, and political relationships is further compounded by a multitude of electronic images, disparate cultural influences, and changes in the dimensional referents of time and space due to advances in transportations and communications. These realities discount the utility of monotheoretical accounts. Instead, it suggests the need for multiple theoretical analysis that avoid reflection on any one dimension in favor of a reflexive understanding of relationships between social, political and economic dimensions[23].

An interesting combination: Lyotard and Boyd

Knowledge production is at the heart of what many consider the core text of post-modernism: Lyotard's book *The Postmodern Condition, a Report on Knowledge*, published in French in 1979 and in English in 1984. Lyotard's aim is to study the conditions of knowledge in developed societies[24]. The term "modern" designates the traditional positivist scientific model. Post-modernists say that a changing social world requires an entirely different way of reflecting on our existence today. They argue, just as social conditions change, so too do the concepts and categories that we use to make sense of the society, a theme central to Boyd's work and one that obviously applies to the societal phenomenon of war too. Thus, social scientists need to fundamentally "deconstruct" the way they habitually look at the social world. Thus modern social theory needs to be reconsidered.

Modern social theory, in the eyes of post-modernists, is rooted in the "Enlightenment project" of the eighteenth and nineteenth century, and has absorbed the underlying assumptions and aspirations about the nature and purpose of social theory, namely the role of knowledge in the improvement of the human condition. The Enlightenment occurred at the threshold of typically modern Western society, and gave it definitive shape to many of the ideas and procedures of modern western social science. The post-modernist challenge to the Enlightenment model of social knowledge involves either rejecting entirely, or at least seriously questioning, the following typical Enlightenment tenets:

- The view that our knowledge of society, like society itself, is holistic, cumulative, and broadly progressive in character.
- That we can attain rational knowledge of society.
- That such knowledge is universal and thus objective.
- That sociological knowledge is both different from, and superior to, 'distorted' forms of thought, such as ideology, religion, common sense, superstition and prejudice.

[22] Manual Castells, *The Informational City*, Oxford, Blackwell, 1989; Alvin and Heidi Toffler, *War and Anti War, Survival at the Dawn of the Information Age*, Little Brown, London, 1993.
[23] Jarvis, p.105
[24] Lyotard, p. xxiii.

- That social scientific knowledge, once validated and acted upon, can lead to mental liberation and social betterment amongst humanity generally[25].

The post-modernist thesis is that, not only have the structures of modern society begun to change dramatically, but also that the foundations of modern social thought have become obsolete and dogmatic. They are convinced that now more than ever before we need to be openly uncertain bout the status of al the concepts an results of social science[26].

For Lyotard, the term post-modern condition is reserved for the condition or status of *knowledge* about society, knowledge about ourselves in the post-modern age. Like Boyd's opening essay, Lyotard is concerned with the basic conceptual frameworks that we adopt in order to understand modern life. Lyotard argues that the Enlightenment model of science does not apply to current social life, because the main feature of the Enlightenment approach to knowledge is its concern to be scientifically legitimate which in this sense implies objective and impartial knowledge of the world (and perhaps this approach is even fallacious in the physics.

He introduces the term "narrative" to explain that knowledge is the outcome of a multiplicity of discourses, of narratives that are locally determined, not legitimated externally. Different institutions and different contexts produce different narratives, which are not reducible to each other. He argues for a narrative understanding of knowledge portraying it as a plurality of smaller stories that function well within the particular contexts where they apply. Instead of claiming the impossibility of knowledge, 'it refines our sensitivity to differences and reinforces our ability to tolerate the incommensurable' [27].

Clifford Geertz had also offered this view that knowledge is "local". In the book *The Interpretation of Cultures* (1973) Boyd had read and later in *Local Knowledge* (1983) Geertz detailed his view that subjectivity is *the* phenomenon for anthropologists (and others in the human sciences) to tackle[28]. Another author, Jacob Bronowski, too homed in on the restricted validity of the enlightenment method for generating absolute knowledge by highlighting for instance the power of literature and poetry to provide meaning and to develop novel insights, thus allowing for a large measure of subjectivism[29].

Lyotard even asserts that the Enlightenment picture of pure knowledge itself is just such a narrative and even a myth, because it derives its legitimacy by reference to a higher level storyline, which he terms "metanarratives". Such metanarratives contain hidden value statements and particular worldviews. And if the objective grandeur of science actually always turns out to rest upon some sort of metanarrative or other – none of which can be objectively proved or refuted, but each acting as the philosophical rationalization of human ideologies – then the very claim of objectivity and value-neutrality is spurious, deceitful and self-canceling. Further, if the mantle of objectivity is simply unavailable, then none metanarrative is inherently privileged over any other. But if this is so, we need to be very skeptical about the ultimate truth-claims of all metanarratives[30].

This does not indicate that every individual can stake a claim for truth, nor that knowledge is an illusion. Knowledge and meaning are constituted through the networked

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[25] One does not have to agree with this description, indeed, the influential German sociologist and philosper Jürgen Habermas has criticized the post-modernists exactly on their interpretation and subsequent critique on the Enlightement.
[26] Gregor McLennan, 'The Enlightenment Project Revisited', in Hall, Held, McGrew, pp. 328-330.
[27] Lyotard, p.xxv.
[28] Watson, p.674.
[29] Bronowski (1965)
[30] McLennan, p.332-333.

nature of individuals: a person is always located at "nodal point" of specific communication circuits. The self is understood in terms of a "fabric of relations", a node in a network. There is "local determinism". There are "interpretative communities". Institutions such as universities, prisons, but obviously also armed forces, form such interpretative communities. Such communities are made up of both producers and consumers of particular kinds of knowledge, of texts. Individuals and groups are held to control mutually within these domains what they consider to be valid knowledge[31].

Lyotard's description of the post-modern condition is a description of the network of our society and of the manner in which it produces and reproduces knowledge[32]. The post-modern society forms an increasingly complex network, with relations 'now more complex and mobile than ever before'[33]. Lyotard refers to the significant changes going on in the whole mode of collecting and communicating social information. And ultimately knowledge is about just that: the storage of, and aura surrounding, certain kinds of discourse and information. Knowledge is a commodity, a set of resources and services, which we can draw upon, and pass on, for particular social purposes.

Thus, relationships are important when it comes to produce knowledge. Through relationships different local narratives interact. And within specific audiences, each having its own criterion of accreditation, the reality of knowledge is a huge array of "moves" within pragmatic "discourses" or "language games"[34]. Cilliers, arguing the close relationship between complexity theory and post-modernism, explains Lyotard's view on the functioning of the network in producing meaning in words that could be taken directly out of Boyd's briefing *The Conceptual Spiral:*

> No discourse is fixed or stabilized by itself. Different discourses - clusters in a network - may grow, shrink, break up, coalesce, absorb others or be absorbed. It is a self-organizing process in which meaning is generated through a dynamic process, and not through the passive reflection of an autonomous agent that can make "anything go". Instead of being self-sufficient and isolated, discourses are in constant interaction, battling with each other for territory.

This dynamic of discourse also leads Lyotard to observe that scientific progress is made through the meeting of dissension and destabilizing forces with dominant views. Whereas paradigms aim to fix knowledge in a permanent grid, Lyotard's view is that we discard the idea of consensus. To proliferate knowledge, we have to proliferate discourses without trying to fix them into a permanent grid[35]. Knowledge is thus as a kaleidoscopic array of limited and transient language games.

Of course, Thomas Kuhn's work contained a similar concept, demonstrating a keen eye for the importance of the social context of knowledge in his discussion of paradigms[36]. Lyotard's notion of a dynamic of dissention and destabilizing forces with the consensus view as a model of creating, or growing, knowledge applies. Cilliers expresses it in complexity theoretical terms: self-organization: knowledge grows through self-adjustment the system

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[31] David Harvey, *The Condition of Postmodernity,* cited in Kenneth Thompson, 'Social Pluralism and Post-Modernity', in Hall, Held and McGrew, p.261.
[32] Cilliers, p.116.
[33] Lyotard, p.15.
[34] McLennan, p.333.
[35] Cilliers, p.118.
[36] Stafano Guzzini, 'A Reconstruction of Constructivism in International Relations', *European Journal of International Relations,* Vol. 6(2), pp. 158-160. This article also includes reference to Bourdieu's concept of habitus and social fields. These concepts can easily be related to military communities and processes of doctrine development. See p.168.

undertakes to improve its own performance[37]. The growth of scientific knowledge, itself a form of social discourse, a field of knowledge and meaning production, can thus be fruitfully approached and understood from a post-modern perspective. In this, Boyd's discussion in his *Discourse* on Gödel and Heisenberg could as easily have included Lyotard.

In fact, various authors consider insights offered by Einstein, Gödel and Heisenberg as key elements of late- or post-modernity. Lyotard himself was much influenced by these authors, as by chaos theory and information theory[38]. Both Stephen Toulmin and Christopher Coker for instance refer to them. For philosopher Toulmin relativity theory and the uncertainty principle are indications of attempts to "humanize" modernity, due to the fact that these scientific insights put the human back in the center. Coker includes a discussion on Heisenberg to build the argument that the West is developing a post-modern way of conceptualizing and waging war which puts the human back on center stage, in reaction to the era of modern, industrialized war and de-humanized war[39]. In any case, this discussion strongly suggest close parallels between Boyd's view on knowledge and the essential uncertainty surrounding us on the one hand, and post-modern views on knowledge.

Structuration Theory

If these two post-modernists perhaps take the argument a bit too far, another link between Boyd and postmodernism is less tenuous. And it lies in the relativity of the act of observation, deriving knowledge from observation, and making predictions upon this analysis. Key is the concept of reflexivity of knowledge[40]. This concept is central to Structuration Theory, a theory developed by sociologist Anthony Giddens, and it is currently the most widely employed sociological theory of change. Social change can be explained by either focusing on contextual, structural factors or on the actions of agents. Giddens combines them in a 'notion of duality', and explains that both need to be examined and that both are mutually constituted. Agents act according to the structural factors that constrain them and they form structures by abiding by them, but also by changing them. The individual both initiates change and participates in it. Structures – rules, ideas, institution and resources recursively implicated in social reproduction - can be changed by action[41]. The structure-agency debate is relevant for strategy for, as one author notes

> structures do not determine outcomes, but define the potential range of alternative strategies. Agents have the opportunity of choosing from several strategies within the structure. Strategic action is the dialectical interplay of intentional and knowledgeable, yet structurally-embedded actors and the preconstituted contexts they inhabit. Eventually, structure may also be transformed by agency over time[42].

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[37] Cilliers, p.117.

[38] Watson, p. 668.

[39] Coker asserts that 'with quantum physics a new form of measurement was introduced in which the whole possibility of science depended on man, no longer on impersonal events. The universe exists only as a series of approximations within the limits determined by our relationship with it. This is particularly true of Heisenberg's Uncertainty Principle'; see Christopher Coker, *Humane Warfare* (Routlegde, London, 2001), p.16. Coker's work is filled with references to postmodern authors.

[40] For an introduction to Giddens, see McLennan, pp.342-347. McLennan positions Giddens as a happy compromise between Enlightenment and (the more extreme and nihilistic versions of) post-modernism.

[41] Andreas Bieler and Adam David Morton, 'The Gordion Knot of Agency-Structure in International Relations: a Neo-Gramscian Perspective', *European Journal of International Relations,* Vol.7 (1), p.22

[42] Ibid, p.27

From a military perspective this sounds like the doctrine development process in which previous experience, established practices and organizational traditions and structures not only shape a military response but also compete with new conceptual insights, more recent experiences, opportunities for improving organizational fitness.

At the heart of this theory is the individual as conscious strategic actor, making decisions on experience and knowledge. And what makes this theory relevant for Boyd's work is that knowing – or mental schema through which people perceive action[43] - is at the heart also of Giddens conception of post-modernity[44]. Uncertainty is dominant, nothing can be known for certain as no pre-existing foundations of epistemology have been shown to be reliable. We are living in a world of multiple authorities[45]. During pre-modernity and modernity, scientist were considered authorities, part of the scientific tradition. Experts disagreed not just because they are defending different pre-established positions but in the very service of overcoming those differences. They disagreed in the interest of a universalism. The post-modern condition lies in the awareness of the paradox that while expert knowledge, and the general accumulation of expertise, are supposed to provide increasing certainty about how the world is, precisely the very condition of such certainty is doubt.

Experts today are highly specialized of necessity in order to be recognized as experts. There are however no experts who cover the broad canvas of knowledge and wisdom accorded to authorities in traditional societies and now there are various abstract expert systems or fields. The meaning of expert knowledge therefore has changed. Subsequently the layman much choose which expert to trust and he must trust the smooth functioning of abstract systems (such as accountants, lawyers, financial experts, medical specialists).

Moreover The 20th Century proved that all claims to knowledge are corrigible (including metastatements made about them) and this has become the existential condition in modern societies. To be sure, many forms of scientific knowledge are relatively secure. However, all must be in principle regarded as open to question and at every juncture a puzzling diversity of rival theoretical and practical claims are to be found in the 'moving' areas of knowledge[46].

Furthermore, knowledge is a factor for change. We live today in a world which the leading figures of the Enlightenment did not anticipate. Such thinkers believed that the more we get to know about the world, as collective humanity, the more we can control and direct it to our own purposes. Increasing knowledge produced about the social and natural world would lead to greater certainty about the conditions under which we lead our lives; and would thereby subject to human dominance what was once the domain of other influences. However, the connections between the development of human knowledge and human self-understanding have proved more complex than such a view suggests[47]. Giddens labels this connection 'the reflexive appropriation of knowledge', and this is another element that marks the transition from modernity to post (or high) modernity. Mirroring Boyd's views on military innovation Giddens states that:

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[43] Ibid,p.17

[44] Giddens employs the terms reflexive modernization, radical-modernity, high-modernity and post-traditional society.

[45] Anthony Giddens, 'Living in a Post-Traditional Society', in Ulrich Beck, Anthony Giddens, Scott Lash, *Reflexive Modernization*, Stanford, 1994, p.87.

[46] Ibid, pp.86-88.

[47] Ibid, p.184.

> The reflexive nature of modern social life consists in the fact that social practices are constantly examined and reformed in the light of incoming information about those very practices, thus constitutively altering their character'[48].
>
> The production of systematic knowledge about social life becomes integral to system reproduction….knowledge applied to the conditions of system reproduction intrinsically alters the circumstances to which it originally referred[49].

An actor uses his knowledge to analyze and adapt to his environment. If he notices that his knowledge does not produce the desired result he will seek alter his knowledge. At the same time the environment is constituted because of knowledge about it and that knowledge allows us to control it at the same time, and alter it. Knowing about the economic behavior of people and nations allows us not only to observe and understand, but also to design economic policy thereby altering the economic behavior and perhaps even altering the rules for economic behavior and thereby invalidating previous knowledge about economic behavior. Knowledge is thus reflexive. Knowledge and observation lead simultaneously to understanding and to uncertainty. This is what Giddens the "double hermeneutic" of social life[50]. The double hermeneutics problematizes exactly the relationship between self-interpretations and second order interpretations. For not only do observers rely on first-hand interpretations, but their interpretations, in turn, can itself have a feedback on the former', a phenomenon already noticed in this study in describing the nature of complex systems such as an economy or armed forces in combat. And not surprisingly it is noted that this double hermeneutic feature of social life differentiates social science from the natural sciences[51].

This is mirrored in various passages in Boyd's work. In *Organic Design for Command and Control* for instance he again emphasizes the centrality of Orientation, which is

> an interactive process of many-sided implicit cross referencing projection, emphatics, correlations, and rejections that is shaped by and shapes the interplay of genetic heritage, cultural tradition, previous experiences and unfolding circumstances. Orientation is the Schwerpunkt. It shapes the way we interact with the environment – hence orientation shapes the way we observe, the way we decide, the way we act. We need to create mental images, views, or impressions, hence patterns that match with activity of world[52].

Boyd's key post-modern insight from science is the fundamental uncertainty inherent in any system for observation, explanation and prediction and the reflexivity of knowledge. Deliberately he refers to this in his discussion on the essence of strategy, making the point that 'we need an external environment, or outside world, to define ourselves and maintain organic integrity, otherwise we experience dissolution/ disintegration'[53].

The growing awareness of inherent uncertainty of social life and the conscious and deliberate embedding of reflexivity of knowledge in institutions is what for Giddens marks the nature of the post-modern condition. Boyd's understanding about knowledge, derived from Heisenberg uncertainty principle, about the role and development of orientation patterns, his ideas of evolution of organizations, the evolutionary nature of the development

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[48] Giddens, *The Consequences of Modernity,* Stanford, 1990, p. 38.
[49] Ibid, pp. 53-54.
[50] See Anthony Giddens, *The Constitution of Society* (Cambridge, 1984), p. 284.
[51] Guzzini, p.162.
[52] Boyd, *Organic Design for Command and Control*, pp.15-16.
[53] Boyd, *Strategic Game of ? and ?*, p.28., and further pp.39 and 41.

of strategic theory and military doctrine, are entirely consistent with Giddens' conceptualization of post-modernity. Importantly, the notion of reflexivity is now considered a defining aspect of the *Zeitgeist* in which the gestation of *A Discourse* took place[54].

Boyd as deconstructionist?

A third arrow in the "post-modern strategist argument" is the similarity between Boyd and deconstructionism. Decontructionism originated from text analysis and is deeply concerned with an understanding and interpretation of our whole life-world. It is less a philosophical position than a way of thinking about and 'reading' texts. Jacques Derrida, as a way of understanding texts, proposed the process of deconstruction. According to deconstructionists texts have no exact and final meaning and can be read in a number of ways. Writers who create texts or use words do so on the basis of all other texts and words they have encountered, while readers deal with them in the same way. Cultural life is then viewed as a series of texts intersecting with other texts, producing more texts.

The de-constructive aspect of deconstructionism lies in the process in which texts are continually broken apart, and re-attached in new combinations. The deconstructionist's impulse is to look inside one text for another, dissolve one text into another, or build one text into another, collage/montage like. The inherent heterogeneity of that stimulates us, the receiver of the text or image, to produce a signification, which could be neither univocal nor stable[55].

Deconstruction is an exploration within strict boundaries of the indeterminacy's and misunderstandings that open up radical reinterpretations of such texts. This acknowledges that the observer of social events and artifacts cannot not possibly be objective, because he himself is entangled in a history, with particular prejudices, language with specific meanings, rituals and symbols etc., that color his perception. Once we recognize this the objectivity of observation, and the generation of knowledge comes into question.

Subsequently, translating and understanding text becomes an exercise not in subjectivity, but in confrontation of past with present. The generation of meaning concerning historical texts is a dialogue between the author's writings, the not-so-autonomous observer, and other historical and cultural objects. Through such a dialogue meaning is negotiated. Deconstruction is a journey fuelled by historical evidence, implicit and explicit assumptions, the analyst's worldview, etc., that yields different interpretations of particular texts, in other words, an activity heavily influenced by what Boyd calls orientation. Though none of the different interpretations can possibly equate to the author's understanding, a richer appreciation of the text is developed[56].

This discussion becomes relevant if we consider social events as a particular text or narrative requiring exploration and interpretation. The analyst must accept that their own predelictions contribute to the way in which the exploration is performed and how interpretations are derived. Analysis can be seen as a dialogue between analyst and the situation under investigation. By uncovering hidden assumptions, by formulating alternative representations, by using empirical evidence and various formal and informal methods, a richer appreciation of the observed situation can be achieved that is moreover cognizant of

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[54] Guzzini, p.152.

[55] Harvey, in Hall, Held, McGrew, p.263.

[56] See Kurt A. Richardson, Graham Mathieson, and Paul Cilliers, 'The Theory and Practice of Complexity Science: Epistemological Considerations for Military Operational Analysis', SysteMexico, 1: p. 19-20, and Cilliers, p.22, and Chapters 3 and 7.

the context within which the situation has taken place. Perhaps stretching Boyd's work into unwarranted dimensions, one could assert that war is thus a strategic contest, an interactive exercise in, or better, a competition in deconstruction in which each side attempts to gauge the other's background, his way of thinking, his experience, his interpretations of events, his image of the opponent, etc.

Both Giddens' work and the deconstructionists offer the view that there is no objective absolute truth. Reality – facts, actors, behavior - is in large part a social construction. Through dialogue, exploration, criticism and using various perspectives a picture can be painted that gives us enough confidence to momentarily base our decisions on. Both lead to views that closely correspond with the views Boyd put in his graphic of the OODA loop.

It is tempting to compare the deconstructive method with the way Boyd constructs his argument; the way he makes sudden connections between seemingly disconnected insights, the way he frequently tears texts apart only to recombine them in a slightly different order than before, and his deliberate refusal to "finish" a briefing but instead altering the slides all the way up to 1995. Moreover, when Boyd concludes that the way to survive and prosper is 'by an instinctive see-saw of analysis and synthesis across a variety of domains, or across competing/independent channels of information, in order to spontaneously generate new mental images or impressions that match-up with an unfolding world of uncertainty and change'[57], he attempts to solve the problems posed by the following characteristics of the socially constructed world:

1. We know the world only as we perceive it;
2. Our perceptions are based on learned interpretations;
3. This learning is social: we learn from and among persons in social interactions
4. The main vehicles which convey meaning are:
   a. symbols, including language
   b. cultural myths
   c. the structure and practice of our institutions
   d. our rules for congruent action
5. These vehicles of meaning together construct:
   a. our world view: how the world works, causality in it, what is valuable
   b. our sense of ourselves, our identity and purpose
   c. our ideologies
6. Our selves, our societies and institutions change continually through interaction[58].

Post-modern security studies

This post-modern notion of the social construction of reality parallels Boyd's ideas, whose understanding on the nature of strategic behavior is very much in tune with developments in security and strategic studies during the nineties, developments stemming from post-modern ideas, adding another justification to regard Boyd as a post-modern strategist[59]. In the past

[57] Boyd, *Strategic Game of ? and ?,* p. 58.
[58] Richardson, p. 22.
[59] This is based on Steve Smith, 'The Increasing Insecurity of Security Studies: Conceptualizing Security in the Last Twenty Years', in Stuart Croft and Terry Terriff (ed), *Critical Reflections on Security and Change* (London, 2000), p. 76. John Mearsheimer, 'Back to the Future: Instability in Europe after the Cold War', *International Security*, vol. 15, no.1 (1990), p.9; David Mutimer, 'Beyond Strategy: Critical Thinking and the New Security Studies' , in Craig Snyder, *Contemporary Security and Strategy*, London,

decades various authors have applied post-modern or critical theory in studying war and security. 'The traditional focus on power and politics in security studies has been challenged robustly this decade by the development of ideational approaches to the subject', Theo Farrel noted in a review of constructivist studies on international security. Constructivists focus on the normative character of ideas, language, identities, images, belief systems and institutions as sources of change, behavior and power[60]. Norms are used as shorthand for 'intersubjective beliefs about the social and natural world that define actors, their situations, and the possibilities of action. Norms are intersubjective in that they are beliefs rooted in an reproduced through social practice, Alexander Wendt states[61]. Constructivism and other post-modern – or critical – schools of security studies locate actors in a social structure that both constitute those actors and is constituted by their interaction[62]. It is closely tied to the "reflexivity concept" developed by Giddens, including the looping effect (!) between observation and action[63].

Keith Krause and Michael Williams for instance state that concerning the study of security: 'What is involved is a shift in focus from abstract individualism and contractual sovereignty to a stress on culture, civilization, and identity; the role of ideas, norms and values in the constitution of that which is to be secured; and the historical context within which this process takes place. Epistemologically, this involves moving away from the objectivist, rationalist approach [...] to a more interpretive mode of analysis'[64]. Subsequently, 'anarchy is what states make of it'[65]. A state is not only an actor, but also a social construct that has been given meaning and role; it is socially constituted and presumes a state culture[66].

Like Boyd, these schools point towards the impact of practice, institutional traditions, repertoires of responses, language, perceptions on behavior of actors in the international arena in matters of national and international security. Ted Hopf mentions 'the power of practice': both material and discursive power are necessary for any understanding of world affairs[67]. Like military doctrine or a CAS' schemata, 'Ideas are not merely rules, or

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1999, p. 92. Mark Neufeld, *The Restructuring of International Relations Theory,* p. 33, quoted in Mutimer, p. 92.

[60] Theo Farrell, 'Constructivist Security Studies: Portrait of a Research Program', *International Studies Review*, 4/1(2002), p.49. He echoes others in positing constuctivism as a challenge for realism. Others considere constructivism a welcome addition to IR theory to add insight where realism is found wanting. This is not the place for a full overview of extant literature on constructivism or critical security studies. Nor is the argument made here a defence or critique on either the realist or constructivist schools in IR. The argument is that Boyd's ideas mirror notions, arguments and concepts that have been developed in the past two decades in security studies, the same period in which Boyd developed his ideas. The benefit of this argument is that it provides an interesting link between Boyd's strategic thought and current discussions in IR.

[61] Alexander Wendt, 'Constructing International Politics', *International Security*, 20, No.1 (1995), pp.73-74.

[62] Ted Hopf, 'The Promise of Constructivism in International Relations Theory', *International Security,* Vol.23, No.1 (Summer 1998), pp.172-173.

[63] See Guzzini p.150 for the argument that constructivism follows from reflexive modernity.

[64] Keith Krause and Micheal Williams (ed), *Critical Security Studies, Concepts and Cases* (London, 1997), p. 49.

[65] Alexander Wendt, 'Anarchy is what states make of it: The social construction of power politics', *International Organization*, 46, pp. 391-425.

[66] After Wendt, *Social Theory of International Politics,* Cambridge, 1999 p. 372. For a critical account see Dale C. Copeland, 'The Constructivist Challenge to Structural Realism', *International Security,* Vol.25, No.2 (Fall 2000), pp. 187-212.

[67] Hopf, p.177.

"road maps for action", but rather ideas operate "all the way down" to actually shape actors and action in world politics[68]. When ideas are norms, they not only constrain actors, but also constitute actors and enable action'[69].

And where constructivists focus on state behavior, other post-modern schools of international relation theory, like culturalists, focus on factors within a state that shape foreign policy. This work has shown how state action regarding military force is shaped by beliefs collectively held by policymakers and political elites (strategic culture) and by military officers (organizational culture)[70]. Not only does political and organization culture account for differences in doctrines, differences in military power or method of control of military forces[71]. This perspective also explains for instance the 'isomorphic pattern of global military development – the fact that militaries around the world are organized along remarkably similar lines, which is a western model formed during the past two hundred years. Currently militaries attempt to emulate the latest variant of this western model – namely the US revolution in military affairs - because that is considered the image of what 'modern' means. The US military has become a paradigm defining according to military elites what militaries should look like and what constitutes modern military power. In Boydian terms militaries observe their environment and take action when mismatches are observed or opportunities for advantage are recognized from a specific viewpoint on their trade.

The role of language and strategic concepts for strategic behavior become evident in studies on nuclear strategy. The logic of nuclear deterrence, the central element in US national security policy throughout the Cold War, becomes 'a construction of the social scientist…the strategic analysts of the so-called Golden Age created the strategies for the American state. They created the very categories by which the decision makers in the US understood the world. It was only after the strategic analysts did their work that the decision makers could think of the world in terms of "assured destruction capabilities", "vulnerabilities to second strikes", or "hard target kill capabilities". These were the theoretical ideas of social scientists, without which US military strategy in the Cold War would not have been possible. Those same practitioners of strategic studies could then make predictions about US state action in the context of its nuclear strategy, but they were predicting behavior that was only made possible by the appropriation of the strategists' own concepts, which enabled that behavior in the first place'[72].

The relation of Boyd and post modern security studies also lies in his use of complexity theory. Boyd uses a metaphor and an approach to study armed forces and their behavior that have also been applied by post-modern theorists. As was discussed in Chapter 5, Boyd regards armed forces as complex adaptive systems and uses evolution theory, systems theory, chaos theory, catastrophe theory and later complexity theory to understand,

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[68] Alexander Wendt, *Social Theory of International Politics* (Cambridge, 1999), pp.92-138.

[69] Farrell, p.50.

[70] Ibid, p.53.

[71] Michael C. Desch, 'Culture Clash, Assessing the Importance of Ideas in Security Studies', *International Security*, Vol. 23, No.1 (Summer 1998), pp.142-143. This is a positive yet critical assessment of the constructivist's claims. A consiliary piece arguing for the benefit of an eclectic approach to explain foreign policy outcomes, employing neoliberalism, realism, rationalism alongside constructivism, is offered by Peter J. Katzenstein and Nobuo Okawara, 'Japan, Asian-Pacific Security, and the Case for Analytic Eclecticism', *International Security*, Vol.26.No.3 (Winter 2001/02), pp.153-185.

[72] Mutimer, p.93. For a elaborate argument about the constructed nature, and the role of language and discourse, of US deterrence policy, see also Bradley Klein, *Strategic Studies and World Order: The Global Politics of Deterrence* (Cambridge, 1994).

explain, and to derive insights and prescriptions from the complex dynamic behavior of such systems. Several authors have argued for the close relationship between post-modern science, and complexity theory. To understand social societies, adopting the view that one is examining a complex systems is paramount. And when the world is considered a complex system a pluralist or multiperspectivist post-modern approach is the right one for deriving meaning[73].

The similarities with post-modern security studies and Boyd's work are self evident. Arguing for the relevance of the multidimensional nature of complexity theory for conflict analysis Sandole states that: 'Complexity theory shares with post-modernity the sense that traditional boundaries are breaking down, together with an emphasis on process. Indeed [….] complexity theory and postmodernism overlap significantly, e.g. complexity theory itself is a postmodern development, while postmodernism is part of the chaos that coexists in complex ways with order (e.g. modernism) at the edge of chaos'[74]. In these developments one recognizes Boyd's understanding of the interplay between orientation patterns and action, and the importance of variety as an element of an effective command and control system. In post-modern security and strategic studies the role of theory, of frames of reference, of discourse, of language, of systems of meaning in understanding and simultaneously shaping and predicting reality becomes clear. Boyd's use of complexity theory only adds to the impression that indeed Boyd is a post-modern strategist.

Boydian concepts and post-modern vision of future war

The rise of the post-modern warform

The argument that Boyd may rightfully considered a post-modern strategist is also based on (a) the close parallels between, and influence of Boyd's ideas on the one hand and visions of future war developed in the nineties on the other hand, and (b) the relation between these future visions of war and post-modernism. The latter is made easy by the fact that "post-modern war" and "the post-modern military" have been frequently employed titles of articles and studies arguing how war and military organizations have changed in the past decades or since the end of the Cold War. The postmodern school of thought in military studies first of

[73] See Best and Kellner, chapter 2, who trace the multispectralist aspect back to Nietsche. See also Kurt A. Richardson et al, who note that the normal scientific reductionist model cannot explain adequately the behavior of complex systems. Not only do we need to examine the sub-systems, but we must also have eye for the relations between those sub-systems and understand the emergent behavior, which from a local sub-system level cannot be explained. No single perspective can capture the rich and intricate behavior of complex systems and the analysis of complex systems requires us to consider a number of perspectives[....] the basic requirement of a complexity-based epistemology is the exploration of perspectives [...] complexity thinking legitimates pluralism. By exploring a number of perspectives a richer appreciation of the state of affairs of interest will be developed, resulting in more informed decision making. In considering a variety of perspectives a negotiation between these perspectives is encouraged that drives the exploration process. The merits and deficiencies of each perspective are examined in light of both the supporting and contradictory evidence offered by other perspectives. As the different perspectives are played against and with each other new perspectives emerge that are at least an eclectic mixture of the parts of the constituent perspectives that seem most relevant to the state of affairs under consideration. This intra and extra perspective exploration will identify other perspectives that might be worthy of inclusion, fuelling another round of exploration. After a number of exploration cycles a number of perspectives are left. These offer the most relevant and most accurate knowledge for that particular moment and the problem at hand.

[74] Sandole, p. 201

all point at the changes the technologist postmodernists also address: new modes of economic production (from the industrial age to the information age), associated new sources of power (information), new modes of representation (virtual reality), and new forms of organization (cross -border commercial firms, borderless internet, erosion of the status of the nation-state due to globalization).

Secondly, the postmodern school addresses the shift from modern armed forces based on 19th century style mass armies consisting of conscripts operating mechanized military systems produced by industrial age heavy industries following an attrition type doctrine in war in which victory depended on out-producing an opponent while eliminating its armed forces towards postmodern militaries of professional armed forces manned by highly skilled personnel operating not weapons but a conglomerate of increasingly capable precision sensors and long range stand-off precision munitions aiming to paralyze the opponent through system-wide parallel attacks on numerous centers of gravity.

Charles Moskos and James Burk for instance have addressed the 'sweeping sociological changes' affecting the militaries of the West after the end of the Cold War. 'This is the postmodern age', Moskos asserts. He refers to the rise of 'the postmodern movement in social theory in the late 1960s and 1970s', a movement one should not mistake as nothing more than an idle intellectual critique of modern society. What supports postmodern claims and makes the theory noteworthy, despite all its pretensions, are real transformations shaking contemporary social organization. Nation-states and their institutions are becoming more fragmented and de-centralized'. Of special relevance for him is 'the relative weakening of central forms of social organizations which have been the hallmark of the modern age: the nation state, national markets, democratic citizenship, and the armed force'. Concerning armed forces he notes that 'We are in a period of transition away from the 'modern' mass army, characteristic of the age of nationalism, to a 'post-modern' military, adapted to a newly forming world-system in which nationalism is constrained by the rise of global social organizations'.

The role and structure of armed forces change. Large scale conscription gives way to full professional armed forces of smaller scale and with a blurring of military and civilian tasks, personnel and expertise due to the fact that modern weapon systems depend on civilian technology and combat activities resemble civilian practices. At the same threats are not defined by the Cold War superpower conflict. Threat perception includes a diverse and proliferating array[75]. Christopher Dandeker calls this 'threat-complexity – a very wide range of security risks which are difficult to prioritize –and a corresponding mixture of missions, ranging from high intensity war fighting to low intensity conflicts and peace keeping operations[76].

Another element of postmodern war is a distinct style of warfare. Full-fledged war is preferably avoided as is prolonged combat. Casualties among own and even enemy military units need to be minimized and public and politicians alike manifest an abhorrence towards 'collateral damage'. There is a loss of belligerency. If wars are fought, the West plays by its strengths - economic power and technological supremacy - to achieve its objectives at minimal cost and bloodshed. This explains the preference for the employment of precision stand-off weapons and air power. These developments are part of a societal trend in which armed force as an instrument has gained questionable legitimacy. Avoiding casualties and

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[75] Charles C. Moskos and James Burk, 'The Postmodern Military', in James Burk, *The Military in New Times* (Westview Press, Boulder, Co., 1994), pp.142-144. Christopher Dandeker notes similar changes, but prefers the term 'late-modernity'.

[76] Christopher Dandeker, 'A Farewell to Arms? The Military and the Nation-State in a Changing World', in Moskos and Burk, pp.128.

destruction is a humanizing trend and the only way to maintain legitimacy for conducting combat operations[77]. As Coker asserts, 'to be just, wars have to be humane. Western societies can now only fight wars which minimize human suffering, that of their enemies' as well as their own. Western societies are trying to humanize war. Is the great project for the twenty-first century'[78].

Others share this postmodern sociological perspective on changes. Martin Shaw discusses changes in society, national security, international security and defense under the headings of risk society, modernity and post-modernity, globalization, global state networks, and post-military society, liberally referring to studies of Anthony Giddens and Zygmunt Bauman, another sociologist who argues that the western world is in a transition from a modern to a postmodern era[79]. In line with both Giddens and Bauman, Shaw notes that risk is not so much objectively rising as subjectively experienced. On the other hand, uncertainty is objectively increasing due to the changing status of institutions, increased transparency and the increasing spatial and temporal interdependence of economic and ecological processes and personal life.

Taking their inspiration unwittingly from a typology offered by Robert Cooper[80] the International Institute of Strategic Studies notes that 'There is the postmodern world of networked society and globalization where a premium is placed on transparency, information sharing and communication, and the economic opportunities that flow from them', in a review of events since the shocking attacks of 11 September 2001, and the attack was a collision of the pre-modern and the postmodern world where postmodern tools provided pre-modern organization to strike at the heart of the postmodern world[81].

Others focus more on the new forms of warfare emanating from the changes in the economy. They see a transition from the industrial age to the "Information Age". Information, or rather, knowledge is the pervading theme, and in that the connection with Boyd is already implicitly evident. Knowledge becomes a key weapon and target in war, both at the societal level and at the battlefield. Chris Hables Gray argues that the logic and culture of war has changed since the Second World War. War is undergoing a crisis that will lead to a radical redefinition of war itself, and this is part of the general worldwide crisis of post-modernity[82]. The importance of information for society and by extension for war and warfare is the defining feature. 'As a weapon, as a myth, as a metaphor, or as a force multiplier, as an edge, as a trope, as a factor, as an asset, information (and its handmaidens – computers to process it, multimedia to spread it, systems to represent it) has become the

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[77] See for instance Andrew Latham, 'Warfare Transformed: A Braudelian Perspective on the 'Revolution in Military Affairs", *European Journal of International Relations,* Vol. 8(2), 2002; Christopher Coker, *Humane Warfare*, London, Routledge, 2001; Colin McInnes, *Spectator- Sport Warfare, The West and Contemporary Conflict* (London, 2002); Zeev Maoz and Azar Gat (ed), *War in a Changing World* (The University of Michigan Press, Ann Arbor, 2001), in particular Edward Luttwak, 'Blood and Computers: The Crisis of Classic Military Power in Advanced Postindustrialist Societies and the Scope of Technological Remedies', and Azar Gat, 'Isolationism, Appeasement, Containment, and Limited War: Western Strategic Policy from the Modern to the "Postmodern" Era'.

[78] Coker (2001), pp.2-5.

[79] Martin Shaw, 'The Development of "Common-Risk" Society: A Theoretical View', in Jurgen Kulman and Jean Callaghan (eds), *Military and Society in 21st Century Europe* (George C. Marshall Center for Security Studies, Garmisch-Partenkirchen, 2000), especially pp.15-19.

[80] Robert Cooper, *The Post-Modern State* (London, 1995).

[81] *Strategic Review 2001/2002* (Oxford University Press for IISS, London, 2002), p.6.

[82] Chris Hables Gray, *Postmodern War, the New Politics of Conflict* (Routledge, London, 1997), p.21. For a critique see Errol A. Henderson and J. David Singer, "'New Wars" and rumours of "New War"', *International interactions,* 28:2002, p.165.

central sign of post-modernity. In war information has always been important. Now it is the single most significant military factor[83], not only for controlling the battlespace, controlling information at home is just as important[84]. Information is the organizing principle of war and post-modernity, hence postmodern war[85].

For nihilist or subversive postmodernists such as Braudillard, the essence of postmodern war lies in the new methods of representation and experience of reality offered by new tools of information and communication. In a series of articles on the Gulf War he questions not the legitimacy of the conflict in the Gulf, but the very reality of the event itself. Our understanding of that war was constructed and mediated by a continuous series of symbolic images and 'virtual media events – simulacra that are not real, but instead 'stand in for the real'. In Boydian terms, our perception of reality was thoroughly shaped by these images. By asserting that the Gulf War did not take place Braudillard prompts us to question whether modern conceptions of military conflict and the central role warfare has played in geopolitics during the modern era have any credibility in a security environment characterized by deterrence, culturally imposed restraint, instantaneous media transmission, and adversaries with profound disparities in their military capabilities[86]. It was a virtual event which is less a representation of real war than a spectacle, a theme picked up by Michael Ignatieff and Colin McInnes to comment on Nato's war in Kosovo - a virtual war - and the way such 'humanitarian' wars have been experienced by the western publics – spectator sport warfare[87].

For Booth et al, several (and Boydian) developments arise from this postmodern phenomenon. The first is that 'the transmission of real-time media from the battlefield creates *a continuous feedback loop* in post-Cold War military operations in which the public can be directly influenced in a more or less predictable fashion depending on the content selected for transmission […] the role of the soldier-statesman will become crucial in courting the media for the purpose of retaining some element of that control'. Additionally they note that 'it becomes possible to employ the media directly as a conduit for disinformation' and a 'marriage of military strategy with the real time transmission capabilities of an ostensibly independent global mass media that invites comparison with the postmodern'[88].

These theme's are present also in other widely read and influential works debating the impact of the information age on war and warfare. Alvin and Heidi Toffler for instance, in their widely circulated and cited book, *War and Anti-War, Survival at the Dawn of the Information Age,* noted that you make war the way you make wealth, and the way the West makes wealth is through the information age - or 'third wave' - economy. This would spawn 'third wave warfare' in which information would be the critical component:

> Today the world is moving from a two-level to a three-level power system, with agricultural economies at the bottom, smokestack economies in the middle, and the knowledge based, or

[83] Ibid, p.22.
[84] Ibid, pp.38-40
[85] Ibid, p.81.
[86] Booth, Kesntbaum and Segal, pp.333-334.
[87] Michael Ignatieff, *Virtual War: Kosovo and Beyond*, (London, 2000); Colin McInnes, *Spectator Sport War, the West and Contemporary Conflict*, (Boulder, Co.,2002).
[88] Booth, et al, p.335. Emphasis is mine.

> Third Wave, economies likely, at least for a time, to occupy the top of the global power pyramid. In this new global structure, war, too, is trisected[89].

The transition to the Information age implied and was manifested in the awareness that information was becoming the driving factor in warfare[90]. Information and communication technology improved the quality of sensor systems, it increased transparency of the battlefield, it enhanced precision of weapons systems and, finally, it speed of command an shortened the "sensor-to-shooter time". In short, as many noted, information age technologies improved the capabilities for observation, orientation and decision, it allowed for compressing the time to complete an OODA cycle.

A revolution in postmodern military affairs

These features where the very subject of the discourse on the Revolution in Military Affairs, a revolution people became aware of after the Gulf War[91]. Debating the postmodern military, three authors note that 'although not quite congruent with our concept of the Postmodern military, the RMA vision does point to qualitative break with the patterns of warfare characteristic of the Modern Era'[92]. Latham, Gray, McInnes and other too see the RMA as part of the wider societal trends concerning war and warfare. The RMA is made up of the same elements of Gray's expression of postmodern war. The RMA is a postmodern development also in the sense that it holds a number of potential benefits to the West, particularly in reducing the exposure of troops to danger, in minimizing the risks of war more generally, and in reducing collateral damage. It fits the pattern of war the West would hope to fight[93]. The RMA also contains arguments for various doctrinal and organizational which are fully in line with Boyd's work. It includes the idea of decision superiority and the importance of superior situational awareness, the importance of time and high reaction capability and the decentralized network form of organization.

First noted by the Russian analysts during the eighties when they noted that the synthesis of technological changes in western militaries constituted something of a military technical revolution, the RMA debate took of in the West to describe and explain the momentous changes taking place[94]. One of the influential definitions of this discourse[95] was offered by Andrew Marshall from the Pentagon's Office of Net Assessments:

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[89] Alvin and Heidi Toffler, *War and Anti-War, Survival at the Dawn of the 21st Century* (New York, 1993), p.81.

[90] Zalmay M. Khalizad and John P. White (eds), *Strategic Appraisal: The Changing Role of Information in Warfare* (RAND, Santa Monica, 1999).

[91] This section is derived from Frans Osinga and Rob de Wijk, 'The Emergence of the Post-Modern Warform: Assessing a Decade of Changes in Military Affairs', in Alfred van Stadne, Jan Rood and Hans Labohm, *Cannon and Canons, Clingendael Views of Global and Regional Politics* (Royal van Gorcum, Assen, 2003); and from a series of articles on Network Centric Warfare, see Frans Osinga: 'Netwerkend de oorlog in? Network Centric Warfare en de Europese militaire transformatie', Deel I, *Militaire Spectator*, JRG 172, 7/8-2003; and Frans Osinga, 'Netwerkend de oorlog in? NCW als product van de revolutie', Deel II, *Militaire Spectator*, JRG 172, 9-2003.

[92] Charles C. Moskos, John Allen Williams, David R. Segal (eds), *The Postmodern Military, Armed Forces after the Cold War* (Oxford University Press, Oxford, 2000), p.5.

[93] McInnes (2002), p.139.

[94] See for the Russian view for instance General Makhmut Gareev, (edited by Jacob W. Kipp) *If War Comes Tomorrow, The Contours of Future Armed Conflic,* (Frank Cass, London, 1998).

[95] This is not the place to discuss the merits of the RMA thesis. Several critical studies have been published that argue that there either is no RMA, it is irrelevant because it is only due to technical

> a revolution in military affairs occurs when technological change makes possible material, which when combined with organizational and operational change, results in a transformation in the conduct of warfare[96].

Another equally influential and similar definition by Andrew Krepinevich posits that an RMA occurs

> when the application of new technologies into a significant number of military systems combines with innovative operational concepts and organizational adaptations in a way that fundamentally alters the character and conduct of conflict[97].

The RMA is the product of a confluence of three streams of technological change combined with organizational changes. Surveillance capabilities improved. It became possible to detecting, observe and tracking things and people of military concern all weather and during day and night time. This translated into improved ability to track potential or actual targets no matter what their speed. Eliot Cohen described it as 'anything that moves on the battlefield can be seen and what can be seen can be hit'[98]. The second technological stream concerns advances in information processing and presentation. The rapid increase in computing power and transmission capabilities of modern communication systems offered the opportunity to analyze, disseminate and access unprecedented quantities of information in ever shortening time. Commanders and tactical operators gain direct access to sensors dramatically improving their situational awareness. And this translated into the third technical stream; the ability to hit targets precisely and quickly. On the organizational and doctrinal level, this implied an empowerment of small units and the ability of armed forces to cover larger distances quicker, to influence events over larger swaths of territory, and to do more things in a given period of time. Combat intensity would go up, risk would go down. Massing of forces would become a thing of the past. Instead, fires would be massed, coming from stand-off weapons launched from ships, aircraft or ground based rocket launchers. Finally, it would become harder for an opponent to find sanctuary anywhere. Indeed, the cumulative effects of the technological and organizational changes stimulated by the information revolution would be revolutionary.

Thus Eliot Cohen claimed that 'a revolution in military affairs in under way. It will require changes of a magnitude that people still do not completely grasp'[99]. Others did grasp it claiming the information revolution based RMA offered a transition from attrition warfare

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developments, or its effects only very temporary. See for instance MacGregor Knox and Williamson Murray, *The Dynamics of Military Revolution 1300-2050*, Cambridge, 2001; Colin Gray, *Weapons for Strategic Effect, How Important is Technology?* (Air University Press, Maxwell Air Force Base, Alabama, January 2001); Collin McInnes, 'Spectator Sport Warfare', in Stuart Croft and Terry Terrif, *Critical Reflecions on Security and Change* (London, 2000). A very fresh approach is offered by Andrew Latham, 'Warfare Transformed; A Braudelian Perspective on the 'Revolution in Military Affairs', *European Journal of International Relations*, Vol. 8(2), pp. 231-266. He sees several technical, political and societal developments of a revolutionary kind, but occurring in different time-scales. This allows him to put into perspective the various schools of thought.

[96] Andrew Marshall, Testimony before the senate Armed Services Committee, subcommittee on Acquisition and Technology, 5 May 1995.

[97] Andrew Krepinevich, 'From Cavalry to Computer', *The National Interest*, no 37, Fall 1994, p.30.

[98] Eliot Cohen, 'A Revolution in Warfare', *Foreign Affairs,* (1996), 75, 2, p.54.

[99] Ibid, p.37.

to precision warfare or knowledge intensive warfare[100], Boydian themes indeed. Whereas Braudillard focused on the media impact, military analysts asserted that the Gulf War 'established the superiority of this new mode of warfare by demonstrating convincingly that information-based Western armies can quickly and decisively defeat the industrial armies of rogue states, even when the latter has had ample time to prepare their defenses'[101]. Capturing the widely shared vision of future war employing RMA capabilities, one authors summarized several studies as:

> The battlefield of the 21st Century will be dominated, not by massed troops and armor, but by long-range smart munitions able to strike with precision over great distances, stealthy and unpiloted weapon platforms with stand-off capabilities; air and space-based sensors that can effectively eliminate the 'fog and friction' of war and provide 'dominant battlespace awareness'; and advanced battle management and communication systems able to integrate, process and distribute information so that commanders can apply dominant forces in just the right place and at just the right time'.
>
> [Instead of] attrition and the conduct of set piece battles along a continuous front such operations will give way tot 'non-linear operations' […] involving high-tempo attacks conducted simultaneously against key tactical, operational and strategic targets throughout the length, depth and breadth of the battlespace. Fighting will take place in disconnected encounters all across the battle zone and in the airspace above it, and in the 'cyberspace' of electronic warfare, high tech surveillance, and instantaneous communications[102].

Others went one step further in exploring the possible consequences of the information revolution. Somewhat predictably after the Gulf War the concept of "Information War" was coined and developed in a flood of publications. "I-War" proponents asserted the shift from "Industrial Age Warfare" to "Information Age Warfare". A short overview of some core arguments and assertions will illustrate the essence of this school of thought, and at the same time demonstrate the close parallels between "I-War" and several Boydian ideas, such as an emphasis on tempo, situational awareness, network structures, and agility. Some quotes from a notable article by John Arquilla and David Ronfeldt, two leading authors on information war, will suffice. *Cyberwar is coming*, sported their article they published in 1993. In it, like others, they argued how the information revolution would affect warfare. They asserted that:

> the information revolution reflects the advance of computerized information and communications technologies and related innovations in organization and management theory. Sea changes are occurring in how information is collected, stored, processed, communicated, and presented, and in how organizations are designed to take advantage of increased information[103].

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[100] Latham, pp.219.
[101] Ibid, p.223
[102] Andrew Latham, 'Warfare Transformed: A Braudelian Perspective on the 'Revolution in Military Affairs", *European Journal of International Relations,* Vol. 8(2), 2002, p.239.
[103] John Arquilla and David Ronfeldt, 'Cyberwar is Coming', *Comparative Strategy*, Vol 12, no.2, p.143. They elaborated on these ideas in an edited volume of studies on information war. See John Arquilla and David Ronfledt, (eds), *In Athena's Camp, Preparing for Conflict in the Information Age* (RAND, Santa Monica, 1997). This volume includes the article 'Cyberwar is Coming'.

This will affect war and warfare: 'the information revolution will cause shifts, both in how societies may come into conflict and how their armed forces may wage war'[104]. And the shape of future war was also explored, showing many features favored by Boyd:

> warfare is no longer primarily a function of who puts the most capital, labor, and technology on the battlefield, but of who has the best information about the battlefield. What distinguishes the victors is their grasp of information, not only from the mundane standpoint of knowing to find the enemy while keeping it in the dark, but also in doctrinal and organizational terms'[…] 'information is becoming a strategic resource that may prove as valuable and influential in the post-industrial era as capital and labor have been in the industrial age.[105]

They posit that in the future war must be waged according to 'information related principles'. And those principles not only apply to large scale high intensity conflict, but also in 'low intensity conflict, in conventional and non-conventional environments and for defensive or offensive purposes'[106]. Additionally conflict may have to be interpreted in a different light, away from the industrial age conception of armed conflict. They distinguish Netwar and Cyberwar, where Netwar surpasses the military dimension and includes economic, political, and virtual dimensions. It refers to ideational conflicts, waged in part through internetted modes of communication. Cyberwar refers to conducting and preparing to conduct military operations according to information related principles. Although information and communication matters, what the authors consider the real significance is that these are forms of war about "knowledge" – about who knows what, when, where and why, and about how secure a society or military is regarding its knowledge of itself and its adversaries.

It is exactly this knowledge that they suggest should be shaped. Pregnant with Boydian notions, postmodern - reflexivist – references and Braudillard's fears, they suggest that conflict in the information age means:

> trying to disrupt, damage, or modify what a target population knows or thinks it knows about itself and the world around it. A Netwar may focus on public or elite opinion, or both. It may involve public diplomacy measures, propaganda and psychological campaigns, political and cultural subversion, deception of or interference with local media, infiltration of computer networks and databases, and efforts to promote dissident or opposition movement across computer networks[107].

With information the key weapons and target of the information age, strategy in Cyberwars are equally in tune with Boydian and postmodern concepts – uncertainty and ambiguity of information and knowledge - for the focus during a conflict must lie on disrupting, if not destroying information and communication systems on which the adversary relies in order to know itself: who it is, where it is, what it can do when, why it is fighting, which threats to counter first, etc. It means trying to know everything about an adversary while keeping the adversary from knowing much about oneself. It means turning the balance of information and knowledge in one's favor. It means using knowledge so that less capital and labor may have to be expended[108].

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[104] Ibid.
[105] Ibid, p. 141.
[106] Ibid, p.146.
[107] Ibid, p.144.
[108] Ibid.

The close parallels with Boydian military thinking also come to the fore in the organizational consequences for militaries in the information age and for their command and control philosophy. Noting that Cyberwar is not simply a set of measures based on technology, but is as much about organization, the organizational consequences should also be addressed, for the information revolution:

> disrupts and erodes the hierarchies around which institutions are normally designed. It diffuses and redistributes power, often to the benefit of what may be considered weaker, smaller actors. It crosses borders, and redraws the boundaries of offices and responsibilities. It expands the spatial and temporal horizons that actors should take into account[109].

Thus the advise to adaptive organization is that:

> The responsive, capable institutions will adapt their structures and processes to the information age. Many will evolve from traditional hierarchical forms to new, flexible, network-like models of organization. Success will depend on learning to interlace hierarchical and network principles. The very changes that trouble institutions, such as erosion of hierarchy, favor the rise of multi-organizational networks[….]Multi-organizational networks consist of (often small) organizations or parts of institutions that have linked together to act jointly. Indeed, the information revolution favors the growth of such networks by making it possible for diverse, dispersed actors to communicate, consult, coordinate, and operate together across greater distances, and on the basis of more and better information than ever before[110].

Adopting a network structure is not an option but an imperative, for case studies strongly suggest that 'institutions can be defeated by networks and it may take networks to counter networks'[111]. Command and organization for future warfare:

> may require major innovations in organizational design, in particular a shift from hierarchies to networks. The traditional reliance on hierarchical designs may have to be adapted to network-oriented models to allow greater flexibility, lethal connectivity, and teamwork across institutional boundaries. The traditional emphasis on command and control may have to give way to an emphasis on consultation and coordination, the crucial building blocks of network designs[112].

> Moving to networked structures may require some decentralization of command and control. But decentralization is only one part of the picture: the new technology may also provide greater 'topsight', a central understanding of the big picture that enhances the management of complexity. The pairing of decentralization with topsight brings the real gains[113].

Several years after this article Arquilla en Ronfeldt explored more in detail the possible optimal organizational concept for information age warfare. The idea that small units now had access to unprecedented levels of situational awareness, and could call in stand-off precision firepower offered new possibilities. They offered the "Swarming concept", taking their inspiration from Martin Libicki's chapter 'The Small and the Many' that was included in

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109 Ibid, p.143.
110 Ibid, p.144
111 Ibid, p.152.
112 John Arquilla and David Ronfeldt, 'Emerging Modes of Conflict', *Comparative Strategy,* vol. 12, no.4, 1993, p. 158.
113 Arquilla and Ronfeldt, 'Cyberwar is Coming', p.146.

Athena's Camp. They see swarming as the logical emerging paradigm in warfare, following three earlier paradigms in military history: the melee, massing, maneuver. The central idea is that IT offers the potential for small networked units to operate as a swarm in a 'seemingly amorphous but deliberately structured, coordinated strategic way to strike from all direction, by means of a sustainable pulsing of force and/or fire, close in as well as form stand-off positions. It works best if it is designed mainly around the deployment of myriad, small, dispersed maneuver units that are tightly internetted and capable to communicate and coordinate with each other at will and are expected to do so'[114]. A swarm force must not only engage in strike operations, but also form part of a "sensory organization", providing the surveillance and synoptic-level observations necessary to the creation and maintenance of "topsight"[115]. A Boydian concept indeed.

These studies did not remain confined to the academic world. On the contrary, it has come to define the US way of war and the vision of the future for the Pentagon. In 1997 then US defence secretary William Cohen asserted that:

> the information revolution is creating a Revolution in Military Affairs that will fundamentally change the way US forces fight. We must exploit these and other technologies to dominate in battle. Our template for seizing on these technologies and ensuring dominance is Joint Vision 2010, the plan set forth by the Chairman of the Joint Chiefs of Staff for military operations in the future[116].

Joint Vision 2010 condenced both some core Boydian ideas, the tenets of information age – or postmodern - warfare and the US defence aspirations in the following lines:

> By 2010, we should be able to change how we conduct the most intense joint operations. In stead of relying on massed forces and sequential operations, we will achieve massed effects in other ways. Information superiority and advances in technology will enable us to achieve the desired effects through the tailored application of joint combat power. Higher lethality weapons will allow us to conduct attacks currently that formerly required massed assets applied in a sequential manner. With precision targetting and longer range systems commanders can achieve the necessary destruction or suppression of enemy forces with fewer systems, thereby reducing the need for time consuming and risky massing of people and equipment. Improved command and control, based on fused, all-source real-time intelligence will reduce the need to assemble maneuver formations days and hours in advance of attacks. Providing improved targetting information directly to the most effective weapon system will potentially reduce the traditional force requirements at the point of main effort. All of this suggests that we will be increasingly able to accomplish the effects of mass - the necessary concentration of combat power at the decisive time and place - with less need to mass forces physically than in the past.[117]

In the latter part of the nineties, an overarching concept – Network Centric warfare (NCW) - was proposed, that incorporated many of the concepts developed in various studies on the impact of the information age on warfare, including swarming and the network structure.

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[114] John Arquilla and David Ronfeldt, *Swarming and the Future of Conflict*, (RAND, Santa Monica, 2000), pp. 21-23.

[115] Ibid.

[116]William S. Cohen, *Report of the Quadrennial Defense Review* (Washington, D.C., U.S. Defense Department, 1997), p. iv.

[117] Joint Chiefs of Staff, *Joint Vision 2010* (Washington D.C.: Department of Defense, United States Government), 1997, p.17. For a short but adequate description of *JV2010* see major-general Charles Link, '21st Century Armed Forces – Joint Vision 2010', *Joint Forces Quarterly*, Autumn 1996, pp.69-73.

NCW, according to its advocates, is the emerging theory of war in the information age, a paradigm shift, and the military embodiment of Information Age concepts and technologies[118]. It has become the concept shaping the future of the US armed forces, and with the agreement by NATO in 2002 to create the NATO Response Force and embark on military transformation, it has also entered the debates among European militaries.

NCW stands for a new way of warfare. It is a 'set of warfighting concepts designed to create and leverage information'[119]. The essence of NCW is captured in the following description:

> the US is poised to harness key information technologies – microelectronics, data networking, and software programming – to create a networked force, using weapons capable of pinpoint accuracy, launched from platforms beyond range of enemy weapons, utilizing the integrated data from all-seeing sensors, managed by intelligent command nodes. By distributing its forces, while still being able to concentrate fires, the US military is improving its mobility, speed, potency, and invulnerability to enemy attack[120].

The network structure is essential, not specific weapon or support systems: 'In NCW no single platform or sensor is the heart of the system', the NCW Report to Congress states[121]. NCW derives its power from the strong networking of a well-informed but geographically dispersed force[122]. NCW is 'a useful shorthand for describing a broad class of approaches to military operations that are enabled by the networking of the force'[123]. And networking does not only imply technological connectivity. NCW goes deeper in that it maintains, like Arquilla and Ronfeldt's studies, that reaping the maximum benefit of information age tools, organization, command and control philosophy and doctrine should also be radically adjusted:

> Networking is being used in its broadest sense to include the networking of information-related processes and all other forms of collaboration among a better informed set of participants[…] 'Networking the force entails much more than providing connectivity among force components in the physical domain. It involves the development of doctrine and associated tactics, techniques, and procedures that enable a force to develop and leverage an information advantage to increase combat power[124].

With explicit reference to Boyd's OODA loop it notes that the advantage for forces that implement NCW lies in gaining and exploiting an information advantage. 'NCW allows the force to achieve an asymmetrical information advantage. NCW is predicated upon dramatically improved capabilities for information sharing'[125]. NCW capabilities allow a force to attain an improved information position that can partially "lift the fog of war" and enable

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[118] David Alberts, *Information Age Transformation, Getting to a 21st Century Military*, (Department of Defence, CCRP, Washington, D.C., June 2002), p.18.
[119] Ibid, p.7.
[120] David Gompert, Richard Kugler and Martin Libicki, *Mind the Gap, Promoting a Transatlantic Revolution in Military Affairs* (National Defence University Press, Washington, D.C.,1997), p. 4.
[121] *DoD Report to Congress on NCW* (Department of Defence, CCRP, Washington, D.C., July 2001), p.vii.
[122] David S. Alberts, John J. Gartska, and Frederick P. Stein, *Network Centric Warfare* (Department of Defence, CCRP, Washington, D.C., 1999), p.90.
[123] *DoD Report to Congress on NCW*, p.3-1.
[124] Ibid, pp.3-5 and 3-1.
[125] Ibid.

commanders to improve their decision making and fight in ways that were not previously possible'. This will be achieved if the following is accomplished in three domains of armed forces[126]. In the "Physical domain", 'all elements of the force are robustly networked which will enable 'achieving secure and seamless connectivity'. In the "Information domain" the force must have the 'capability to collect, share, access, and protect information', as well as 'the capability to collaborate in the information domain, which enables a force to improve its information position through processes of correlation, fusion, and analysis'. This will allow a force to 'achieve information advantage over an adversary in the information domain'. In the "Cognitive domain" the force must have 'the capability to develop and share high quality situational awareness' and the 'capability to develop a shared knowledge of commander's intent'. This will enable 'the capability to self-synchronize its operations'.

Summarizing the warfighting advantages, one article lists the following, and Boydian tenets clearly are manifest[127]:

- NCW could permit a geografically dispersed force to operate as a system –in effect, as a "dispersed mass". Such a force, though its elements might be spread over a large area, should be able to concentrate precision weapons rapidly upon targets hundreds of miles away.

- Its units may be able to mass fires not only with decisive effect but without the need to maneuver – without having to get closer to targets, avoid geographical constraints, or achieve some positional advantage

- NCW offers the flexibility, operational reach, and battlespace awareness needed to operate on the strategic, operational, and tactical levels at once. Combat would no longer have to proceed in the traditional step-by-step, or serial, manner. Combat would instead be multidimensionally and comprehensively joint.

- Such parallel warfare can produce the systemic disruption of the enemy's operational functions and lock out (preclude) options.

- NCW, by making a force capable of concentrating fires precisely where desired, may be able to influence enemy actions and perceptions of options in ways that once only forces on the spot, and usually on the ground, could achieve. That is, the capabilities offered by a NCW force should produce operational advantages and second-order consequences that once required the tangible presence, and particular physical dispositions, of combat power.

These advantages are embedded in the "tenets" of NCW: 'a force with these attributes and capabilities will be able to increase combat power by

- Better synchronizing effects in the battlespace
- Achieving greater speed of command
- Increasing lethality, survivability, and responsiveness[128].

Thus Steven Metz concludes that 'the US military will be the first *postmodern state* combatant, attaining greatly amplified speed and precision by the integration information technology and development of a system of systems which link together methods for target acquisition,

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[126] Ibid, pp.3-9 en 3-10.

[127] Paul Murdock, 'Principles of War on the Network-Centric Battlefield: Mass and Economy of Force', *Parameters*, Spring 2002, pp.91-92.

[128] These "tenets" appear in several NCW publicatieons. See *NCW Report to Congress,* p.i, v, or 3-10.

strikes, maneuver, planning, communication, and supply'[129]. And in postmodern war, 'time will be the key element. Postmodern militaries will attempt to use speed and knowledge to bring the conflict to quick resolution[130]. Boyd would not care much about those who emphasize the technological aspect of post-modern war, but he certainly would agree with the doctrinal and organizational tenets and the operational and strategic benefits accruing from it.

The asymmetric response

Boyd would however also have agreed with those who argue that, precisely because the West has unsurpassed conventional military power, future opponents will revert to unconventional - asymmetrical - methods. War is a contest of ideas, and the highly visible western pattern of operations make the West predictable. In dialectic fashion a response can be expected, and in fact one author discerns a counter-revolution in militaire affairs. Not only will trusted tactics such as camouflage and dispersion be vigorously employed to negate the advantage of precision stand-off weapons, but opponents are likely to turn the Western conceptualization of war against itself. If civilian casualties are to be avoided by Western militaries, opponents will aim to cause the West to inflict massive and highly visible civilian casualties. The use of human shields and using schools, mosques, cultural objects and hospitals as hiding places for military equipment are examples of this mode of thinking that have been witnessed during Desert Storm, Allied Force, Enduring Freedom, Iraqi Freedom and the ensuing stabilization operations. Additionally, adversaries can employ non-military forms of combat such as information war, extortion, bribery, etc.

This asymmetric countering of the West is developing into a deliberate attempt to use the Clausewitzian paradigm against the West. To illustrate this, in a remarkable book published in China, titled *Unrestricted Warfare*[131] the authors, serving senior officers of the Chinese armed forces, unveiled their view on how to counter the Western style of warfare. It begins with a thorough examination of the way the West, and in particular the US, has fought wars in the past decade. They recognize the pattern. In response their approach is multi-dimensional and deliberately not confined to the military dimension. In the following table are listed the domains in which war can be waged according to the authors.

They advocate nonmilitary means such as Information Warfare related concepts, such as the use of hackers, the mass media and financial information terrorism. Rules and conventions, such as the Laws of Armed Combat are not adhered to, while the West's political, moral and military restraints that fighting according to these rules imply, are fully exploited. The key is the unique alignment and integration of psychological, diplomatic, resource and other warfare techniques. Weapons and combat methods are not necessarily related to military hardware or military organizations.

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[129] Steven Metz, *Armed Conflict in the 21st Century: The Information Revolution and Post-Modern Warfare* (US Army Strategic Studies Institute, Carlisle Barracks, April 2000), p.24.

[130] Ibid, p.87.

[131] Qiao Liang and Wang Xiangsui, *Unrestricted Warfare* (Beijing, 1999), p.156. In the past decade, and in particular in the past five years a large number of papers have been published on asymmetric warfare. See for instance Robert Scales, 'Adaptive Enemies: Dealing With the Strategic Threat after 2010', *Strategic Review,* vol.27, no.1, 1999; and Daniel Byman, Kenneth Polak and Matthew Waxman: 'Coercing Saddam Hussein: Lessons from the Past', *Survival,* vol. 40, no.3, 1998. For an overview of the debate on this topic and some notable studies, see Frans Osinga, 'Asymmetric Warfare; Rediscovering the Essence of Strategy' in Olson (2002).

Military War	Beyond Military War	Nonmilitary War
Nuclear	Diplomatic	Financial
Conventional	Internet	Trade
Bio-Chemical	Information Ops	Natural Resource
Ecological	Psychological	Economic Aid
Space	High Tech	Law and Regulations
Electronic	Smuggling	Sanctions
Guerrilla	Drug	Media War
Terrorism	Deterrence	Ideological

More philosophically, the authors turn the West's perception concerning the nature, the meaning and purpose of war against itself. War is not identical with violent military clashes, instead it must be understood as constant contest or struggle. The authors deliberately redefine the meaning of war and stretch it far beyond what most political leaders consider the current meaning of war. Thus academically they open the possibility of being engaged in a war, employing non-military methods to achieve their aim, while the West would not recognize it was engaged in one[132]. Martin van Creveld may be right when he asserted that this mode of warfare, combined with terrorism, rape, plunder, assassination, ethnic cleansing is the other face of the transformation of war that is currently taking place, but this one in the non-western part of the world, and it would spell doom for Western democratic societies for against this threat the conventional defence forces of the West would be irrelevant[133].

The attacks of September 11, 2001 were so shocking in part because they broke the pattern of Western style warfare, they shattered the framework of war and warfare Western society had become accustomed to[134]. These attacks had already been envisioned in 1989 by a group of US military officers that were inspired by Boyd in an article in which these trends were described and labeled as 4th Generation Warfare, and they agreed with van Creveld that this was the most likely future threat for the West. They even predicted how Islamic terrorists would freely roam through the open societies of the West and could strike with non-military means. In the aftermath of 11 September 2001, the article was rediscovered. Another testimony to the merits of Boyd's mode of thinking.

Boyd and post-modern strategy.

In light of his eclectic approach, and the specific sources Boyd drew inspiration and insight from, I have argued that Boyd must be considered the first post-modern strategist because of the close resemblance of both his method and his arguments with leading post-modern theorists. It is the post-modern feature which gives him a unique position as a strategist, besides the novelty of his strategic arguments. Boyd called his work *A Discourse* because it was through interaction with his public that understanding and meaning would be generated. Boyd also had a discourse with history, using various lenses to analyze events, to derive meaning and understanding of a complex phenomenon called war, and the non-linear way people acted, and attempted to control events in it through a dialectic process, a constant

[132] This section is derived from a chapter by this author titled 'Asymmetric Warfare; Rediscovering the Essence of Strategy', in John Olson (ed), *Asymmetric Warfare*, Oslo (2002).
[133] Martin van Creveld, *The Transformation of War*, The Free Press, New York 1991.
[134] See for instance Colin McInnes (2001), p.76, for a similar observation.

process of analysis and synthesis, based on experience, culture, genetics, one's relationships with others, etc. His starting premise, contained in his essay, is that the world is fundamentally uncertain, truth is an arena of combat, knowledge is a weapon as is the capability to evolve one's knowledge base. Indeed, Boyd's work itself, Boyd's approach in making it, and Boyd's views on combat and strategy implicitly are pregnant with post-modern epistemological principles. Although Boyd would feel more acquaintance with Kuhn than with Lyotard, Bourdieu, Derrida or Giddens, Boyd does implicitly include ideas which these authors have suggested.

As is the case with post-modernism, at the heart of Boyd's view on war and strategy lies the fundamental issue of epistemology. The first step Boyd takes in developing (what later turned into) *A Discourse* is an attempt to discover how we develop knowledge, how we learn, and contains the explicit recognition of fundamental uncertainty. His observation was derived from physics and mathematics, that undermined fundamentally the predictive potential of science and the certainty of knowledge, core features of post-modernism. Moreover, post-modernism and complexity theory arose during the period Boyd formulated most of his ideas, insights and explanations. And post-modernism and complexity theory share the notion of knowledge as unfolding, evolving, as a dialectic process and uncertain. This epistemological understanding is the foundation of his subsequent investigations in history and his attempt to derive meaning from it.

Boyd also makes a pluralist approach part of his theory for conflict. Linking his work with postmodern security theory, his work revolves around perception and affecting the perception of the opponent, while conscious of the fact that the act of observing will affect observed reality. Ideas, practices, doctrines, and frames of reference matter. Reality is ambiguous, in particular when an opponent manipulates our perception of it and to uncover 'truth' one needs to combine, and select from, views from several perspectives on the same phenomenon. To survive one needs to have a repertoire of frames of reference and several causal models (both are captured in Boyd's 'orientation patterns') to make sense of what is happening and to adequately react and anticipate. One needs to know different paradigms and be able to operate within those in parallel. Additionally Boyd stresses that one should constantly modify and improve one's orientation patterns, and this not only links his work with Complexity Theory, but also with structuration theory and deconstructionism of the social sciences. The OODA loop as an epistemological and as a behavioral model fits in comfortably with post-modern epistemological and agency-structure discussions.

The OODA loop itself indeed is a epistemological statement. It is an abstract and theoretical model of the way we derive knowledge from our environment. The OODA loop models the way the brain functions or malfunctions. Boyd's theory of rapid OODA looping is about affecting the functioning of the brain (individual and/or some sort of collective mental capacity that lies in military headquarters) and the capability to make sense of the world. More importantly Boyd's theory implicitly contains propositions about the way we perceive the world, make sense of it, classify the events and act according to our perception. It contains explicit statements about the nature of knowledge, about information and about the limitations of our understanding of the world. Epistemology explicitly forms the philosophical foundation and the starting point of further investigation. Epistemology, how we derive knowledge and act upon it, is the core issue of the OODA loop, and Boyd's focus on cognition - the vital importance Boyd attaches to Orientation - emanates from this interest in epistemological questions. Schemas, mental models, paradigms and orientation patterns refer to the same notion. Boyd shows how we can relate it to warfare.

When Boyd argues for rapidity and variety in tempo within OODA loops, he is building upon a higher-level capability, which he presumes to exist, to adapt and evolve one's

schemas. Gell-Mann developed the idea that organisms adapt across different time scales. The evolution of new and varied schemata is the most fundamental form of adaptation, and it is precisely that form which Boyd considers the most vital for military organizations for consistent success. Orientation patterns define what we observe, and what meaning we assign to what we observe. This can be an individual activity, but the notion of assigning meaning to it also has relevance in social contexts. Boyd even warns against monochromatic views and argues that command organizations should consist of people with different frames of reference, thereby ensuring a variety of interpretations of one observation. Truth is dialogical, in postmodern terms; it arises from people in discourse. Assigning meaning to events, phenomena or objects is not just an individual process. It becomes problematical and very important when people want to communicate. Meaning is to a large extent the outcome of a social activity. And Boyd points to the importance for military organizations of creating a common system of meaning.

As a model for post-modern strategy the value of the OODA loop and the arguments Boyd makes using it, lies in pointing towards the non-traditional tools for creating combat power and non-traditional targets in an enemy system. Language, doctrine, belief systems, experience, culture, symbols, schemata, dataflows, knowledge about itself and its opponent, perception, organizational ability to learning, the capability to change practices, all positioned in the temporal dimension, are at least as valuable as technology, weapons, numbers of soldiers in defining combat effectiveness.

The discourse on the shape of warfare in the postmodern age, affected by the information revolution reflects these postmodern themes, revolving around the importance of knowledge, about situational awareness, about exploiting information superiority and adopting network organization structures because of the inherent flexibility of such arrangements. Postmodern warfare aims to enlarge the already inherent uncertainty of knowledge in the enemy camp. Postmodern strategy for war and peace aims to create, magnify and exploit mismatches between the environment and the opponent's perception of the environment. It aims to create a favorable impression of one's own image during peacetime. In war it aims to disrupt cohesion, and to create superior situational awareness and blanket an opponent's environment with menacing yet ambiguous fluid attacks, strikes and movements from all directions. Its project is a way of warfare distinctly not resembling modern era industrial style attrition type warfare. Many of the features of the RMA debate in the nineties and the preferred shape of future armed forces in the postmodern era thus not incidentally echo arguments and propositions developed by Boyd. There is clearly a conceptual linkage between Boyd, postmodernism, and postmodern warfare.

In a recently published textbook on strategy in the contemporary world Lawrence Freedman acknowledged that 'the practical strategist is (perhaps unwittingly) something of a constructivist'[135]. In light of the above analysis concluding that Boyd may be considered the first post-modern strategist is as warranted as it is beneficial in understanding Boyd. It explains Boyd's ideas from yet another angle, while demonstrating the continuing relevance and influence of Boyd's work. Moreover, and importantly, it allows positioning Boyd within the larger academic currents in social theory, IR theory and security studies.

[135] John Baylis, James Wirtz, Eliot Cohen, Colin Gray, *Strategy in the Contemporary World,* Oxford, 2002, p.338.

Closing the loop

John Boyd is dead but he has left a sophisticated, multi-layered and multidimensional legacy and a new set of terms and concepts to study war and conflict that is useful, if at places abstract. This study has offered a full text interpretation of Boyd's slides. The ideas, themes and concepts contained in his work have become evident after a thorough discussion of the various formative factors that have shaped and colored his work. I have argued that Boyd's ideas involve much more than exclusively the idea of "rapid OODA looping" or a theory for maneuver warfare, as has been the perception by most judging from a survey of references to Boyd's work. Taking issue with some authors who categorically dismiss the validity of the OODA concept, I have shown that Boyd's work is deep and rich in ideas, explanations, hypotheses, propositions, concepts and suggestions concerning conflict in general and contain valid concepts, and is firmly based on a thorough study of military history and informed by insights on learning and the behavior of social systems derived from various disciplines.

As Boyd's ideas can incorporate the spectrum of ideas and concepts in strategic level and operational level theories of war, to some extend, I have argued, Boyd's work is indeed a comprehensive theory of conflict. It addresses various levels of war that are normally recognized: the tactical, operational (or grand tactical), the strategic and the grand strategic level, developing insights concerning the dynamics at play at each level and the asociated factors for success. Boyd also shows how the mental, moral, physical components of war interrelate and how the temporal and the spatial dimensions of war affect these in turn.

The rapid OODA loop idea is a very important one, but in itself often misunderstood. Whereas rapid OODA loop is often equated with superior speed in decisionmaking, Boyd employs the OODA loop model to show how organisms evolve and adapt. It has become evident that, in addition to the common narrow interpretation of the OODA loop idea, Boyd work is infused with the larger theme of equal or even surpassing importance of adaptation. While rapid OODA looping – as in rapid decision making - is quite relevant for success at the tactical level, and to some extent also at the operational level, Boyd regards the OODA loop schematic in general as a model for organizational learning, or even more general, the way organisms adapt and thus evolve. It incorporates ideas such as double loop learning, maintaining a variety of frames of reference, (or schemata), a variety of responses, the influence and relevance of organizational culture and experience

I have also shown that Boyd's work conceptually follows closely in the footsteps of Sun Tzu, Julian Corbett, J.F.C. Fuller, T.E. Lawrence and Basil Liddell Hart, to name but a few familiar authors, and that his work his rooted in an impressive, if sometimes biased study of military history. I have furthermore indicated that an important and often overlooked value lies in Boyd's approach to studying strategy and operational art, and conflict in general, in his holistic approach and in particular in his use of contemporary scientific insights from a variety of disciplines to study conflict. Expanding on the previous argument I demonstrated that Boyd's views on the nature of war and strategy evolved with his familiarization first with epistemological debates and cybernetics, then with the systems-theoretical perspective, and from cognitive sciences and evolution theory, to chaos theory to finally complexity theory. The value of Boyd's work lies of course in the concepts he develops, but at least to an equal

extent in the novel approach for thinking about strategy, making strategic theory and making strategy, and in introducing current scientific developments into strategic theory.

Although Boyd would probably have disapproved of this label, in this aspect of his work also lies the justification to regard his work to fall very comfortably within the post-modern framework of the social sciences, and Boyd can be considered the first post-modern strategist both in content and in his approach to making strategy and strategic theory, in light of the similarities of his work and his sources with moderate post-modern social theorists, with developments in post-modern security and strategic studies, and because of the economic or technologist interpretation of post-modernism, which has spawned correlating views of post-modern war and post-modern warfare.

Boyd furthermore infected a generation of senior military and political leaders with the virus of novelty and led them to think in different ways about the conduct of war. It inspired AirLand Battle, C2W, Information Warfare concepts and US Marines doctrine. Today his ideas inform emerging warfighting concepts such as Network-Centric Warfare. Those arguments alone would argue for closely studying and appreciating the incredible achievement of Boyd. But his influence is even more widespread if unconscious in most of us. Reading through Boyd's work nowadays one does not encounter novelty or experience difficulty following his arguments and accepting his ideas. His language and logic, his ideas, terms and concepts are part and parcel now of the military conceptual frame of reference. Western military organizations have to a large extent internalized Boyd's concepts, and perhaps even learned Boyd's way of thinking.

Moreover, Boyd's work offers important insights for understanding the threats of the "post- 9/11" world. So called asymmetric responses to western modes of warfare too become a natural feature only to be expected from adversaries. An adversary is a complex adaptive system attempting to adapt, to survive and prosper. The attacks of "9/11" introduced the contours of a new warform, and the West has been challenged to understand the nature of this new game of survival. In no small measure is it waged in the cognitive and moral domain. Ideas such as interaction and isolation can be traced in counter terrorism publications and policy, and the need for rapid adaptation can be seen in the changes in Western intelligence services and the creation of homeland security organizations in direct response to the threats which has blurred the boundaries of external and internal security. Orientation is indeed key.

Azar Gat said that:

> New and significant intellectual constructions usually emerge at times of fundamental change or paradigmatic shifts, when prevailing ways of interpreting and coping with reality no longer seem adequate. Rather than being alone in their views, the thinkers who generate them usually make their names by early sensing, conceptualizing, and turning into philosophical and political programs the feelings and notions which are beginning to emerge, more or less hazily, around them[136].

Those words apply to the position, approach and relevance of John Boyd. Boyd's work is comprehensive, novel and important.

[136] Azar Gat (1998), p.307.

ANNEX A : BIBLIOGRAPHY OF *DESTRUCTION AND CREATION*

1. Beveridge, W.I.B, *The Art of Scientific Investigation*, Vintage Books, Third Edition 1957
2. Boyd, John R., *Destruction and Creation*, 23 Mar 1976
3. Brown, G. Spencer, *Laws of Form*, Julian Press, Inc. 1972
4. Conant, James Bryant, *Two Modes of Thought*, Credo Perspectives, Simon and Schuster, 1970
5. DeBono, Edward, *New Think*, Avon Books 1971
6. DeBono, Edward, *Lateral Thinking: Creativity Step by Step*, Harper Colophon Books 1973
7. Foster, David, *The Intelligent Universe*, Putnam 1975
8. Fromm, Erich, *The Crisis of Psychoanalysis*, Fawcett Premier Books 1971
9. Gamow, George, *Thirty Years That Shook Physics*, Anchor Books 1966
10. Gardner, Howard, *The Quest for Mind*, Vintage Books 1974
11. Georgescu-Roegen, Nicholas, *The Entropy Law and the Economic Process*, Harvard U. Press 1971
12. Gödel, Kurt, *On Formally Undecidable Propositions of the Principia Mathematica and Related Systems*, pages 3-38, 'The Undecidable', Raven Press 1965
13. Heilbroner, Robert L., *An Inquiry into the Human Prospect*, Norton and Co. 1974
14. Heisenberg, Werner, *Physics and Philosophy*, Harper Torchbooks 1962
15. Heisenberg, Werner, *Across the Frontiers*, World Perspectives, Harper and Row 1974
16. Hoyle, Fred, *Encounter with the Future*, Credo Perspectives, Simon and Schuster 1968.
17. Hoyle, Fred, *The New Face of Science*, Perspectives in Humanism, World Publishing Co. 1971
18. Kramer, Edna E., *The Nature and Growth of Modern Mathematics*, Fawcett Permier Books, 1974
19. Kuhn, Thomas S., *The Structure of Scientific Revolutions*, University of Chicago Press 1970
20. Layzer, David, 'The Arrow of Time', *Scientific American*, December 1975
21. Levinson, Harry, *The Exceptiona1 Executive*, Mentor Books 1971
22. Maltz, Maxwell, *Psycho-Cybernetics*, Wilshire Book Co. 1971
23. Nagel, Ernest and Newman, James R., *Gödel's Proof*, New York U. Press 1958
24. Osborne, Alex F., *Applied Imagination*, Scribners and Sons 1963
25. Pearce, Joseph Chilton, *The Crack in the Cosmic Egg*, Pocket Book 1975
26. Pearce, Joseph Chilton, *Exploring the Crack in the Cosmic Egg*, Pocket Book 1975
27. Piaget, Jean, *Structuralism*, Harper Torchbooks 1971
28. Polanyi, Michael, *Knowing and Being*, University of Chicago Press 1969
29. Singh, Jagjit, *Great Ideas of Modern Mathematics: Their Nature and Use*, Dover 1959
30. Skinner, B.F., *Beyond Freedom and Dignity*, Bantam/Vintage Books 1972
31. Thompson, William Irwin, *At the Edge of History*, Harper Colophon Books 1972
32. Thompson, William Irwin, *Evil and World Order*, World Perspective, Harper and Row 1976
33. Tse-Tung, Mao, *Four Essays on China and World Communism*, Lancer Books 1972
34. Waismann, Friedrich, *Introduction to Mathematical Thinking*, Harper Torchbooks 1959
35. Watts, Alan, *The Book*, Vintage Books 1972
36. Yukawa, Bideki, *Creativity and Intuition*, Kodansha International LTD 1973

ANNEX B: BIBLIOGRAPHY OF *PATTERNS OF CONFLICT*

Adcock, F.E., "The Greek and Macedonian Art of War", 1957
Alger, John I., "The Quest for Victory", 1982
Asprey, Robert B., "Guerrilla Warfare" (Encyclopedia Britannica -EB), 1972
Asprey, Robert B., "Tactics"(EB), 1972
Asprey, Robert B., "War in the Shadows" (two volumes), 1975
Atkinson, Alexander, "Social Order and the General Theory of Strategy", 1981
Axelrod, Robert, "The Evolution of Cooperation", 1984
Balck, William, "The Development of Tactics", 1922
Baldwin, Hanson W., "Tiger Jack", 1979
Barnett, Correlli, "Bonaparte", 1978
Barron, John, "KGB: The Secret Work of Sovjet Secret Agents", 1974
Bateson, Gregory, "Mind and Nature", 1979
Bayerlein, Fritz, "With the Panzers in Russia 1941 & 43" (Marine Corps Gazette), December 1954
Beaufre, Andre, "An Introduction to Strategy", 1965
Beaufre, Andre, "Strategy of Action", 1967
Becker, Ernest, "The Structure of Evil", 1968
Beesley, Patrick, "Room 40", 1982
Beesley, Patrick, "Very Special Intelligence", 1977
Betts, Richard K., "Surprise Attack", 1982
Bioom, Allan, "The Closing of the American Mind", 1987
Blumentritt, Glunther "Experience Gained from the History of War on the Subject of Command Technique", 27 January 1947
Blumentritt, Gunther "Operations in Darkness and Smoke", 1952
Bretnor, Reginald, "Decisive Warfare", 1969
Briggs, John, and Peat; F. David, "Looking Glass Universe", 1984
Bronowski, J., "A Sense of the Future", 1977
Bronowski, J., "The Identity of Man", 1971
Brown, Anthony Cave, "Bodyguard of Lies", 1975
Brownlow, Donald Grey, "Panzer Baron", 1975
Brzezinski, Zbigniew, "Game Plan", 1986
Callendar, H.L, and Andrews, D.H., "Heat, Entropy and Information" (EB), 1972
Calvocoressi, Peter, "Top Secret Ultra", 1980
Campbell, Jeremy, "Grammatical Man", 1982
Capra, Fritjof, "The Tao of Physics", 1976
Carver, Michael, "The Apostles of Mobility", 1979
Chaliand, Gerard (editor), "Guerrilla Strategies", 1982
Chambers, James, "The Devil's Horsemen", 1979
Chandler, David G., "The Campaigns of Napoleon", 1966
Cincinnatus, "Self-Destruction", 1981
Clausewitz, Carl von, "On War" (translated by M. Howard and P. Paret, 1976), 1832
Clausewitz, Carl von, "Principles of War" (translated by Hans W. Gatske, 1942), 1812
Clausewitz, Carl von, "War, Politics and Power" (translated by Edward M. Collins" 1962)
Cline, Ray S., "Secrets, Spies and Scholars", 1976
Clutterbuck, Richard, "Guerrillas and Terrorists", 1977

Cole, K.C. , "Sympathetic Vibrations", 1984
Colin, Jean, "The Transformations of War", 1912
Conway, James, "Mr. Secret Weapon" (Washington Post Magazine), 15 May 1982
Cooper, Matthew, "The German Army 1933-1945", 1978
Corbett, Julian S., "Some Principles of Maritime Strategy", 1911
Cruickshank, Charles, "Deception in World War II", 1979
Daniel, Donald, and Herbig, Katherine L., "Strategic Military Deception", 1982
Davies, W.J.K., "German Army Handbook 1932-1945", 1973
Gardner, Martin, "The Computer as Scientist" (Discover), June 1983
Georgescu-Roegen, Nicholas, "The Entropy law and the Economic Process", 1970
Gleick, James, "Exploring the Labyrinth of the Mind" (New York Times Magazine), 21 August 1983
Golenan, Daniel, "Vital lies, Simple Truths", 1985
Goodenough, Simon and Deighton, Len, "Tactical Genius in Battle", 1979
Gribbin, John, "In Search of Schrödinger's Cat", 1984
Griffith, Paddy, "Forward into Battle", 1981
Grigg, John, "1943 The Victory That Never Was", 1980
Guderian, Heinz, "Panzer leader", 1952
Guevara, Che, "Guerrilla Warfare", 1961
Hall, Edward T., "Beyond Culture", 1976
Handel, Michael I., "Clausewitz in the Age of Technology" (The Journal of Strategic Studies), June/Sept 1981
Handel, Michael I., "The Yom Kippur War and the Inevitability of Surpris" (International Studies Quarterly), September 1977
Heibroner, Robert L., "Marxism: For and Against", 1980
Herrington, Stuart A., "Silence Was a Weapon", 1982
Hoffer, Eric, "The True Believer", 1951
Holmes, W.J., "Double-Edged Secrets", 1979
Howard, Michael, "The Causes of Wars", 1983
Hoyt, Edwin P., "Guerilla", 1981
Humble, Richard, "Hitler's Generals", 1974
Irving, David, "The Trail of the Fox", 1977
Isby, David C., "Modern Infantry Tactics, 1914-74" (Strategy and Tactics), Sept/Oct 1974
Jomini, "Summary of the Art of War" (edited by J.D. Hittie, 1947), 1838
Jomini, "The Art of War" (translated by G.H. Mendell and W.P. Craigbill, 1862), 1836
Jones, R.V., "Intelligence and Deception" (lecture), 29 November 1979
Jones, Roger, "Physics As Metaphor", 1982
Kahn, David, "Hitler's Spies", 1978
Kahn, David, "The Codebreakers", 1967
Karnow, Stanley, "In Vietnam, the Enemy Was Right Beside Us" (Washington Star), 22 March 1981
Karnow, Stanley, "Vietnam: A History", 1983
Keegan, John, "The Face of Battle", 1977
Kennedy, Marilyn Moats, "Powerbase: How to Build It; How to Keep It", 1984
Kesselring, Albert, et al, "Manual for Command and Combat Employment of Smaller Units" (Based on German, World War II), 1952
Kitson, Frank, "Low Intensity Operations", 1971
Kohn, Hans and Hazard, John N., "Communism", 1972
Krepinevich, Andrew F. Jr., "The Army and Vietnam", 1986
Lamb, Harold, "Genghis Khan", 1927
Landauer, Carl, "Marxism" , 1972
Lanza, Conrad H., "Napoleon and Modern War, His Military Maxims", 1943
Laqueur, Walter, "Guerrilla", 1976
Laqueur, Walter (editor), "The Guerrilla Reader", 1977
Lawrence, T.E., "Seven Pillars of Wisdom", 1935
Layzer, David, "The Arrow of Time" (Scientific American), December 1975

LeBoeuf, Michael, "GMP, The Greatest Management Principle in the World", 1985
Leonard, George, "The Silent Pulse", 1978
Lewin, Ronald, "Ultra Goes to War", 1978
Liddell, Hart, B.H., "A Science of Infantry Tactics Simplified", 1926
Liddell, Hart, B.H., "History of the Second World War" (two volumes), 1970
Liddell, Hart, B.H., "Strategy", 1967
Liddell, Hart, B.H., "The Future of Infantry", 1933
Liddell, Hart, B.H., "The German Generals Talk", 1948
Liddell, Hart, B.H., "The Ghost of Napoleon", 1934
Lorenz, Konrad, "Behind the Mirror" (translated by Ronald Taylor, 1977), 1973
Lupfer, Timothy T., "The Dynamics of Doctrine: The Changes in German Tactical Doctrine During the First World War" (Leavenworth Papers #4), July 1981
Macksey, Kenneth, "Guderian: Creator of the Blitzkrieg", 1976
Macksey, Kenneth, "Panzer Division", 1968
Manstein, Erich von, "Lost Victories", 1958
Mao Tse- Tung, "Selected Military Writings", 1963
Mao Tse-Tung, "Four Essays on China and World Communism", 1972
Mao Tse-Tung "Basic Tactics" (translated by Stuart R. Schramm 1966), 1938
Mao Tse-Tung, "On Guerrilla Warfare", (translated by S.B. Griffith, 1961), 1937
Marchetti, Victor and Marks, John, "The CIA and the Cult of Intelligence", 1974/1980
Marshall, S.L.A., "Men Against Fire", 1947
Marshall, S.L.A., "The Soldiers Load and The Mobility of a Nation", 1950
Martin, David C., "Wilderness of Mirrors", 1980
Masterman, John C., "The Double-Cross System", 1972
Matloff, Maurice, "Strategy" (EB), 1972
May, Rollo, "The Courage to Create", 1975/1976
McWhiney, Grady and Jamieson, Perry D., "Attack and Die", 1982
Mellenthin, F.W. von, "Panzer Battles", 1956
Mellenthin, F.W. von, "Armored Warfare in World War II" (conference), 10 May 1979
Mellenthin, F.W. von, "German Generals of World War II", 1977
Mendel, Arthur P. (editor), "Essential Works of Marxism", 1961
Messenger, Charles, "The Blitzkrieg Story", 1976
Mikheyev, Dmitry, "A Model of Soviet Mentality" (Presentation before International Studies Association), March 1985
Miksche, F.O., "Blitzkrieg", 1941
Miksche, F.O., "Atomic Weapons & Armies", 1955
Milier, Russeli, "The Commandos" (Time-Life Books), 1981
Montross, Lynn, "War Through the Ages", 1960
Morris, Eric; Johnson, Curt; Chant, Christopher; Wilmott, H.P., "Weapons and Warfare of the 20th Century", 1976.
Musashi, Miyamoto, "The Book of Five Rings" (translated by Victor Harris, 1974), 1645
Musashi, Miyamoto, "The Book of Five Rings" (translated by Nihon Services, 1982), 1645
Oman, C.W.C., "The Art of War in the Middle Ages" (edited and revised by John H. Feeler, 1953), 1885
Ortega y Gasset, Jose, "The Revolt of the Masses" (anonymous translation, 1932), 1930
Ouchi, William, "Theory Z", 1981
Pagels, Heinz R., "The Cosmic Code", 1982
Palmer, Bruce Jr., "The 25 Year War", 1984
Pascale, Richard T. and Athos, Anthony G., "The Art of Japanese Management", 1981
Patrick, Stephen B., "Combined Arms Combat Operations in the 20th Century" (Strategy and Tactics), Sept/Oct 1974.
Pauker, Cry J., "Insurgency" (EB), 1972
Peters, Thomas J. and Waterman, Robert H., Jr., "In Search of Excellence", 1982
Phillips, T.R. (editor), "Roots of Strategy", 1940/1985

Pike, Douglas, "PAVN: Peoples Army of Vietnam", 1986
Pincher, Chapman, "Their Trade is Treachery", 1982
Polanyi, Michael, "Knowing and Being", 1969
Pomeroy, William J. (editor), "Guerrilla Warfare and Marxism", 1968
Powers, Thomas, "The Man Who Kept the Secrets", 1979
Prigogine, Ilya and Stengers, Isabelle, "Order Out of Chaos", 1984
Pustay, John S., "Counterinsurgency Warfare", 1965
Reid, T.R., "Birth of a New Idea" (Washington Post Outlook), 25 July 1982
Rejai, M., "Mao Tse-Tung On Revolution and War", 1976
Restak, Richard M., "The Brain: The Last Frontier", 1980
Rifkin, Jeremy with Ted Howard, "Entropy -A New World View", 1980
Rommel, Erwin, "Infantry Attacks" (translated by G.E. Kidde, 1944), 1937
Rosen, Ismond, "Genesis", 1974
Rothenberg, Gunther E., "The Art of Warfare in the Age of Napoleon", 1978
Rucker, Rudy, "Infinity and the Mind", 1982
Rushbrooke, George Stanley, "Statistical Mechanics" (EB), 1972
Russell, Francis, "The Secret War" (Time Life Books), 1981
Satter, David, "Soviet Threat is One of Ideas More Than Arms" (Wall Street Journal), 23 May 1983
Savkin, V. YE., "The Basic Principles of Operational Art and Tactics" (A Soviet View), 1972
Sella, Amnon, "Barbarossa: Surprise Attack and Communication" (Journal of Contemporary History), 1978
Senger und Etterlin, Frido von, "Neither Fear Nor Hope", 1963
Shannon, Claude E., "Information Theory" (EB), 1972
Sidney, Hugh, "Playing an Assassin Like a Fish" (Washington Star), 14 June 1981
Sidorenko, A.A., "The Offensive" (A Soviet View), 1970
Singh, Baljitt & Mei, Ko-Wang, "Modern Guerrilla Warfare", 1971
Sprey, P.M., "Taped Conversation with General Hermann Balck" (for Battle), 12 January and 13 April 1979
Sprey, P.M., "Taped Conversation with Lt. General Heinz Gaedcke", (for Battle), 12 Apri/1979
Stevenson, William, "A Man Called Intrepid", 1976
Strausz-Hupe; Robert; Kintner, William R.; Dougherty, James E.; Cottrell, Alvin J., "Protracted Conflict", 1959/1963
Summers, Harry G. Jr., "On Strategy: The Vietnam War in Context", 1981
Sun Tzu, "The Art of War" (Edited by James Clavell, 1983), about 500 B.C.
Sun Tzu, "The Art of War" (translated by S.B. Griffith, 1971), about 400 B.C.
Taber, Robert, "The War of the Flea", 1965
Tang Zi-Chang, "Principles of Conflict" (Recompilation of Sun Li's Art of War), 1969
Thayer, Charles W., "Guerrilla", 1961
Thompson, R.W., "D-Day", 1968
Thompson, William Irwin, "Darkness and Scattered Light", 1978
Toffler, Alvin, "Future Shock", 1970
Van Creveld, Martin, "Command", 1982
Van Creveld, Martin, "Fighting Power: German Military Performance, 1914-1945", December 1980
Van Creveld, Martin, "Supplying War", 1977
Vigor, P.H., "Soviet Blitzkrieg Theory" (A British View), 1983
Vo Nguyen Giap, "How We Won the War", 1976
Vo Nguyen Giap, "Peoples War Peoples Array", 1962
Wallace, Mike, "Inside Yesterday: Target USA" (for CBS News), 21 August 1979
Watts, Alan, "Tao: The Watercourse Way", 1975
Wernick, Robert, "Blitzkrieg" (Time-Life Books), 1976
Whiting, Charles, "Patton", 1970
Wilson, Edward O., "On Human Nature", 1978
Winterbotham, F.W., "The Ultra Secret", 1975
Wintringham, Tom, "The Story of Weapons and Tactics", 1943

Wolf, Eric R., "Peasant Wars of the Twentieth Century", 1969
Wolf, Fred Alan, "Taking the Quantum Leap", 1981
Wylie, J.C., "Military Strategy", 1967
Wynne, G.C., "If Germany Attacks", 1940
Zukav, Gary, "The Dancing Wu Li Masters", 1979

Sources by Institution

BDM "Generals Balck and Van Mellinthin on Tactics: Implications for Military Doctrine", 19 December 1980
German Army Regulation 100/100 "Command and Control in Battle", September 1973
German Army Regulation 100/200 "Army Command and Control System", August 1972
National Defense University "The Art and Practice of Military Strategy", 1984
ORD/CIA, "Deception Maxims: Fact and Folklore", April 1980
U.S. Army FM 110-5 "Operations", July 1976
U.S. Army FM 100-5 "Operations", 20 August 1982
U.S. Army FM 100-5 "Operations", 5 May 1986
U.S. Army Pamphlet 20-233 "German Defense Tactics Against Russian Breakthroughs", October 1951
U.S. Army Pamphlet 20-269 "Small Unit Actions During the German Campaign in Russia", July 1953
Westinghouse "I Am the Punishment of God" (Westinghouse integrated Logistic Support #5)
West Point Department of Military Art and Engineering, "Jomini, Clausewitz and Schlieffen", 1954
West Point Department of Military Art and Engineering, "Summaries of Selected Military Campaigns", 1956

BIBLIOGRAPHY

Adams, Thomas K.: 'The Real Military Revolution'*, Parameters,* Autumn 2000.

Addington, Larry, H.: *The Patterns of War Since the Eighteenth Century*, Indiana University Press, Bloomington, second edition, 1994.

Alberts, David S., and Thomas J. Czerwinski: *Complexity, Global Politics, and National Security,* National Defence University Press, Washington, D.C., 1998.

Alberts, David S., John J. Gartska, Richard E. Hayes, and David A Signori: *Understanding Information Age Warfare,* CCRP Publication Series, US Department of Defense, Washington D.C., August 2001.

Alberts, David S., John J. Gartska, Frederick P.: *Network Centric Warfare, Developing and Leveraging Information Superiority,* 2nd Revised Edition, CCRP Publication Series, US Department of Defense, Washington D.C., July 2002.

Alberts, David: *Information Age Transformation, Getting to a 21st Century Military*, CCRP, Washington, D.C., June 2002.

Alberts, David S., and Richard E. Hayes: *Power to the Edge, Command and Control in the Information Age,* CCRP Publication Series, US Department of Defense, Washington D.C., June 2003.

Allardice, Robert R.: *One Half a Revolution in Orientation, implications for Decision Making*, Maxwell AFB, Alabama, 1998.

Allison, Graham: *The Essence of Decision,* Harvard, 1971.

Allison, Graham, and Philip Zelikov: *The Essence of Decision*, 2d edition, New York, 1999.

Ames, Roger (transl): *Sun Tzu, The Art of Warfare*, Ballantine Books, New York, 1993.

Argyris, Chris, and Donald Schon: *Organizational Learning: A Theory of Action Perspective*, Addison-Wesley, Reading, Mass, 1978.

Arquilla, John and David Ronfeldt: 'Cyberwar is Coming', *Comparative Strategy*, Vol 12, no.2.(1993).

Arquilla, John and David Ronfeldt: 'Emerging Modes of Conflict', *Comparative Strategy,* vol. 12, no.4. (1993).

Arquilla, John and David Ronfeldt: *Swarming and the Future of Conflict*, RAND, Santa Monica, 2000.

Arquilla, John and David Ronfledt (eds): *In Athena's Camp, Preparing for Conflict in the Information Age*, RAND, Santa Monica, 1997.

Arreguin-Toft, I.: 'How the Weak Win; A Theory of Asymmetric Conflict', *International Security,* Vol. 26, No.1, 2001, pp. 93-128.

Arthur, Brian: 'Positive Feedback in the Economy', *Scientific American* (February, 1990).

Atkeson, Edward: 'The Operational Level of War', *Military Review*, March 1987, pp. 28-36

Avant, Deborah: *Political Institutions and Military Change,* Cornell University Press, Ithaca (1994).

Bak, Per, and Kan Chen in 'Self-Organized Criticality:, *Scientific American*, January 1991.

Barlow, Jason B. (Maj.): *Strategic Paralysis, An Airpower Theory for the Present,* Maxwell AFB, Alabama, May 1992.

Bartolomasi, Paolo: 'The Realities and Challenges for Concepts and Capabilities in Joint Manoeuvre', *RUSI Journal*, August 2000.
Bassford, Christopher: 'John Keegan and the Grand Tradition of Trashing Clausewitz', *War and History*, Volume 1, No.3 (November 1994).
Bateson, Gregory: *Mind and Nature, A Necessary Unity*, Hampton Press, Cresskill, New Jersey, 2002.
Baylis, John, Ken Booth, John Garnett and Phil Williams: *Contemporary Strategy, Theories and Policies*, New York, 1975.
Beagle, T. W. (Maj.): *Effects-Based Targeting: Another Empty Promise?,* Air University Press, Maxwell AFB, June 2000.
Beaufre, André: *An Introduction to Strategy,* London, 1963.
Beaumont, Roger: *War, Chaos and History*, Westport, CT, USA, 1994.
Beaumont, Roger: 'On the Wehrmacht Mystique', *Military Review*, January 1981, pp. 44-56.
Beck, Ulrich, Anthony Giddens, Scott Lash: *Reflexive Modernization*, Stanford, 1994.
Beckerman, Linda P. Dr.: *The Non-Linear Dynamics of War,* SAIC, 1999, at *www.belisarius.com/modern_business_strategy/beckerman/non_linear.htm.*
Beinhocker, Eric D.: 'Robust Adaptive Strategies', *Sloan Management Review,* Spring 1999, pp. 95-106;
Bernstein, Steven, Richard Ned Lebow, Janice Gross Stein, Steven Weber: 'God Gave Physics the Easy Problems: Adapting Social Science to an Unpredictable World', *European Journal of International Relations*, Vol.6(1).
Bertalanffy, Ludwig von: *General Systems Theory*, 2nd edition, New York, 1968.
Best, Steven, and Douglas Kellner: *The Postmodern Turn*, the Guildford Press, New York, 1997.
Betts, Richard K.: 'Is Strategy an Illusion?', *International Security*, Vol. 25, No.2 (Fall 2000)
Beyerchen, Alan D.: 'Clausewitz, Nonlinearity and the Unpredictability of War', *International Security,* 17:3 (Winter, 1992), pp. 59-90.
Biddle, Stephen: 'The Past as Prologue: Assessing Theories of Future Warfare', *Security Studies,* 8, no.1, 1998.
Bieler, Andreas, and Adam David Morton: 'The Gordion Knot of Agency-Structure in International Relations: a Neo-Gramscian Perspective', *European Journal of International Relations,* Vol.7 (1).
Bobbit, Phillip: *The Shield of Achilles*, Penguin, London, 2002.
Booth, Bradford, Meyer Kestnbaum, and David R. Segal: 'Are Post-Cold War Militaries Postmodern?', *Armed Forces & Society*, Vol.27, No.3, Spring 2001,
Booth, Ken: 'The Evolution of Strategic Thinking', in John Baylis, Ken Booth, John Garnett and Phil Williams, *Contemporary Strategy, Theories and Policies*, New York ,1975.
Borodzicz, Edward and Kees van Haperen: 'Individual and Group Learning in Crisis Simulations', *Journal of Contingencies and Crisis Management*, Volume 10, No. 3, September 2002.
Boyd, John: *A New Conception of Air to Air Combat*, unpublished presentation, 1976.
Boyd, John: *Destruction and Creation,* unpublished essay, 1976.
Boyd, John: *Patterns of Conflict*, unpublished presentation, draft version, 1982.
Boyd, John: *The Strategic Game of ?and ?,* unpublished presentation, 1987.
Boyd, John: *Organic Design for Command and Control,* unpublished presentation, 1987.
Boyd, John: *The Conceptual Spiral,* unpublished presentation, 1992.
Boyd, John: *The Essence of Winning and Losing,* unpublished presentation, 1995.
Boyd, John: *The Personal Papers of Colonel John Boyd, Part II*, electronic version, at *www.belisarius.com.*

Boyer, Peter, J.: 'The New War Machine', *The New Yorker*, June 30, 2003.
Braam, A van: *Filosofie van de Bestuurswetenschappen*, College Uitgevers, Amersfoort, 1992.
Brandon, Robert, and Alex Rosenberg: 'Philosophy of Biology', in Peter Clark and Katherine Hawley, *Philosophy of Science Today*, Oxford University Press, Oxford, 2003.
British Defence Doctrine, Joint Warfare Publication 0-01, Her Brittanic Majesty's Stationary Office, London, 1997.
Brodie, Bernard: *War and Politics*, MacMillan, New York , 1973.
Brodie, Bernard: 'The Continuing Relevance of *On War*', in Clausewitz, *On War,* 1976.
Brodie, Bernard: 'Strategy as an Art and a Science', *Naval War College Review,* Winter 1998, Vol. LI, No.1.
Jacob Bronowski: *The Identity of Man*, (1964) Prometheus Books edition, New York, 2002.
Brown, Shona L., and Kathleen M. Eisenhardt: *Competing on the Edge, Strategy as Structured Chaos,* Harvard Business School Press, Boston, 1998.
Burk, James: *The Military in New Times*, Westview Press, Boulder, Co.1994.
Burton, J.W.: *Systems, States, Diplomacy and Rules*, Cambridge University Press, (Cambridge, 1968)
Buzan, Barry, and Richard Little: *International Systems in World History*, Oxford University Press, (Oxford, 2000).
Byeon, Jong Heon: 'Non-Equilibrium Thermodynamic Approach to the Change in Political Systems', *Systems Research and Behavioral Science*, 16, (1999).
Byman, Daniel, Kenneth Polak and Matthew Waxman: 'Coercing Saddam Hussein: Lessons from the Past', *Survival,* vol. 40, no.3, 1998.
Byman, Daniel, and Matthew Waxmann: *The Dynamics of Coercion, American Foreign Policy and the Limits of Military Might*, Cambridge University Press, 2002.
Byrne, David: *Complexity Theory and the Social Sciences, An Introduction*, Routledge, London (1998).
Capra, Fritjof: *The Turning Point*, Bantam Books, New York, 1982.
Capra, Fritjof: *The Tao of Physics: An Exploration of the Parallels Between Modern Physics and Eastern Mysticism*, 3rd edition, Shambala, Boston, 1991.
Capra, Fritjof: *The Web of Life, A New Understanding of Living Systems*, New York , 1996.
Castells, Manuel: *The Information Society*, Oxford, Blackwell, 1989.
Casti, John: *Complexification: Explaining a Paradoxical World through the Science of Surprise*, New York, 1994.
Cebrowksi, Arthur, and John J. Gartska: 'Network Centric Warfare: It's Origin and Future', *Proceedings of the Naval Institute*, 124:1 (January 1998): 28-35.
Cebrowski, Arthur: 'Presidents notes', *Naval War College Review*, Autumn, 1999.
Chairman of Joint Chiefs of Staff, US Department of Defense: *Joint Vision 2010*, Washington DC, 1996.
Chalmers, Alan: *What is this thing called Science?*, 3rd Edition, Cambridge, 1999.
Chandler, David: *The Campaigns of Napoleon,* New York, 1966.
Church, Michael: 'Organizing Simply for Complexity: Beyond Metaphor Towards Theory', *Long Range Planning*, Vol.32, No.4, 1999, pp.425-440.
Cilliers, Paul: *Complexity and Postmodernism*, Routledge, London, 1998.
Cimbala, Stephen J.: *Clausewitz and Chaos, Friction in War and Military Policy*, Preager, Westport, Connecticut, 2001.
Clark, Peter, and Katherine Hawley: *Philosophy of Science Today*, Oxford University Press, Oxford (2003).
Clausewitz, Karl von: *On War,* trans. Michael Howard and Peter Paret, Princeton, NJ, 1976,
Cohen, Eliot: 'A Revolution in Warfare', *Foreign Affairs,*75, 2, (1996).

Cohen, William S.: *Report of the Quadrennial Defense Review,* Washington, D.C., U.S. Defense Department, 1997.
Coker, Christopher: 'Post-modernity and the end of the Cold War: has war been disinvented?', *Review of International Studies*, 1992, Vol. 18.
Coker, Christopher: *Humane Warfare*, Routlegde, London, 2001.
Coker, Christopher: *Waging War Without Warriors, The Changing Culture of Military Conflict,* IISS, London, 2002.
Coleman, Henry: 'What Enables Self-Organizing Behavior in Businesses', *Emergence*, Volume 1, issue 1.
Conant, James Bryant: *Two Modes of Thought*, Trident Press, New York (1964).
Coon, Dennis: *Essentials of Psychology*, seventh edition, Brookes/Cole, Pacific Grove, Ca, 1997.
Cooper, Robert: *The Post-Modern State*, London, 1995.
Copeland, Dale, C.: 'The Constructivist Challenge to Structural Realism', *International Security,* Vol.25, No.2 (Fall 2000), pp. 187-212.
Coram, Robert: *Boyd, The Fighter Pilot Who Changed the Art of War*, Little Brown and Company, Boston, 2002.
Corbett, Julian S.: *Some Principles of Maritime Strategy*, Annapolis, Maryland: Naval Institute Press, 1988.
Coroalles, Anthony: 'Maneuver to Win: A Realistic Alternative', *Military Review*, September 1981, p.35.
Coveney, Peter, and Roger Highfield: *Frontiers of Complexity, The Search for Order in a Chaotic World*, Ballantibe Books, New York, (1996).
Coveney, Peter, and Roger Highfield: *The Arrow of Time,* Flamingo, London, 1991.
Cowan, Jeffrey: *From Fighter pilot to Marine Corps Warfighting*, electronic version*, www.defence-and-society.org/FCS_Folder/boyd_thesis.htm*, on 14 Aug 2000.
Crane, Conrad, C.: *Avoiding Vietnam: The US Army's Response to Defeat in Southeast Asia,* Strategic Studies Institute, US Army Carlisle Barracks, September 2002.
Creveld, Martin van: *Command in War*, Harvard, 1986.
Creveld, Martin van: *The Transformation of War,* New York, 1991.
Croft, Stuart, and Terry Terriff (ed): *Critical Reflections on Security and Change*, London, 2000.
Czerwinski, Thomas, J.: 'Command and Control at the Crossroads'*, Parameters*, Autumn 1996.
Czerwinski, Thomas, J.: *Coping with the Bounds, Speculations on Nonlinearity in Military Affairs,* National Defence University Press, Washington, D.C., 1999.
Daalder, Ivo, and Michael O'Hanlon: *Winning Ugly, NATO's War to Save Kosovo,* Brookings, Washington, D.C., 2000.
Dachev, Alex: 'Liddell Hart's Big Idea', *Review of International Studies* (1999), 25, pp.29-48.
Dahl, Arden: *Command Dysfunction, Minding the Cognitive War*, Maxwell AFB, Alabama, May, 1998.
Dandeker, Christopher: 'A Farewell to Arms? The Military and the Nation-State in a Changing World', in James Burk, *The Military in New Times*, Westview Press, Boulder, Co.1994.
Dark, K.R.: *The Waves of Time*, (London, 1998)
Davies, Paul: *God and the New Physics*, Penguin Books (1990).
Dawkins, Richard: *The Selfish Gene*, Oxford University Press, Oxford, (paperback edition 1989).
Dennet, Daniel, C.: *Darwin's Dangerous Idea, Evolution and the Meaning of Life*, Touchstone, New York, 1996.
Dent, Eric, B.: 'Complexity Science: A Worldview Shift', *Emergence*, Vol. 1, issue 4 (1999).

Department of Defense: *Field Manual 100-5, Operations,* Washington DC, Department of the Army, 1982.
Department of Defense: *Marine Corps Doctrinal Publication 1, Warfighting*, Washington D.C., 1997.
Department of Defense: *Report to Congress on NCW*, CCRP, Washington, D.C., July 2001.
Deptula, David A.: *Effects-Based Operations: Change in the Nature of Warfare,* Aerospace Education Foundation, Washington, D.C., at *www.aef.org/pub/psbook.pdf* .
Desch, Michael C.: 'Culture Clash, Assessing the Importance of Ideas in Security Studies', *International Security*, Vol. 23, No.1 (Summer 1998).
Deutsch, David: *The Fabric of Reality*, Penguin Books, London (1998).
Downing, Wayne A.: 'Firepower, Attrition, Maneuver, US Army Doctrine: A Challenge for the 1980s and Beyond', *Military Review*, January 1981, pp. 64-73.
Duffield, John: 'Political Culture and State Behavior, Why Germany Confounds Realism', *International Organization*, 53, 4, Autumn 1999.
Dunlap, C.J.: 'Technology: Recomplicating Moral Life for the Nation's Defender's ', *Parameters,* Autumn, 1999.
Durham, Susanne E.: *Chaos Theory For The Practical Military Mind,* Maxwell AFB, March 1997.
Echevarria II, Antulio J.: 'Auftragstaktik: in its Proper Perspective', *Military Review*, October 1986, pp. 50-56.
Echevarria II, Antulio J.: *After Clausewitz, German Military Thinkers Before the First World War,* University Press of Kansas, 2000.
Echevarria II, Antulio J.: "'Reining in" the Center of Gravity Concept'*, Air & Space Power Journal*, Summer 2003.
Eisenhardt, Kathleen, and Donald N. Sull: 'Strategy as Simple Rules', *Harvard Business Review*, January 2001.
Evan Ellis, R..: 'Organizational Learning Dominance, The Emerging Key to Success in the New Era of Warfare', *Comparative Strategy,* 18, 1999.
Eve, Raymond, et al (ed): *Chaos, Complexity and Sociology, Myths, Models and Theories*, Sage Publications, Thousand Oaks, Ca, (1997).
Faber, Peter (Lt. Col.): *Competing Theories of Airpower: A Language for Analysis,* Aerospace Power Chronicles, at *www.airpower.au.af.mil/airchronicles/presentation/faber.html.*
Faber, Peter: 'The Evolution of Airpower Theory in the United States', in John Olson (ed), *Asymmetric Warfare,* Royal Norwegian Air Force Academy, Oslo, 2002.
Fadok, David S.: *John Boyd an John Warden, Air Power's Quest for Strategic Paralysis,* Maxwell AFB, Alabama, February 1995.
Fadok, David, S.: *John Boyd and John Warden: Air Power's Quest for Strategic Paralysis*, in *The Paths to Heaven*, ed. by Col. Phillip Meilinger, Maxwell AFB, Alabama, 1997.
Fallows, James: *National Defense*, Random House, New York, 1981.
Farrell, Theo: 'Constructivist Security Studies: Portrait of a Research Program', *International Studies Review*, 4/1 (2002): 49-72.
Felker, Edward J. (Lt. Col.): *Airpower, Chaos and Infrastructure, Lords of the Rings,* Maxwell Paper No. 14, Maxwell AFB, Alabama, July 1998.
Fischerkeller, Michael: 'David Versus Goliath: Cultural Judgements in Asymmetric Wars', *Security Studies*, 7, no.4 (Sumer 1998).
Fodor, Jerry: 'The Trouble with Psychological Darwinism' in *London Review of Books*, Vol.20,. no.2, 22 January 1998.
Freedman, Lawrence: 'The First Two Generations of Nuclear Strategists', in Peter Paret (ed), *Makers of Modern Strategy*, Princeton, NJ, 1986.
Freedman, Lawrence: 'The Third World War?', *Survival,* vol.43, no.4, Winter 2001-02.

Fukuyama, Francis: *The Great Disruption, Human Nature and the Reconstitution of Social Order,* Free Press, New York, 1999.
Fuller, J.F.C.: *The Foundations of the Science of War* (London: Hutchinson and Company, 1925).
Fuller, J.F.C.: *The Conduct of War, 1789-1961*, (1961), Da Capo Press edition, New Brunswick, NJ., 1992.
Fuller, Steve: 'Being There with Thomas Kuhn: A Parable for Postmodern Times', *History and Theory*, October 1992, Vol.31, Issue 3.
Gardner, Howard: *The Quest for Mind, Piaget, Lévi-Strauss and the Structuralism Movement*, second edition, University of Chicago Press, Chicago, (1972, 1981).
Gardner, Howard: *The Mind's New Science*, *A History of the Cognitive Revolution*, Basic Books, New York, 1985.
Gareev, Makhmut (edited by Jacob W. Kipp): *If War Comes Tomorrow, The Contours of Future Armed Conflic,* Frank Cass, London, 1998.
Garnett, John C.: *Commonsense and the Theory of International Politics*, London, 1984.

Garwin, David A.: *Learning in Action*, Harvard Business School Press, Boston, Ma., 2000.
Gat, Azar: *The Origins of Military Thought,* Oxford, 1989.
Gat, Azar: *The Development of Military Thought: The Nineteenth Century*, Clarendon Press, Oxford, 1992.
Gat, Azar: *Fascist and Liberal Visions of War, Fuller, Liddell Hart, Douhet, and other Modernists*, Clarendon Press, Oxford, 1998.
Gat, Azar: *A History of Military Thought, From the Enlightenment to the Cold War*, Oxford University Press, Oxford, 2001.
Gat, Azar: 'Isolationism, Appeasement, Containment, and Limited War: Western Strategic Policy from the Modern to the "Postmodern" Era', in Zeev Maoz and Azar Gat (ed), *War in a Changing World*, The University of Michigan Press, Ann Arbor, 2001.
Geertz, Clifford: *The Interpretation of Cultures,* Basic Books, New York, 1973.
Geller, Daniel, S., and J.David Singer: *Nations at War,* Cambridge 1998.
Gell-Mann, Murray: 'The Complex Adaptive Business', *Perspective on Business Innovation*, Cap Gemini Ernst & Young Journal, Issue 1, p.75-76.
Gell-Mann, Murray: *The Quark and the Jaguar, Adventures in the Simple and the Complex*, Freeman & Company, New York, 1994, pp.17-25.
George, Alexander: 'Forword' in Miroslav Nincic and Joseph Lepgold (ed), *Being useful, Policy Relevance and International Relations Theory,* Ann Arbor, 2000.
George, Alexander: *Bridging the Gap, Theory and Practice in Foreign Policy*, United States Institute of Peace Press, Washington DC, 1993.
Ghysczy, Tiha von, Bolko von Oetinger and Christopher Bassford: *Clausewitz on Strategy*, John Wiley & Sons, New York, 2001.
Giddens, Anthony: 'Living in a Post-Traditional Society', in Ulrich Beck, Anthony Giddens, Scott Lash, *Reflexive Modernization*, Stanford, 1994.
Giddens, Anthony: *The Consequences of Modernity,* Stanford, 1990.
Giddens, Anthony: *The Constitution of Society,* Cambridge, 1984,
Gjertsen, Derek: *Science and Philosophy, Past and Present*, Penguin Books, London, 1989.
Gleick, James: *Chaos, Making a New Science,* Penguin Books, New York, 1987.
Glenn, Kevin B.: *"Complex" Targeting: A Complexity-Based Theory of Targeting and its Application to Radical Islamic Terrorism*, Maxwell AFB, Alabama, June 2002.
Goemans, H.E.: *War and Punishment, The Causes of War Termination & the First World War*, Princeton, New Jersey, 2000.

Gompert, David, Richard Kugler and Martin Libicki: *Mind the Gap, Promoting a Transatlantic Revolution in Military Affairs*, National Defence University Press, Washington, D.C. ,1997.
Gray, Colin: 'Strategy in the Nuclear Age', in Williamson Murray, MacGregor Knox and Alvin Bernstein, *The Making of Strategy, Rulers, States, and War*, Cambridge University Press, Cambridge, 1994.
Gray, Colin: *Explorations in Strategy*, Greenwood Press, Westport Connecticut, 1996.
Gray, Colin: *Modern Strategy*, Oxford, 1999.
Gray, Colin: *Weapons for Strategic Effect, How Important is Technology?,* Maxwell Air Force Base, Alabama, January 2001.
Green, Kenyon B.: 'Field Theoretic Framework for the Interpretation of the Evolution, Instability, Structural Change, and Management of Complex Systems', in L. Douglas Kiel and Euel Eliot (ed), *Chaos Theory in the Social Sciences*, University of Michigan Press, Ann Arbor, 1997.
Grush, Rick: 'Cognitive Science', in Machamer, Peter, and Michael Silberstein, *The Blackwell Guide to the Philosophy of Science*, Blackwell Publishers, Oxford, 2002.
Guzzini, Stafano: 'A Reconstruction of Constructivism in International Relations', *European Journal of International Relations,* Vol. 6(2).
Hables Gray, Chris: *Postmodern War, the New Politics of Conflict*, Routledge, London, 1997.
Halberstam, David: *War in a Time of Peace, Bush, Clinton and the Generals*, Scribner, New York, 2001,
Hall, Edward T: *Beyond Culture*, Anchor Books, New York, 1977.
Hall, Stuart, David Held and Tony McGrew: *Modernity and its Futures*, Polity Press, Blackwells, Oxford, 1992.
Hallion, Richard: *Air Power Confronts An Unstable World*, London, 1997.
Hallion, Richard: *Storm over Iraq, Air Power and the Gulf War*, Smithsonian Institution Press, Washington DC, 1992.
Ham, Peter van: *European Integration and the Postmodern Condition*, Routlegde, London, 2001.
Hamilton, Mark: 'Maneuver Warfare and All That', *Military Review*, January 1987, p.3.
Hammond, Grant T.: *The Essential Boyd*, unpublished paper, at *www.belisarius.com.*
Hammond, Grant, T.: *The Mind of War, John Boyd and American Security*, Smithsonian Institution Press, Washington, D.C., 2001.
Heilbroner, Robert: *An Inquiry into The Human Prospect*, W.W. Norton & Company, New York, 1974.
Heisenberg, Werner: *Physics and Philosophy: The Revolution in Modern Science*, (1962) Penguin, London, 1990.
Henderson, Errol, A, and J. David Singer: "'New Wars" and rumours of "New War'", *International Interactions,* 28:2002.
Henley, Lonnie D.: 'The RMA After Next', *Parameters,* Winter 1999-2000.
Holland, John: *Hidden Order, How Adaptation Builds Complexity*, Perseus Books, Reading, Massechussetts, 1995.
Holsti, Kalevi J.: *The State, War, and the State of War*, Cambridge University Press, Cambridge, 1996.
Hopf, Ted: 'The Promise of Constructivism in International Relations Theory', *International Security,* Vol.23, No.1 (Summer 1998).
Horgan, John: *The End of Science*, Broadway Books, New York, 1996.
Howard, Michael: 'The Influence of Clausewitz', in Karl von Clausewitz, *On War*, Princeton, NJ. 1976.

Hughes, Daniel: 'Abuses of German Military History', *Military Review*, December 1986, pp. 66-76.
Hughes, Thomas: 'The Cult of the Quick', *Air Power Journal,* Vol XV, no. 4, Winter 2001.
Ignatieff, Michael, *Virtual War: Kosovo and Beyond*, London, 2000.
International Institute for Strategic Studies: *Strategic Review 2001/2002,* Oxford University Press, London, 2002.
Jablonsky, David: *Roots of Strategy, Book 4,* Stackpole Books, Mechanicsburg, Pa, 1999.
James, Glenn, E.: *Chaos Theory: The Essentials for Military Applications*, Naval War College, Newport R.I., 21 February 1995.
Janis, Irvin: *Crucial Decisions*, New York, 1988.
Janis, Irving L., and Leon Mann: *Decision Making,* New York, 1977.
Jantsch, Erich: *The Self-Organizing Universe, Scientific and Human Implications of the Emerging Paradigm of Evolution*, Pergamon Press, Oxford, 1980.
Jarvis, Darryl: 'Postmodernism: A Critical Typology', *Politics and Society*, Vol.26, No.1, March 1998.
Jencks, Charles: *Post-Modernism, the New Classicism in Art and Architecture*, Academy Editions, London, 1987.
Jervis, Robert: 'Complexity and the analysis of Political and Social Life', *Political Science Quarterly*, Volume 112, Number 4 (1997-1998)
Jervis, Robert: *Perception and Misperception in International Politics,* Princeton, 1976.
Jervis, Robert: *System Effects, Complexity in Political and Social life*, Princeton University Press, Princeton, New Jersey, 1997.
Johnson, Stuart and Martin Libicki: *New Challenges, New Tools for Defense Decisionmaking,* RAND, Santa Monica, 2003.
Johnsson, David E., Mueller, Karl, P.Taft V, William: *Conventional Coercion Across the Spectrum of Conventional Operations: The Utility of U. S. Military Forces in the Emerging Security Environment,* RAND, Santa Monica, 2002.
Johnston, Alastair Iain: *Cultural Realism, Strategic Culture and Grand Strategy in Chinese History*, Princeton University Press, Princeton, New Yersey, 1995.
Johnston, Paul: 'Doctrine is not Enough: the Effect of Doctrine on the Behavior of Armies', *Parameters*, Autumn 2000.
Joint Chiefs of Staff: *Joint Vision 2010*, (Washington D.C.: Department of Defense, United States Government), 1997.
Jones, Archer: 'The New FM 100-5: A View From the Ivory Tower', *Military Review*, February 1977, pp. 27-36.
Kaldor, Mary (ed).: *Global Insecurity,* London, 2000.
Kaldor, Mary: *New & Old Wars, Organized violence in a Global Era,* Cambridge, 1999.
Kaplan, Abraham: *The Conduct of Inquiry,* Chandler publishing Company, San Francisco, 1964.
Katzenstein, Peter J., and Nobuo Okawara: 'Japan, Asian-Pacific Security, and the Case for Analytic Eclecticism', *International Security*, Vol.26.No.3 (Winter 2001/02).
Katzenstein, Peter, (ed): *The Culture of National Security,Norms and Identity in World Politics,* New York, 1996.
Kauffman, Stuart: *The Origins of Order, Self-Organization and Selection in Evolution*, Oxford University Press, Oxford, (1993).
Kauffman, Stuart: *At Home in the Universe, The Search for the Laws of Complexity*, Penguin Books, London, 1995.
Kelly, Susanne, and May Ann Allison: *The Complexity Advantage, How the Sciences Can Help Your Business Achieve Peak Performance,* New York, 1999.

Khalizad, Zalmay M., and John P. White (eds): *Strategic Appraisal: The Changing Role of Information in Warfare*, RAND, Santa Monica, 1999.
Kiel, L.Douglas and Euel Elliott (ed): *Chaos Theory in the Social Sciences, Foundations and Applications*, The University of Michigan Press, Ann Arbor, (1996).
Kier, Elizabeth: 'Culture and French Military Doctrine Before World War II', in Peter Katzenstein (ed), *The Culture of National Security, Norms and Identity in World Politics*, Columbia University Press, New York, 1996.
Killion, Thomas, H.: 'Decision Making and the Levels of War, *Military Review*, November-December 2000.
Kimminau, Jon: *The Psychology of Coercion: Merging Airpower and Prospect Theory*, , Maxwell AFB, Alabama, June 1998.
King, Gary, Robert Keohane, Sidney Verba: *Designing Social Inquiry,* Princeton, NJ, 1994.
Klein, Bradley: *Strategic Studies and World Order: The Global Politics of Deterrence,* Cambridge, 1994.
Klein, Gary: 'Strategies of Decision Making', *Military Review*, May 1989.
Klein, Gary: *Sources of Power, How People Make Decisions*, MIT Press, Cambridge, Ma, 1999.
Knox, MacGregor, and Williamson Murray: *The Dynamics of Military Revolution 1300-2050*, Cambridge, 2001.
Kober, Avi: 'Nomology vs Historicism: Formative Factors in Modern Military Thought', *Defense Analysis,* Vol. 10, No. 3, 1994.
Koertge, Noretta: 'New Age Philosophies of Science: Constructivism, Feminism and Postmodernism', in Peter Clark and Katherina Hawley, *Philosophy of Science Today*, Clarendon Press, Oxford, 2000.
Krause, Keith, and Micheal Williams (ed): *Critical Security Studies, Concepts and Cases,* London, 1997.
Kreighbaum, Jay M. (Maj.): *Force Application Planning: A System-and-Effects-Based Approach,* Maxwell AFB, Alabama, June 1998.
Krepinevich, Andrew: 'From Cavalry to Computer', *The National Interest*, no 37, Fall 1994.
Krepinevich, Andrew: *The Army and Vietnam*, Johns Hopkins University Press, Baltimore (1986).
Krulak, C.C.: 'Obituary', *Inside the Pentagon,* 13 March 1997,
Kuhn, Thomas: *The Structure of Scientific Revolutions*, Chicago, 1970.
Kulman, Jurgen, and Jean Callaghan (eds): *Military and Society in 21st Century Europe*, George C. Marshall Center for Security Studies, Garmisch-Partenkirchen, 2000.
Laqueur, Walter: 'Postmodern Terrorism', *Foreign Affairs*, September/October 1996.
Lambert, Andrew: 'Shattering Impact: The Psychology of Air Attack', in Richard Hallion, *Air Power Confronts An Unstable World*, London, 1997.
Lambeth, Benjamin: *The Transformation of American Air Power,* RAND, Santa Monica, 2000.
Laszlo, Ervin: *The Systems View of the World, A Holistic Vision of Our Time,* Hampton Press, 1996.
Laszlo, Ervin: 'The Contribution of the System Sciences to the Humanities', *Systems Research and Behavioral Sciences*, Vol.14, No.1, 1997.
Latham, Andrew: 'A Braudelian Perspective on the Revolution in Military Affairs', *European Journal of International Relations*, Vol.8(2).
Lawrence, T.E.: *The Seven Pillars of Wisdom*, Wordsworth Editions, (Ware, Hertfordshire, 1997).
Levy, Jack: 'Prospect Theory, Rational Choice, and International Relations', *International Studies Quarterly* (1997) 41.

Lewin, Roger, and Birute Regine: 'An Organic Approach to Management', *Perspective on Business Innovation*, Cap Gemini Ernst & Young Journal, Issue 4.
Liang, Qiao, and Wang Xiangsui: *Unrestricted Warfare,* Bejing, 1999.
Liddell Hart, Basil: *Strategy: The Indirect Approach,* London, 1967.
Lind, William: 'Some Doctrinal Questions for the United States Army', *Military Review*, March, 1977.
Lind, William: 'Defining Maneuver Warfare for the Marine Corps', *Marine Corps Gazette*, March 1980.
Lind, William, Keith Nightengale, John Schmitt, Joseph Sutton, G.I. Wilson: 'The Changing Face of War, Into the Fourth Generation', *Military Review*, October 1989.
Lind, William: 'The Three Levels of War, Don't Take John Boyd's Name in Vain', *Counterpunch*, May 3, 2003, electronic version, *www.counterpunch.org/lind05032003.html.*
Link, Charles: '21st Century Armed Forces – Joint Vision 2010', *Joint Forces Quarterly*, Autumn 1996.
Liotta, P. H.: 'Chaos as Strategy'*, Parameters*, Summer 2002.
Lissack, Michael: 'Complexity: the Science, its Vocabulary, and its Relation to Organizations', *Emergence,* Vol. 1, Issue 1, (1999).
Lock-Pullan, Richard: "'An Inward Looking Time": The United States Army, 1973-1976', *The Journal of Military History*, 67 (April 2003).
Luttwak, Edward: 'Blood and Computers: The Crisis of Classic Military Power in Advanced Postindustrialist Societies and the Scope of Technological Remedies', in Zeev Maoz and Azar Gat (ed), *War in a Changing World*, The University of Michigan Press, Ann Arbor, 2001.
Luttwak, Edward: *Strategy, the Logic of War and Peace*, Harvard University Press, Cambridge, Ma, 1987.
Luvaas, Jay: 'Clausewitz: Fuller and Liddell Hart', *Journal of Strategic Studies,* 9 (1986).
Luvaas, Jay: 'Military History: Is It Still Practicable?', *Parameters*, March 1995.
Lynne, John: *Battle, A History of Combat and Culture*, Westview Press, Boulder Colorado (2003).
Lyotard, Jean-Paul: *The Postmodern Condition*, University of Minnesota Press, Minneapolis, 1979 (11th printing, 1997).
Lyotard, Jean-Paul: *The Postmodern Condition: A Report on Knowledge*, Manchester, 1984.
Machamer, Peter, and Michael Silberstein: *The Blackwell Guide to the Philosophy of Science*, Blackwell Publishers, Oxford, 2002.
Malik, J. Mohan: 'The Evolution of Strategic Thought', in Graig Snyder (ed), *Contemporary Security and Strategy,* MacMillan, London, 1999.
Mann, Edward, III, Gary Endersby and Tom Searle: *Thinking Effects, Effects-Based Methodology for Joint Operations,* Maxwell AFB, CADRE Papers No. 15, October 2002.
Mann, Edward (Col., Ret.), Gary Endersby, and Tom Searle: 'Dominant Effects: Effects-Based Joint Operations', *Aerospace Power Journal*, Fall 2001.
Mann, Steven R.: 'Chaos Theory and Strategic Thought', *Parameters*, Autumn 1992.
Manwaring, Max, G.: *Internal Wars: Rethinking Problem and Response*, Strategic Studies Institute, Carlisle Barracks, September 2001.
Maoz, Zeev, and Azar Gat (ed): *War in a Changing World*, The University of Michigan Press, Ann Arbor, 2001.
March, James G., and Johan P.Olson: 'The Uncertainty of the Past: Organizational Learning Under Ambiguity', *European Journal of Political Research*, 3 (1975).
Marshall, Andrew, Testimony before the senate Armed Services Committee, subcommittee on Acquisition and Technology, 5 May 1995.

Mayr, Ernst: *The Growth of Biological Thought*, Harvard University Press, Cambridge, Ma, 1982.
McCrabb, Maris Dr.: *Uncertainty, Expeditionary Air Force and Effects-Based Operations,* electronic version *www.eps.gov/EPSdata/USAF/Synopses/1142/Reference-Number-PRDA-00-06-IKFPA/*
McInnes, Colin: *Spectator- Sport Warfare, The West and Contemporary Conflict,* London, 2002,
McInnes, Collin: 'Spectator Sport Warfare', in Stuart Croft and Terry Terrif, *Critical Reflecions on Security and Change*, London, 2000.
McKercher, B.J.C., and Michael A. Henness:*, The Operational Art, Developments in the Theories of War*, Preager, Westport, 1996.
McLennan, Gregor: 'The enlightenment Project Revisited', in Stuart Hall, David Held and Tony McGrew, *Modernity and its Futures*, Polity Press, Blackwells, Oxford, 1992
McNeil, William: 'History and the Scientific Worldview', *History and Theory*, Feb. 1998, Vol 37, issue 1.
McNeil, William: 'The Changing Shape of World History', *History and Theory*, May 1995, Vo.34, Issue 2.
Mearsheimer, John: 'Back to the Future: Instability in Europe after the Cold War', *International Security*, vol. 15, no.1 (1990).
Mearsheimer, John: *Liddell Hart and the Weight of History*, Ithaca, New York, 1988.
Meilinger, Phillip, S.: 'Air Targetting Strategies: An Overview', in Richard Hallion, *Air Power Confronts An Unstable World*, London, 1997.
Meilinger, Phillip, S.: *The Paths to Heaven*, (ed)., Maxwell AFB, Alabama, 1997.
Merry, Uri: *Coping with Uncertainty, Insights from the New Sciences of Chaos, Self-organization and Complexity,* Westport, Connecticut, 1995.
Mets, David R.: *The Air Campaign, John Warden and the Classical Airpower Theorists,* Revised Edition, Air University Press, Maxwell AFB, April 1999.
Mets, David R.: 'Boydmania, Review Essay', *Air & Space Power Journal*, September 2005.
Metz, Steven: *Armed Conflict in the 21st Century: The Information Revolution and Post-Modern Warfare*, Strategic Studies Institute, Carlisle Barracks, April 2000.
Metz, Steven: 'The Next Twist of the RMA', *Parameters,* Autumn, 2000.
Metz, Steven: 'Strategic Asymmetry', *Military Review,* July-August 2001.
Militaire Doctrine, Sdu Uitgevers, Den Haag, 1996.
Mintzberg, H, Ahlstrand, B., Lampel, J.: *Strategy Safari, A Guided Tour Through the Wilds of Strategic Management,* The Free Press, 1998.
Monod, Jacques, *Chance and Necessity*, Alfred A. Knopf, New York, 1971.
Montuori, Alfonso: 'Editors Introduction', in Gregory Bateson, *Mind and Nature, A Necessary Unity*, Hampton Press, Cresskill, New Jersey (2002).
Morgan, Forrest: *Compellence and the strategic Culture of Imperial Japan*, Unpublished Dissertation, University of Maryland, 1998.
Morgan, Gareth: *Images of Organization*, Sage, New York, 1986.
Morgan, Patrick: 'The Impact of the Revolution in Military Affairs', *Journal of Strategic Studies,* March 2000.
Morton, Adam:, 'The Theory of Knowledge: Saving Epistemology from the Epistemologists', in Peter Clark and Katherina Hawley, *Philosophy of Science Today*, Clarendon Press, Oxford, 2000.
Moskos, Charles C., and James Burk: 'The Postmodern Military', in James Burk, *The Military in New Times*, Westview Press, Boulder, Co., 1994.
Moskos, Charles C., John Allen Williams, David R. Segal (eds): *The Postmodern Military, Armed Forces after the Cold War*, Oxford University Press, Oxford, 2000.

Murdock, Paul, 'Principles of War on the Network-Centric Battlefield: Mass and Economy of Force', *Parameters*, Spring 2002.
Murray, Williamson, and Mark Grimsley, 'Introduction: On Strategy', in Murray, MacGregor Knox, and Alvin Bernstein (eds.), *The Making of Strategy: Rulers, States, and War,* Cambridge, 1994.
Murray, Williamson, and Allan R. Millett, *Military Innovation in the Interwar Period,* Cambridge, 1996.
Murray, Williamson, MacGregor Knox and Alvin Bernstein, *The Making of Strategy, Rulers, States, and War*, Cambridge University Press, Cambridge (1994).
Murray, Williamson, and MacGregor Knox, 'Conclusion, the future behind us', in MacGregor Knox and Williamson Murray, *The Dynamics of Military Revolution, 1300-2050*, Cambridge University Press, 2001.
Mutimer, David, 'Beyond Strategy: Critical Thinking and the New Security Studies', in Craig Snyder, *Contemporary Security and Strategy*, London, 1999.
Naveh, Shimon, *In Pursuit of Excellence, The Evolution of Operational Theory*, Frank Cass, London, 1997,
Nicholls, David, and Todor Tagarev: 'What Does Chaos Theory Mean for Warfare?', *Aerospace Power Journal*, Fall 1994.
Nicolis, G.: *Introduction to Non-linear Science*, Cambridge University Press, Cambridge, 1995.
Nincic, Miroslav, and Joseph Lepgold (ed): *Being useful, Policy Relevance and International Relations Theory,* Ann Arbor, 2000.
Novlin David, and Ronald Stupak: *War as an Instrument of Policy*, Oxford, 1998.
O'Connor, Joseph, and Ian McDermott: *The Art of Systems Thinking*, Thorsons, San Fransisco, 1997.
O'Dowd, Edward, and Arthur Waldron: 'Sun Tzu for Strategists', *Comparative Strategy*,Volume 10, 1991.
Olvey, Lee, D., Henry A. Leonard and Bruce E. Arlinghaus: *Industrial Capacity and Defense Planning,* Lexington Books, Lexngton, Massechussets, 1983.
Oseth, John M.: 'FM 100-5 Revisited: A Need for Better "foundations Concepts"?', *Military Review*, March 1980.
Osinga, Frans: 'Asymmetric Warfare; Rediscovering the Essence of Strategy', in John Olson (ed), *Asymmetric Warfare*, Oslo, 2002.
Osinga, Frans: 'Airpower in het postmoderne tijdperk', *Militaire Spectator*, JRG 172, 6-2003.
Osinga, Frans: 'Netwerkend de oorlog in? Network Centric Warfare en de Europese militaire transformatie', Deel I*, Militaire Spectator*, JRG 172, 7/8-2003.
Osinga, Frans: 'Netwerkend de oorlog in? NCW als product van de revolutie', Deel II*, Militaire Spectator*, JRG 172, 9-2003.
Osinga, Frans: 'Netwerkend de oorlog in? Network Centric Warfare als twistpunt', Deel III, *Militaire Spectator*, JRG 173, 1-2004.
Pagels, Heinz: *The Cosmic Code, Quantum Physics as the Language of Nature*, Simon and Schuster, New York, 1982.
Paret, Peter: *Clausewitz and the State,* New York, 1976.
Pascale, Richard: 'Surfing the Edge of Chaos', *Sloan Management Review*, spring 1999.
Peat, F. David: *From Certainty to Uncertainty, the Story of Science and Ideas in the Twentieth Century*, Joseph Henry Press, Washington, D.C., 2002.
Pellegrini, Robert P.: *The Links Between Science and Philosophy and Military Theory, Understanding the Past; Implications for the Future,* Maxwell AFB, Alabama, June, 1995.
Pentland, Pat A.: *Center of Gravity Analysis and Chaos Theory,* Maxwell AFB, Alabama, April 1993.

Perlmutter, Amos: 'Carl von Clausewitz, Enlightement Philosopher: A Comparative Analysis', *The Journal of Strategic Studies,* Volume 11, March 1988, number 12.
Peters, Ralph: 'The New Warrior Class', *Parameters,* Summer 1994.
Peters, Ralph: *The Culture of Future Conflict,* US Army War College Quarterly, Winter 1995-96.
Pfaff, Charles A.: Chaos, 'Complexity and the Battlefield'*, Military Review*, July-August 2000.
Piaget, Jean: *Structuralism*, London, Routledge and Kegan Paul (1971).
Pinker, Steven: *How the Mind Works*, Norton & Company, New York, 1997.
Plehn, Micheal T.: '*Control Warfare: Inside The OODA Loop*', Maxwell AFB, Alabama, June, 2000.
Polanyi, Michael: *Knowing and Being,* Routledge and Kegan Paul, London, 1969.
Polk, Robert: 'A Critique of the Boyd Theory-Is it Relevant to the Army', *Defence Analysis*, Vol. 16, No.3, 2000.
Popper, Karl: *Objective Knowledge,* Oxford University Press, Oxford, 1972.
Popper, Karl: *The Logic of Scientific Discovery*, New York, 1968.
Popper, Karl: 'Evolutionary Epistemology', in David Miller (ed): *A Pocket Popper*, Fontana, Oxford, 1983.
Posen, Barry, R.: 'The War for Kosovo; Serbia's Political-Military Strategy', *International Security,* Vol. 24, No. 4, 2000.
Posen, Barry, R.: *The Sources of Military Doctrine, France, Britain, and Germany Between the World Wars,* Cornell University Press, Ithaca, 1984.
Powe, Marc B.: 'The US Army After The Fall of Vietnam', *Military Review*, February 1976.
Prigogine, Ilya, and Isabella Stengers, *Order out of Chaos*, London, 1984.
Progogine, Ilya, *The End of Certainty*, The Free Press, New York, 1996.
Regner, Patrick: 'Complexity and Multiple Rationalities in Strategy Processes', in Henk W. Volberda and Tom Elfring, *Rethinking Strategy*, Sage Publications, London, 2001.
Reiter, Dan: *Crucible of Beliefs, Learning, Alliances and World Wars*, Cornell University Press, Ithaca, 1996.
Richards, Diana: 'From Individuals to Groups: The Aggregation of Votes', in L. Douglas Kiel and Elliott, Euel, (ed), *Chaos Theory in the Social Sciences, Foundations and Applications*, The University of Michigan Press, Ann Arbor, 1996.
Richardson, William: 'FM 100-5, The AirLandBattle in 1986', *Military Review*, March 1986.
Richardson, Kurt, A., Graham Mathieson, and Paul Cilliers: 'The Theory and Practice of Complexity Science: Epistemological Considerations for Military Operational Analysis'*, SysteMexico*, 1 (2000).
Rifkin, Jeremy: *Entropy, A New World View*, The Viking Press, New York, 1980.
Rifkin, Jeremy: *Time Wars, The Primary Conflict in Human History,* Henry Holt & Co, New York 1987.
Rinaldi, Stephen: 'Complexity Theory and Air Power; a new paradigm for air power in the 21th century', *Complexity, Global Politics and National Security*, NDU press, electronic version, *www.ndu.edu/ndu/inss/books/complexity/ch10a.html.*
Rinaldi, Steven M.: *Beyond the Industrial Web, Economic Synergies and Targeting Methodologies,* Maxwell AFB, Alabama, April 1995.
Ritzer, George: *The Blackwell Companion to Major Contemporary Social Theorists*, Blackwell Publishing, Oxford, 2003.
Rosati, Jerel A.: 'The power of human cognition in the study of world politics', *International Studies Review,* Volume 2:3, 2000.
Rosen, Stephen Peter: *Winning the Next War, Innovation and the Modern Military*, Cornell University Press, Ithaca, 1991.

Rosenau, James, N.: 'Many Damn Things Simultaneously: Complexity Theory and World Affairs', in Davids and Czwerinski (1997).
Rosenau, James, N.: *The Scientific Study of Foreign Policy,* 2nd edition, New York, 1980.
Rosenau, James, N.: *Turbulence in World Politics*, Harvester Wheatsheaf, New York, 1990.
Rosenau, James, Vincent Davis, Maurice East: *The Analysis of International Politics*, New York, 1972.
Rosenau, Pauline: *Post-Modernism and the Social Sciences,* Princeton, 1992.
Ross Ashby, W.: *An Introduction to Cybernetics*, John Wiley & Sons, New York, 1956.
Russ, Marion and Josh Bacon: 'Organizational Extinction and Complex Systems', *Emergence*, Vol. 1, issue 4, (2000).
Russett, Bruce, and Harvey Starr: *World Politics, A Menu for Choice,* San Fransico, 1981.
Russo, J.Edward and Paul J.H. Schoemaker: *Winning Decisions*, Doubleday, New York, 2002.
Sanders, Irene: *Strategic Thinking and the New Science*, The Free Press, New York, 1998.
Sandole, Dennis, J.D.: *Capturing the Complexity of Conflict*, Pinter Books, London, 1999.
Saperstein, Alvin, 'Chaos- A Model for the Outbreak of War', *Nature* 309.
Saperstein, Alvin: 'The Prediction of Unpredictability: Applications of the New Paradigm of Chaos in Dynamical Systems to the Old Problem of the Stability of a System of Hostile Nations', L. Douglas Kiel and Elliott, Euel, (ed), *Chaos Theory in the Social Sciences, Foundations and Applications*, The University of Michigan Press, Ann Arbor, 1996.
Sawyer, Ralph, D.(transl): *Sun Tzu, the Art of War,* Barnes and nobles, New York, 1994.
Sawyer, Ralph, D.(transl): *The Seven Military Classics of Ancient China*, Westview Press, Boulder, Co., 1993.
Scales, R.H.: 'Adaptive Enemies: Dealing With the Strategic Threat after 2010', *Strategic Review,* vol.27, no.1, 1999.
Schmitt, John: 'Command and (Out of) Control: The Military Implications of Complexity Theory', in David Alberts and Thomas Czerwinski, *Complexity, Global Politics and National Security,* CCRP, Washington D.C., 1997.
Schneider, Barry, and Lawrence E. Grinter: *Battlefield of the Future,* Maxwell AFB, Alabama, 1998.
Senge, Peter: *The Fifth Discipline, The Art and Practice of The Learning Organization*, Doubleday, London, 1992.
Shaw, Martin: 'The Development of "Common-Risk" Society: A Theoretical View', in Jurgen Kulman and Jean Callaghan (eds), *Military and Society in 21st Century Europe*, George C. Marshall Center for Security Studies, Garmisch-Partenkirchen, 2000.
Shermer, Michael: 'Exorcising Laplace's Demon: Chaos and Antichaos, History and Metahistory', *History and Theory,* February 1995, vol 34, issue 1.
Shy, John: 'Jomini' in Peter Paret, *Makers of Modern Strategy*, Princeton, NJ, 1986.
Singer, J.D.: 'Theorists and Empiricists: The Two Culture Problem in International Politics', in James Rosenau, Vincent Davis, Maurice East, *The Analysis of International Politics*, New York, 1972.
Skinner, B.F.: *Beyond Freedom and Dignity*, Jonathan Cape, London, 1972.
Smith, Edward. A.: *Effects Based Operations, Applying Network Centric Warfare in Peace, Crisis, and War,* CCRP Publication Series, US Department of Defense, Washington D.C., available from *www.ccrp.org/publications.*
Smith, Hugh: 'The womb of war: Clausewitz and international politics', *Review of International Studies,* (1990), 16.

Smith, Steve: 'The Increasing Insecurity of Security Studies: Conceptualizing Security in the Last Twenty Years', in Stuart Croft and Terry Terriff (ed), *Critical Reflections on Security and Change*, London, 2000.
Snyder, Graig, (ed): *Contemporary Security and Strategy,* MacMillan, London, 1999.
Spender, J.-C.: 'Business Policy and Strategy as a Professional Field', in Henk W. Volberda and Tom Elfring, *Rethinking Strategy*, Sage Publications, London, 2001.
Starry, Donn, A.: 'Tactical Evolution – FM 100-5', *Military Review*, August 1978.
Steblin, Mark E.: *Targeting for Effects: Is There an Iceberg Ahead? Air War College,* Maxwell AFB, Alabama, April 1997.
Stein, George: 'Information Warfare', *Air Power Journal*, No.1, (Spring 1995).
Steinbrunner, John, D.: *The CyberneticTheory of Decision*, Princeton University Press, Princeton, New Jersey, 1974.
Stillman, Todd: 'Introduction: Metatheorizing Contemporary Social Theorists', in George Ritzer, *The Blackwell Companion to Major Contemporary Social Theorists*, Blackwell Publishing, Oxford, 2003.
Stinchcombe, Arthur, L.: *Information and Organizations*, Berkeley, 1990.
Storr, Jim: 'Neither Art Nor Science- Towards a Discipline of Warfare', *RUSI Journal*, April 2001.
Sullivan, Gordon, R., and James M. Dublik: 'War in the Information Age', *Military Review*, April 1994.
Sullivan, Mark P.: *The Mechanism for Strategic Coercion, Denial or Second Order Change?* Maxwell AFB, Alabama, April 1995.
Sumida, Jon Tetsuro: *Inventing Grand Strategy and Teaching Command*, The Woodrow Wilson Center Press, Washington, D.C., 1997.
Swain, Richard M.: 'Filling the Void: The Operational Art and the US Army', in B.J.C. McKercher and Michael A. Hennessy*, The Operational Art, Developments in the Theories of War*, Preager, Westport, 1996.
Tanner, Jason B., Walter E. Lavrinovich, and Scott R. Hall: 'Looking at Warfare Through a New Lens', *Marine Corps Gazette*, Vol. 82, Iss.9, September 1998.
Tetlock, Phillip, et al: *Behavior, Society and Nuclear War,* Oxford, 1989,
Thomas, Troy, et al: 'Expeditionary Air Force Leaders, Cognitive Skills for the Naturalistic Battlespace', Maxwell AFB, February 2001, *www.airpower.maxwell.af.mil/airchronicles/cc/stratton.html*.
Thompson, Kenneth: 'Social Pluralism and Post-Modernity', in Stuart Hall, David Held and Tony McGrew, *Modernity and its Futures*, Polity Press, Blackwells, Oxford, 1992.
Toffler, Alvin and Heidi: *War and Anti-War, Survival at the Dawn of the 21st Century,* New York, 1993.
Trigg, Roger: *Understanding Social Science*, second edition, Blackwell Publishers, Oxford, 2001.
Tversky, Amos, and Daniel Kahneman: 'Prospect Theory: an analysis of Decision under Risk', *Econometrica,* 47:2 (March 1979).
Vertzberger, Yaakov: *Risk Taking and Decision Making,* Stanford University Press, 1998.
Vincent, Gary, A.: 'In the Loop, Superiority in Command and Control', *Airpower Journal*, Summer 1992.
Vincent, Gary, A: 'A New Approach to Command and Control, the Cybernetic Design', *Airpower Journal,* Summer 1993.
Volberda, Henk W. and Tom Elfring: *Rethinking Strategy*, Sage Publications, London, 2001.
Waldrop, Mitchell: *Complexity: The Emerging Science at the Edge of Order and Chaos*, Viking, London , 1993.

Walt, Stephen M.: 'Rigor or Rigor Mortis?, Rational Choice and Security Studies', *International Security,* Vol. 23, No 4 (Spring 1999)
Walt, Stephen M.: 'The Search for a Science of Strategy', *International Security,* Summer 1987, Vol 12, no.1.
Walton, C. Dale: 'The Strategist in Context: Culture, the Development of Strategic Thought, and the Pursuit of Timeless Truth', *Comparative Strategy*, 23, 2004.
Warden, John, 'The Enemy as a System'*, Airpower Journal,* Spring, 1995.
Wass de Czege, H, and L.D. Holder: 'The New FM 100-5', *Military Review*, July 1982.
Wass de Czege, H.: 'How to Change an Army', *Military Review,* November 1984.
Watson, Peter: *A Terrible Beauty, The People and Ideas that Shaped the Modern Mind,* Phoenix Press, London, 2000.
Watts, Barry: *Clausewitzian Friction and Future War,* Institute for National Strategic Studies, NDU, Washington D. C., McNair Paper 52, October 1996 (Revised July 2000).
Watts, Barry: *The Foundations of US Air Doctrine, the Problem of Friction in War*, Air University Press, Maxwell AFB, Alabama, 1984.
Weighley, Russell F.: *The American Way of War, A History of United States Military Strategy and Policy,* MacMillan Publishing Co, New York 1973.
Wendt, Alexander: 'Constructing International Politics', *International Security*, 20, No.1 (1995).
Wendt, Alexander: 'Anarchy is what states make of it: The social construction of power politics', *International Organization*, 46.
Wendt, Alexander: *Social Theory of International Politics,* Cambridge, 1999.
Williams, Phil: 'United States Defence Policy', in John Baylis, et al, *Contemporary Strategy*, Holmes and Meier Publishers, New York, 1975.
Woodmansee, John: 'Blitzkrieg and the AirlandBattle', *Military Review*, August 1984.
Woodward, Jim: 'Explanation', in Peter Machamer and Michael Silberstein, *The Blackwell Guide to the Philosophy of Science*, Blackwell Publishers, Oxford, 2002.
Worrall, John: 'Philosophy of Science: Classical Debates, Standard Problems, Future Prospects', in Peter Machamer and Michael Silberstein, *The Blackwell Guide to the Philosophy of Science*, Blackwell Publishers, Oxford, 2002.
Wright,Quincy: *The Study of International Relations*, New York, 1955.
Wylie, J.C.: *Military Strategy: A General Theory of Power Control,* Rutgers University Press, New Brunswick, NJ.
Zimm, Alan: 'A Causal Model of Warfare', *Military Review*, January-february 2001.

CURRICULUM VITAE

Frans Osinga was born on February 8 1963 in Leeuwarden, the Netherlands. He attended secondary education at the Christelijke Lyceum in Veenendaal. He graduated from the Royal Netherlands Military Academy in 1986. After pilot training in the US he was posted to various F-16 squadrons, including a tour as instructor pilot. In 1996 he completed the Advanced Staff Course of the Netherlands Defence College. In 1998-1999 he attended the School of Advanced Airpower Studies for a post-graduate course on strategy and air power, following which he became head of the Airpower Studies Department of the Netherlands Defence College. He completed his dissertation while seconded to the Clingendael Institute of International Relations as a senior research fellow.

His publications and lectures cover a range of topics such as European defence policy, NATO's changing ambitions, asymmetric warfare, the revolution in Military affairs, military transformation, analysis of operations Enduring Freedom and Iraqi Freedom, the transatlantic relationship, (bio)terrorism, and modern strategic theory. His work has appeared in French, Norwegian and Dutch publications. He also appeared on Dutch national tv channels as a military analist during the aftermath of 9/11, and during Operation Enduring Freedom and during Operation Iraqi Freedom.