Multiple interdependencies and workgroup effectiveness

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CHAPTER ONE

Prologue

1.1 Introduction

This thesis focuses on the question how the alignment of interdependency leads to an effective level of performance in work groups or teams. For the continuance of every organization it is important to organize individuals so that their actions are aligned (the coordination problem) (Heath & Staudenmayer, 2000). In this thesis I claim that the relationship between coordination and effectiveness is still not clearly understood and lacks theoretical clarity and empirical evidence.

Few researchers have empirically studied the coordination-performance relationship (Birnbaum 1981; Cheng 1983), and these studies show mixed results, which will be described more thoroughly in chapter two. For now it is sufficient to say that past theory has not yet been able to explain the complex relationship between coordination and performance. The little empirical research on the coordination-performance relationship in organizations suggests that there is a limited understanding of this connection even though the literature highlights the importance of coordination. Gaining more knowledge about this complex relationship is especially interesting since organizations increasingly install teams, which is thought to be a more productive and effective way of organizing (Tjosvold, 1991; Katzenbach & Smith, 1993; Nijstad, 2000) yet which also require a high amount of coordination.

Of special interest in this thesis is the social aspect of coordination which, I argue, is a fundamental component of effective group coordination. To investigate the coordination-performance relationship, I unravel the concept of coordination and specifically investigate a crucial aspect of coordination, namely that which needs to be coordinated: interdependencies among the group members. The

objective of this thesis is to gain insight in the effect of coordination on performance by investigating the process of coordinating interdependencies. I extend prior research, which examines task interdependencies almost exclusively, by focusing on other interdependencies as well that exist among work group members.

The outline of this chapter is as follows. First, I will briefly introduce the different concepts of coordination and interdependencies, and identify their interrelationship. Second, I present the research question and research problems in section 1.3. This chapter ends with an outline of the thesis.

1.2 Coordination and Interdependence

Classical definitions of organizations often refer directly to coordination (e.g., Barnard, 1938; Fayol, 1947). In general, coordination in organizations refers to the alignment of individuals' actions (Heath & Staudenmayer, 2000). The need for coordination is a consequence of the division of labor; division of labor leads to specialization and concentration which is expected to result in higher productivity, efficiency, and, ultimately, competitive advantage (Adam Smith, 1776). The other side of the coin however, is that division of labor in turn causes interdependence among organizational tasks and members (March & Simon, 1957) which needs to be integrated or coordinated. In other words, coordination and interdependence are closely intertwined. This linkage is nicely worded in the definition of coordination by Malone and Crowston (1994), who define coordination as managing interdependencies between actors, goals, and activities by means of various mechanisms. I elaborate on this definition by expanding the conceptual understanding of the use of various mechanisms. Though it is widely accepted that coordination requires instruments of several kinds, there are still few attempts to build a complete theory of coordination and its mechanisms (Hatchuel, 1997). Concentrating on coordination mechanisms offers the advantage that it combines both a structural, and a process

framework, therefore, combining static and dynamic viewpoints (Hansen, 2001). Furthermore, I focus on Malone and Crowston's (1994) aspect of coordinating actors, which means that I concentrate on the interpersonal interdependencies. Most organizational literature on coordination focuses mostly on tasks and resources, often neglecting the actors who need to perform the tasks. Organizations are social entities; conglomerates of individuals occupying different jobs and positions (Simon, 1947/1997). Neglecting these actors, or taking them for granted, means that the informal or more social aspect of (the process of) coordination is ignored. Coordination mechanisms are in this thesis defined as instruments to manage interpersonal interdependencies in order to produce or create coordination.

Interdependence is in this thesis defined as a state of being in which a person is determined, influenced, or controlled by some other person (DeSanctis, Staudenmayer & Wong, 1999: p. 82). As will be explained in more detail in chapter two, my main critique on the existing organizational literature on coordination is that the main focus is on only one type of interdependence, namely interdependence that stems directly from the division of labor and is connected with the tasks and goals at hand. This thesis concentrates on three different types of interpersonal interdependencies. In addition to the type most referred to in the literature, functional interdependence (Lindenberg, 1997), I also consider cognitive (Lindenberg, 1997; Wittek, 1999), and affect-based interdependence. Interdependencies connected to the tasks and goals at hand are functional in nature (Lindenberg, 1997). Cognitive interdependence refers to the fact that people are interdependent by a common system of categories and stereotypes (shared frame of reference), and interdependence in terms of affecting each other's categorizations (Lindenberg, 1997). Affect-based interdependence refers to the fact that people are interdependent upon each other for a feeling of social well being, or social acceptance (Baumeister & Leary, 1995). These distinguished interdependency types and their interrelationships are discussed in more detail in the next chapter.

1.3 Conceptual Model and Research Questions

The central question this dissertation addresses is how coordination of interdependencies leads to the effective performance of individuals and groups. Because coordination and interdependency are so closely intertwined, and coordination is actually about the alignment of interdependence, the question becomes how the different interdependency types might affect effectiveness.

Interdependence by nature is a relational concept. Therefore I used a relational approach in studying the different interdependencies among group and team members in organizations. Moreover, this research is based on the network approach which views organizations as consisting of multiple networks through which resources flow (Tichy, 1980). Using a network theory approach allows me to study different types of interdependency more comprehensively than prior work. The network approach is based on a few important assumptions: 1) actors and their actions are viewed as interdependent, 2) relational ties between actors are channels for transfer of resources (material and/or nonmaterial), 3) network models focusing on individuals view the network structural environment as providing opportunities for or constraints on individual action, and, 4) network models conceptualize structure as lasting patterns of relations among actors (Wasserman & Faust, 1992: p. 4).

The different interdependencies this thesis considers (i.e., functional, cognitive, and affect-based interdependency) can be conceptualized in these terms as different relational contents. An interdependence relationship is a relationship between two or more individuals, in which information or other resources are exchanged. Depending on the type of interdependence, a different type of resource is transferred via that relationship. The use of a network approach not only makes it possible to conceptualize interdependencies as interpersonal relationships, but at the same time to conceptualize the coordination mechanism. Several network scholars have emphasized the relational content of the coordination concept (e.g., Zucker, 1986;

Sitkin & Roth, 1993; Uzzi, 1997). Following these authors, the structure of interdependence relationships is seen as a coordination mechanism, meaning that such a network structure serves as an instrument for managing the different interdependencies. Such a structure (i.e., coordination mechanism) might be more or less efficient and effective. In other words, I do not presume that such a structure is by definition effective. So even though the alignment of the interdependency relationships might not be the most effective, the network theory approach allows application of the concept of coordination. Furthermore, this conceptualization leaves room for the often neglected informal coordination mechanisms (cf. Larsson, 1990) and offers the possibility to study the social side of coordination as well.

The main research question this study addresses is:

Main Research Question (RQ): *How do multiple types of interdependence affect both individual and group effectiveness?*

The first issue that needs clarification is by what mechanisms interdependencies influence or determine the level of effectiveness. In order to investigate this, the first main issue this thesis addresses is how the different interdependencies affect effectiveness. Effectiveness is a multidimensional construct (Chang & Bordia, 2001; Hackman, 1987) and defined in this dissertation as encompassing performance (i.e., the goal attainment level), satisfaction, extra-role behavior, and learning-goal achievement.

RQ1: How do interdependencies influence effectiveness?

With respect to the research question, I also address the differences in levels of analysis. Are the effects of the different interdependencies the same for individual and group outcomes or not?

RQ1a: What effect do the different interdependencies have on

the effectiveness of individuals?
RQ1b: What effect do the different interdependencies have on group effectiveness?

The effect of the interdependencies on effectiveness can be investigated separately for each type. But the interdependencies coexist in organizations and are very likely to integratively influence effectiveness (Lindenberg, 1997).

RQ2: What is the integrative effect of the interdependency types on performance?

Again, both the individual as the group level will be accounted for:

RQ2a: What is the integrative effect of the interdependency types on the effectiveness of individuals?
RQ2b: What is the integrative effect of the interdependency types on group effectiveness?

In this thesis I will study how interdependency and its alignment affect individual and group outcomes in an organizational setting. Specific attention is given to the social side and the process of coordination. In the empirical chapters interdependency is studied in two departments of a railroad company, in research and development (R&D) teams, and student workgroups. The purpose of this research is to generate and test hypotheses concerning the effect of multiple interdependencies on performance. The results of this study should result in new information about the coordination-performance relationship.

1.4 Conclusion

In this chapter I introduced the research problem this thesis is concerned with. The major drive for pursuing clarity concerning the

coordination-performance relationship within organizations is the lack of attention to the social side of coordination, which is more extensively discussed in chapter two. After presenting the major constructs that are important in this thesis – coordination and interdependency - the research questions were introduced. After this introduction, this thesis continues with a detailed description of the theoretical background of the research problem in chapter 2. Not only is the relevant literature discussed in chapter 2, also the shortcomings of past research are specified from which the focus of this current research is derived.

CHAPTER TWO

Theoretical Background

2.1 Introduction

In chapter one, I already noted that in the organizational coordination literature the social side of coordination has not received the attention it deserves (for exceptions see Gittel, 2000, 2001, and 2002). The reasons why I formulated this critique are described in this chapter and I will position my research in the organizational literature and emphasize how the investigation of the social side of coordination might enhance our understanding of the coordination-performance relationship.

Section 2.2 presents a discussion of coordination in the organizational literature and its link with performance. The literature on interdependencies within organizations is discussed in section 2.3, considering both the organizational literature as well as the social-psychology literature. Insights from social psychology are beneficial for the study of interdependencies among organizational members, which the organizational literature often ignores. In section 2.4, a solution in the form of my research plan is suggested to bridge the gaps in the past research and literature. In section 2.5 of this chapter, I discuss the literature on the dependent variable of this research, which is effectiveness. This chapter ends with an overview of the thesis.

2.2 Coordination in organizations

The importance of coordination is reflected in early organizational theories where the concept is defined as being fundamental to what an organization is (Hatchuel, 1997). Barnard (1938), for example, emphasized the formal nature of coordination in his definition of an organization as a "system of consciously coordinated activities or forces of two of more persons" (1938: p.73). Coordination for Barnard (1938) includes the aspects of

communication, authority, specialization, and purpose. Simon (1947) described an administrative organization as a system of coordinated behavior. Organization members are expected to focus their behaviors on specific goals that are given as organization objectives. This leaves the problem of coordinating multiple members' behaviors – of providing each one with knowledge of the behaviors of the others upon which s/he can base her/his own decisions and behaviors (cf. Simon, 1947). Fayol (1949) thus defined coordination as those activities that connect all individual efforts and direct them toward a common objective. A more recent yet similar definition states that coordination is the management of interdependencies among actors, activities, and goals (Malone & Crowston, 1994). The mechanisms of how to obtain coordination are documented in the organizational literature and are described in the next section.

2.2.1 Mechanisms of coordination in organizations

Some of the most important contributions in the organizational design literature related to coordination within organizations are of Thompson (1967), Galbraith (1973, 1977), and Van de Ven et al. (1976), all of which focus on coordination mechanisms. Thompson (1967), building on the work of March and Simon (1958), tied different types of task interdependencies to different coordination mechanisms. He distinguished three types of interdependencies within organizations: pooled, sequential, and, reciprocal interdependence. These types are, in the given order, increasing in complexity and are thought to be additive. This means that organizations with reciprocal interdependence also experience pooled and sequential task interdependence. Pooled interdependence refers to a situation in which group members can work individually on their task, and each task contributes to the overall (group) task. This interdependence type is best (i.e., least costly in terms of communication and decision effort) coordinated by standardization (Thompson, 1967). One can think of bank employees behind a counter. The activities of these employees are standardized; they follow certain rules and procedures when

customers deposit or withdraw money.

Work processes that are arranged such that person A needs to perform her/his task because the completed task of person A is a prerequisite for person B to be able to start and perform her/his task, are typified as sequentially interdependent and should be coordinated by a plan (Thompson, 1967). A simple example of a situation in which this type of task interdependency is present is an assembly line where the end product of one worker, for example a doll, is the input for another worker's task, to paint the face of a doll. In other words, output of one worker is the input of another.

Reciprocal interdependence means that operations of group members precede and act as prerequisites to all of the other's. An example of a group or organization experiencing this type of interdependency is a string quartet (Murnighan & Conlon, 1991); they need each other to perform music. This type of interdependence is best coordinated by mutual adjustment and is the most demanding of communication and decision effort (Thompson, 1967).

In line with Thompson (1967), the simplest and least costly method of coordinating interdependent work activities, according to Van de Ven and Ferry (1980), is to specify impersonally the behaviors to be followed in advance of their execution (March and Simon, 1958). This mechanism should facilitate coordination by prespecifying tasks and the sequence in which to perform them, and at the same time decrease the amount of needed interaction (Gittel, 2002). Others have used the term 'routines' for this type of coordination mechanism (e.g., Levitt & March, 1986; Nelson & Winter, 1981). As the interdependence rises, a greater need arises for hierarchy in addition to impersonal coordination because rules, policies, and procedures have limited information-processing capacities (Galbraith, 1973). In moderate interdependence situations predictable variations are programmed through plans, schedules, and forecasts whereas exceptions are referred to higher levels of authority. Also Van de Ven, Delbecq, and Koenig (1976) classified three modes of coordinating increasing interdependent work activities: impersonal (plans and

rules), personal (vertical supervision), and group (formal and informal meetings) modes. These modes, like Thompson's (1967) classification, are appropriate in the described order for increasingly complex situations. The more tasks are interdependent, the more the use of personal, horizontal coordination modes and group coordination modes is necessary (Van de Ven et al., 1976). Although several researchers in the organizational literature have used different terms, they all seem to agree on different levels of task interdependency requiring different coordination mechanisms. In table 2.1, several examples of the various suggested coordination mechanisms are listed. The suggested coordination mechanisms in the organizational design literature are all instruments to align the interdependency that is caused by the division of labor: task (i.e., functional) interdependence. In the following sections I show that there is limited empirical evidence that the suggested coordination mechanisms do what they are supposed to do. In addition, coordinating functional interdependency while it is likely that more types of interdependence exist among organizational members is not enough to ensure effectiveness. Therefore, in this thesis I suggest two additional types of interdependence.

2.2.2 The coordination-performance relationship: empirical evidence

The division of labor is expected to lead to higher productivity and efficiency of organizations (Smith, 1776). It is therefore not a surprise, and already obvious from the definitions of organization described earlier in this chapter, that in the organizational literature on coordination the major assumption is that the better coordinated these functional interdependencies, the higher the organizational performance. The question thus is: is there empirical evidence that coordination of this type of interdependence (i.e., functional interdependence) leads to effective performance? Are the suggested mechanisms found to be effective?

Table 2.1 Several 'classic' coordination mechanisms

Author(s)	**Coordination mechanism(s)**
March & Simon (1958)	Standardization
	Planning
	Feedback
Thompson (1967)	Standardization
	Planning
	Mutual Adjustment.
Galbraith (1973)	Rules, programs & procedures
	Hierarchies of authority
	Goal setting
	Slack resources
	Self-contained structure
	Vertical information systems
	Lateral relations
Mintzberg (1979)	Mutual adjustment (individual work)
	Direct supervision
	Standardization of work
	Standardization of outputs
	Standardization of skills
	Mutual adjustment
McCann & Galbraith (1981)	Hierarchies of authority
	Rules, programs & feedback
	Interactive planning
	Spatial-physical strategies
	Lateral control

(Larsson 1992: p. 7)

Despite the previously mentioned theorizing about coordination, the assumption that coordination leads to effective performance is lacking empirical evidence (cf. Hage, 1980). After Hage's observation, some researchers did explicitly focus on the

coordination-performance relationship within organizations and tried to establish this relationship empirically. Birnbaum (1981) investigated coordination and performance in university research groups. Birnbaum's main hypothesis - that if university research group members agree on the importance of research outputs as organizational goals then high performance groups will be less integrated (coordinated) - is confirmed by the data. These findings seem to indicate that increasing the coordination in research teams may result in decreased research output. In other words, increasing coordination results in lower output levels. This finding seems to challenge the major assumption in organizational literature. However, Birnbaum (1981) does not consider the quality of coordination (i.e., how the interdependencies are managed), but instead only focuses on the amount of needed coordination and the accompanying costs. Birnbaum concludes that more coordination (i.e., coordination costs) is not associated with higher performance.

Ostensibly in contrast to Birnbaum (1981) is Cheng's (1983) study in which a positive relationship between coordination and performance was hypothesized. Cheng expected that as the level of interdependency increased, the more impact coordination has on unit output. In low interdependence situations [in which the performance of one individual is relatively independent of the performance of another worker, and each worker makes a discrete contribution to group task] the impact of coordination on organizational performance will be an additive effect of organizational members' performances. For example, Albert is baking a cake and Burt makes the icing. When both their outcomes (cake and icing) combined constitutes the end result, which in this case is a birthday cake. In high interdependence situations individuals can only perform if all or most other individuals have performed properly (for example a string quartet). In those situations, the impact of coordination on organizational performance will be a "super additive effect of organizational members' performances" (cf. Cheng, 1983: p. 158). This hypothesis received support from the data that were collected on research units. An

empirical study conducted by Lawrence and Lorsch (1976) supports the findings of Cheng (1983). These authors also found a positive relationship between coordination and organizational performance, although their study was conducted on a higher aggregation level, that is, on an organizational instead of work unit level. A year later, Cheng (1984) again studied the relationship between coordination and performance in high interdependence situations. This study clarified that in situations of high interdependence the relationship between coordination and output quality in groups is more positive than in situations with lower uncertainty levels. This finding seems to replicate the results of the 1983 study, albeit this time for the quality of the output instead of quantity.

The results of the Birnbaum (1981) and the Cheng (1983) study seemingly contradict each other. According to Birnbaum (1981), more coordination does not lead to an increase in performance. Cheng (1983, 1984) on the other hand, states that the more interdependence, the more coordination is needed, and hence, the more positive the impact coordination has on performance. In low task uncertainty situations, equivalent to research groups with little or no interdisciplinary characteristics – which are characterized by low levels of interdependence – the effect of coordination on performance is not that strong according to Cheng. Although the results of Birnbaum (1981) seem to imply otherwise, I have to stress the fact that Birnbaum was mainly interested in the costs of coordination - higher coordination costs did not lead to higher performance levels- whereas Cheng was interested in the amount of coordination[1]. It is also worth indicating that in Birnbaum's (1981) study, goal agreement is a very important variable that already implies a certain state of coordination[2]. Having said this, the studies of Birnbaum (1981) and

[1] Although it has been said that more coordination also entails more costs (e.g. Galbraith, 1973; Thompson, 1967) Cheng does not mention the costs at all in his study (1983).

[2] Agreeing on what to achieve implies that group members think about the task and the situation in a similar manner. Such similarity is one aspect of coordination (Levesque et al., 2001). See also section 2.3 (and further) on cognitive interdependence.

Cheng (1983) might not be as different as thought at first glance. Nevertheless, as Cheng (1984) and Cheng and Miller (1985) suggested, the effect of coordination on performance is not as simple or as straightforward as many analysts have believed, but is affected by several contingencies.

What characterized these early studies on the relationship between coordination and performance (Birnbaum, 1981; Cheng, 1983, 1984; Cheng & Miller, 1985) is the static perspective of coordination. Coordination is seen as a 'state' rather than a process, and furthermore, it remains a question whether or not the coordination itself was appropriate or effective given the situation. Birnbaum (1981) only mentioned the costs of coordination, whereas Cheng (1983, 1984) only talks about the (super-) additive effect of coordination. There are no clues about how the task dependencies are actually coordinated, that is, there is no attention to (the effectiveness of) the coordination mechanisms.

Are coordination mechanisms effective in the sense that they enhance performance? Given the variety of coordination mechanisms suggested in the literature, the empirical proof that they are indeed effective is surprisingly rare. According to Gittel (2002) there is no or little evidence to show that routines or standardization of work improve performance by reducing the need for interaction. But Gittel notes that there is some empirical evidence that routines work best in low task interdependency situations but the effects on performance are not explored (cf. Gittel, 2002). Researchers have established a positive association between performance and the fit between the level of task interdependence and the coordination mechanisms in use (Lawrence & Lorsch, 1976; Khandwalla, 1974). Argote (1982) found that the effectiveness of routines is decreased by increasing task interdependence, whereas Pennings (1975) found only weak proof for the performance effects of fit between the level of interdependence and coordination. For the coordination mechanisms boundary spanners (i.e., individuals whose primary task is to coordinate the activities of others) and team meetings, the empirical evidence is also

scarce (Gittel, 2002). Only the studies of Lawrence and Lorsch (1976) and Khandwalla (1974) find a correlation between the degree of task interdependence and the use of these coordination mechanisms, but whether these mechanisms are more effective in high task interdependency situations was not tested (Gittel, 2002). Gittel's (2002) own empirical study does find positive effects of all these coordination mechanisms on several performance outcomes of care provider groups. Authors have also suggested installing teams as a means of facilitating coordination in highly interdependent situations (e.g., Van de Ven et al., 1976). However, the empirical evidence of the effectiveness of using teams for the organization as a whole seems to be limited to descriptive case studies (Cohen & Ledford, 1994; Glassop, 2002; Gupta & Ash, 1994). This thesis contributes to the organizational design literature by empirically examining the effect of interdependency among group members and its alignment on individual and group outcomes.

In sum, the literature on how to obtain coordination is large but there is hardly any empirical evidence to back up the claims made by organizational theorists. Since the 1970s and 80s, little empirical research has been devoted to the coordination-performance link within organizations, exceptions being the recent work of Gittel (2000, 2002, 2004) and the studies in the area of information systems (e.g., Malone & Smith, 1988; Von Martial, 1989, Wilensky, 1983) and software development teams (e.g., Andres & Zmud, 2002; Espinosa et al., 2004). While the assumed relationship between coordination and performance perseveres and is very alluring to common sense, I believe it is understudied. This thesis therefore re-examines this relationship by taking three different interdependency types into account.

2.2.3 Criticism on coordination theory in the organizational literature

In this paragraph, I formulate several points of criticism regarding the existing empirical and theoretical explanations for coordination in organizations. I will do so, first, by focusing on the

mechanisms of coordination. What exactly do these mechanisms entail, are there weaknesses with respect to the suggested mechanisms and organizational reality? Second, I criticize the contingency perspective taken in most of the empirical studies on the coordination-performance relationship.

The various mechanisms suggested in the 'classical' organizational design literature (see also table 2.1) between the late 1950s and 1980 for coordination are almost all formal mechanisms. Formal coordination mechanisms are designed in advance by others than the actors whose actions are to be coordinated (cf. Larsson, 1990). Mainly focusing on pre-planned coordination (except feedback, mutual adjustments, and direct contacts) implies that the informal, and often more social aspect of coordination, is neglected. This might be detrimental for explaining the coordination-performance relationship, since the official blueprint, plan, or organizational chart can never completely determine the social contacts between the organizational members and in every formal organization an informal organization emerges (Blau & Scott, 1963). The accomplishments of an organization can be much more attributed to unintended or unexpected occurrences than to intentional actions (Cunha & Cunha, 2002). Furthermore, even if the task interdependencies are efficiently coordinated, problems of coordination at the social level may arise (cf. Jones, 1984).

Several scholars do mention that informal coordination can and does occur (e.g. Davis, 1967; see also table 2.2); however, they do not match the theoretical and conceptual clarity of the formal coordination mechanisms such as planning or standardization. Coordination mechanisms on the group level do consider the more social side. For example, Kiesler (1979) noted that roles and norms are coordination mechanisms within groups. Roles may establish an efficient division of labor and norms guide, for instance, interpersonal communication (cf. Kiesler, 1979). Another example is the study of Alderfer and Smith (1982) in which coordination is established via expectations. Also Thompson (1967), Van de Ven et al. (1976), and Galbraith

(1973) mention some more social, that is, interactive, coordination mechanisms such as mutual adjustment, team meetings and feedback. However, these initiatives appear to lack conceptual development compared with the formal coordination mechanisms (cf. Larsson, 1990). In other words, the missing attention to and the lack of conceptual clarity of spontaneous informal coordination are important reasons to re-investigate the coordination-performance relationship. These same reasons clearly must have inspired recent studies in which the social and informal side of coordination receive new attention (e.g., Gittel, 2000, 2002, 2004) as does the attention to the role of shared cognition in the coordination process (e.g., Levesque et al., 2000; Mohammed & Dumville, 2001; Olivera & Argote, 1999).

Gittel (2000, 2002), for example, studied the so-called relational coordination between organizational members, which refers to spontaneous coordination. Relational coordination is characterized by frequent, timely, problem solving communication, and by helping, shared goals, shared knowledge, and mutual respect (cf. Gittel, 2000: p.517). Gittel (2002) empirically established the mediating role of relational coordination between formal coordination mechanisms and several performance measures of care provider groups.

Table 2.2 Examples of social coordination mechanisms

Author(s)	Coordination mechanism(s)
Kiesler (1978):	Roles
	Norms
	Status
Cummings (1978, 1981):	Values
	Self-regulating teams
Alderfer & Smith (1982):	Expectations
Gittel (2000, 2002):	Cross-functional liaisons

This recent work by Gittel is very informative about the relationship between coordination and performance. However, more knowledge about the informal and social aspects of coordination in addition to the formal side is needed that is not provided even in this recent research. First, the concept of social coordination as Gittel defines it does not explicate interdependence and its amount among group members. Most of the described organizational theories on formal coordination mechanisms do not develop any measure for interdependence (Victor & Blackburn, 1987), instead the theories as well as the empirical studies focus on the fit between organizational structure (coordination mechanisms) and environmental characteristics (e.g., Galbraith, 1973; Gittel, 2002; Lawrence & Lorsch, 1976; Thompson, 1967; Van de Ven, et al., 1976). Contingency research in general has received much criticism, such as lack of clarity in its theoretical statements (Schoonhoven, 1981). To reflect these criticisms is beyond the scope of this thesis; however I do want to bring attention to the fact that it seems by investigating what contingencies may influence the coordination-performance relationship, the issue of interdependence is avoided. The discussed theories and empirical studies (Cheng, 1984; Galbraith, 1973; Lawrence & Lorsch, 1976) suggest that low uncertainty seems to be related to low levels of interdependence, hence there are a few interdependencies that need to be coordinated, and vice versa, high uncertainty seems to be related to high levels of interdependence that need coordination. Thompson (1967) and McCann and Galbraith (1981), as one of the few, did give a classification and a measure, respectively, of the amount of interdependence among organizational members, although their attempts received criticism that it was not a sufficient measure (Victor & Blackburn, 1987; see also Van der Vegt & Van de Vliert, 2001). In other words, researchers can –as they have for a long time- investigate coordination in organizations under several conditions (such as high or low environmental uncertainty), or, as I advocate, try to establish the level of interdependence. By doing so, interdependence is a characteristic of the group instead of being

inherent to the task (e.g., Thompson, 1967), which I propose is critical to unravel the complex relationship between coordination and performance that previous research and theory have not yet accomplished.

Related to above reasoning, in the recent studies by Gittel (2000, 2002) the neglect of the concept of interdependence as the main component of coordination, does not add to our understanding of the relationship between coordination and performance, since Weick (1979) called interdependence the basic constitutive organizational process. The more dated studies and theories of organizational coordination discussed earlier seem to focus only on the type of interdependence that stems from the division of labor (e.g., Birnbaum, 1981; Cheng, 1983; Thompson, 1967). For a full understanding of the relationship between coordination and performance, I argue that organizational research should focus on the process of coordination among organizational members. Some authors argue that coordination resembles learning-by-doing and that organizations simply become more effective over time (Sorenson, 2003). Even then the question still remains how that process works and what factors are important. From the perspective of group theorists and social psychologists, coordination is more fundamentally an interactional process among group or organizational members (Gittel, 2002). According to Lindenberg (1997), in order to understand group processes – such as coordination - different interdependencies need to be studied as a whole. Only then researchers can investigate the optimal level and profile of interdependence between members of a group or organization and organize their coordination accordingly. In other words, managing interdependencies involving the group's tasks and goals alone does not guarantee effective outcomes (Cohen & Cohen, 1991; Gittel, 2002; Van der Vegt, Emans & Van de Vliert, 1998; Wittek, 1999). The next section will deal with the issue of interdependence among organizational and group members in detail.

In sum, I noted the following weaknesses in prior organizational research on the relationship between coordination and

performance in organizations: 1) there is a lack of interest in, and theoretical clarity of, the social side of coordination, 2) there is a lack of attention towards the concept of interdependence, and to establish its amount, among organizational and group members as a direct antecedent of coordination, and 3) if there is attention for the interdependence involved, researchers primarily focus on task interdependency.

2.3 Interdependency literature

Interdependence is a key component of coordination. To be specific, interdependence, due to the division of labor, is the reason why coordination is necessary in organizations (Crowston, 1997; March & Simon, 1958). Despite its essentiality, further development and investigation of this concept has received little attention in the organizational design literature. However, researchers did establish a positive association between task interdependence and an overall use of various coordination mechanisms (Cheng, 1983; Van de Ven, et al., 1976). Coordination and interdependence are not only research topics within organization studies but are also a main focus of research in social psychology. Lindenberg (1997) offers an extensive overview of the study of groups as the study of different types of interdependencies. In his overview, Lindenberg classifies three interdependence types: functional, cognitive, and structural interdependence. Initially these interdependencies were studied together as equally interesting sides of groups and their processes. The theory however, did not develop fully into a mature state, and as a consequence, the several interdependence types were only studied separately later on (cf. Lindenberg, 1997). I will briefly introduce each of the interdependency types below.

Functional interdependence refers to interdependency concerning group goals and tasks. A group is defined as a group because the individuals share common goals or tasks that they cannot reach on their own. These interdependencies are the ones that are most

commonly referred to in the organizational literature (e.g., Birnbaum, 1981; Cheng, 1983, 1984; Thompson, 1967; Victor & Blackburn, 1987) because they are the basis of organizations. Although researchers have differentiated among subtypes of this interdependence (e.g., task, pooled, sequential interdependence), these types all refer to interdependencies connected to the groups' goals and tasks (Lindenberg, 1997; Wittek, 1999).

Cognitive interdependence refers to the fact that people are interdependent by sharing a common system of categories and stereotypes (shared frame of reference) to satisfy their need for ordered and predictable information about the world. However, individuals are also interdependent in terms of affecting each other's categorizations in any given action situation (Lindenberg, 1997). Influential work in developing research on cognitive interdependence (cf. Lindenberg, 1997) has been the work of Sherif (1966) in which it was argued that people can act as individuals or as group members, and the way they act differs from case to case.

Finally, *structural* interdependencies refer to the network of interpersonal relationships among the individual group members (Lindenberg, 1997; Wittek, 1999). Relationships (ties) connect individuals (nodes). Mapping these nodes and ties will show a certain pattern of the relationships between the involved individuals. Every person has a unique position in such a network, and these positions either enable or constrain people in whatever their efforts are (Lindenberg, 1997). Individuals are part of a larger social collective; changes in relationships with others also imply changes in the relationships with the rest of the group (Wittek, 1999). The stream of research that studies structural interdependence is located within the study of social networks. The focus of the network approach is on relationships among social entities and on the patterns and implications of these relationships (Wasserman & Faust, 1994). Investigations how structural interdependency effects group performance and other types of group behavior are rather scarce (cf. Dirks, Shah & Chervany, 2001; see also Baldwin, Bedell & Johnson,

1997; Krackhardt & Stern, 1988; Sparrowe, Liden, Wayne & Kraimer, 2001 for exceptions).

2.3.1 Refining Lindenberg's classification

In this thesis, I propose a model that incorporates different types of interdependence and their effect on performance integratively. In addition, I explicitly view interdependence as a relational feature. This means that interdependencies are comprised of interpersonal relationships. Use of a network theory approach makes it possible to study the different types of interdependency more comprehensively and integratively than prior research. Using a network theory approach, given that social network research is mainly concerned with structural interdependency, will advance prior work. The consequence of a network theory approach is that the typology of Lindenberg (1997) cannot be copied as such into this study. Network studies are mainly focused on structures of interpersonal relationships (pattern of ties) and how certain characteristics of a structure (for example the centrality or marginality of individuals) enable or impair the efforts of individuals or collectives. What type of relationship constitutes a certain structure is often neglected in network studies (Podolny & Baron, 1997) but is also not the main concern when studying those structural interdependencies. However, in this current research I argue that it is important to make a distinction between the structural features of interpersonal interdependency relationships as well as the content of those relationships (i.e., the type of interdependency). The model I propose in this dissertation advances the examination of the coordination-performance link by incorporating several interdependencies and takes a view that theoretically integrates the three types.

The different interdependencies can be conceptualized in network terms whereby the different relational *contents* refer to the different types of interdependence. When using a network approach, the question of what flows through the relations, or networks, among individuals must be answered. For example, in a functional

interdependency relationship, individuals are dependent upon one another for task-related resources without which it would be impossible to perform the task. The pattern or structure of these relationships can provide opportunities or constraints on the actions of the individuals. In a cognitive interdependency relationship, (social) information regarding the task or the group is the content that flows through the ties (relationships) between organizational members. Tichy, Tushman and Fombrun (1979) already noted there is also an exchange of 'affect' or 'liking' in organizations. People are also interdependent upon one another for a feeling of well being, for social acceptance (Baumeister & Leary, 1995). This interdependency type is in this current research added to Lindenberg's functional and cognitive interdependence. *Affect-based* interdependencies are introduced to the past conceptualization, defined as those relationships by which people get their feeling of well being, of social acceptance. Again, structural features of this last type of interdependence are accounted for as well in using a network theory approach.

In sum, the different interdependence types are conceptualized as different relationships between organizational members. The pattern of those different relationships (i.e., networks) can be seen as coordination mechanisms, meaning that those network structures serve as an instrument for managing different interdependencies (e.g., Sitkin & Roth, 1993; Uzzi, 1997; Zucker, 1986). Such social networks can help individuals to coordinate critical interdependencies and to overcome the dilemmas of collective action (Blau 1955; Gargiulo 1993; Gulati 1995a; Kotter 1982; Pfeffer & Salancik 1978).

2.3.2 Three interdependency types: concepts and earlier research

The three interdependency types that are central in this thesis are conceptualized in this section and the empirical knowledge is reviewed below.

The majority of research that explicitly focuses on interdependency is situated in the organizational team literature and can be classified as studies that examine a subcategory of functional

interdependence. Wageman (1995), for example, examined task and outcome interdependency and their integrative effect on group effectiveness. Wageman and Baker (1997) also investigated the effects of task- and reward interdependency on group behavior and outcomes. Van der Vegt and coauthors have studied task and outcome interdependence in groups (Van der Vegt, Emans & Van de Vliert, 1998, 1999, 2000; Van der Vegt & Janssen, 2001). Again, like the organizational design studies (e.g., Galbraith, 1973; Thompson, 1967), the interest in functional interdependence is not new. Functional interdependencies are a consequence of the division of labor, and since they are so significantly tied to the groups' task, I conceptualize them as workflow relationships among group members. Workflow is defined by Van de Ven and Ferry (1980: p. 242) as the materials, objects or clients and customers that are transacted between units, hierarchical levels, and organizations. Brass (1981) further conceptualizes workflow in network terms. Brass defines workflow as a network that locates task positions to each other. The patterned interactions that occur between related positions as the work flows through the organizations are the basis for the relationships among different positions. Workflow transactions are the inputs to and outputs from task positions (Brass, 1981: 332). I use Brass' definition and define in this research functional interdependence as those relationships between group members in which necessary task resources are exchanged in order to be able to perform one's task.

Cognitive interdependence refers to the fact that people are interdependent by a common system of knowledge to satisfy their need for ordered and predictable information about the world (Levesque, Wilson & Wholey 2001; Lindenberg 1997; Turner et al., 1987). This inherently means that individuals are also interdependent upon each other for forming their mental model or shared cognition about a certain situation or phenomenon (Lindenberg, 1997). Individuals have a tendency to develop and use mental models because effective action requires an understanding of the situation within one is located (Johnson-Laird, 1983; Lindenberg, 1997).

CHAPTER TWO

The traditional view on cognition is individualistic; however, a number of studies have examined the impact of social factors on the content of cognition and the processes of underlying cognitive activity (cf. Levine and Moreland, 1999). The construct of cognitive interdependence that is used in this current study is closely related to what is labeled as shared cognition. Although a myriad of terms and concepts (e.g., shared cognition, shared mental model, team situation awareness, collective mind, transactive memory systems) has been used by researchers, they all refer to a socially constructed cognitive structure that represents shared knowledge or beliefs about an environment and its expected behavior (Druskat & Pescosolido, 2002). The body of evidence which suggests that shared cognition has a positive influence on group processes and outcomes (e.g., Klimoski & Mohammed, 1994; Levesque, et al., 2001) is growing, but has not been directly linked to group member interdependencies.

Regarding the question of what must be shared, Cannon-Bowers and Salas (2001) investigated the social cognition literature and identified four broad categories of which the following two are captured in the current research: (1) task-related knowledge, (2) values/beliefs about group processes. Both categories are captured in the current research and will be further discussed in the empirical chapters.

Identifying cognitive interdependence as being linked to shared cognition (or shared mental models, etc.) does not mean that they are the same thing however. In this thesis, I define cognitive interdependency in general as interpersonal relationships that constitute or maintain a shared frame of reference (regarding the task and regarding group processes). More specifically, I examine those relationships among team-members through which task-related knowledge and values concerning group processes are disseminated (Cannon-Bowers & Salas, 2001; Druskat & Pescosolido, 2002). The more cognitive interdependency relationships there are among group members, and the more people can be reached via those relationships, the more the frame of reference is assumed to be shared. In other

words, a high level of cognitive interdependence among group members resembles a situation of shared cognition.

The last category of interdependence- affect based interdependency- refers to the interdependency people experience in their quest for a feeling of social well being, of social acceptance, which according to some researchers, is one of the universal goals people strive for (Coleman, 1990; Lindenberg, 1997; Wittek, 1999). Employees, as social beings, seek belonging and acceptance (Baumeister & Leary, 1995). Affect-based interdependency in this thesis is defined as those relationships by which people get their feeling of well-being and social acceptance. These relationships are operationalized as friendship relationships among workgroup members. Research has shown that a significant part of a person's social network consists of personal relationships with colleagues (Van der Poel, 1993). Being involved in relationships that generate feelings of social well-being and acceptance means that individuals are influenced by those relationships. After all, friendship is thought to serve several functions, such as stimulating companionship (doing enjoyable things together), help (e.g., providing guidance), and self validation (reassurance), among other things (Buhrmester, 1990; Buhrmester & Furman, 1987; Bukowski et al., 1994; Jones, 1991; Mannarino, 1976).

2.4 Bridging the gap in the literature

In the previous paragraphs I described the theoretical background of this research. In line with the recent trend in organizational research (Gittel, 2000, 2002; Espinosa, et al., 2004), I consider in this thesis in addition to the functional side, the informal side of coordination. Unlike these new initiatives (Gittel, 2000, 2002; Espinosa et al., 2004) - in which interdependence is not explicitly discussed - I specifically investigate the influence of different interdependency types on both group and individual performance. To study multiple interdependencies among group members in

organizations, I use a relational perspective. Using a network theory approach allows me to simultaneously investigate different interdependencies, which is necessary in order to enhance our understanding of the coordination within workgroups (Lindenberg, 1997). I extend Lindenberg's social psychology-based typology of interdependency by considering affect-based interdependence in addition to functional and cognitive interdependencies. Previous research suggests that the coordination of functional interdependencies (e.g., Thompson, 1967; Wageman, 1997), of cognitive interdependencies (e.g., Levesque, et al., 2001; Faraj & Sproull, 2000), and of affect-based interdependencies (e.g., Jehn & Shah, 1997) each separately affects performance levels. However, previous research has left us with an insufficient theoretical framework to explain the coordination-performance relationship. This thesis therefore incorporates and integrates three interdependence types and investigates their effect on effectiveness in workgroups. The model in which all interdependency types are studied integratively will be described in more detail in the following chapters.

Another departure from previous work is my characterization of interdependence not as a task characteristic but as a group characteristic. Many researchers have viewed functional interdependence as a characteristic of the task or directly stemming from the task technology (Wageman & Baker, 1997). In this thesis I consider interdependence as a characteristic of the group. Following this reasoning, I investigate in this thesis what can be described as self-coordination in groups. Self-coordination is defined as the alignment of interdependencies by group members themselves rather then by third parties. While past researchers (e.g., Khandwalla, 1974) have focused on the effects of formal coordination mechanisms (designed to coordinate functional interdependencies among group members), I examine the "actual" daily situation. By investigating the interdependence relationships with respect to the task individuals have to perform, I map the "actual" functional interdependencies among group members. By doing so, I also respond to Larsson's (1990)

criticism on organizational design theories in which he states that prior research ignored self-coordination. Even more recently, authors have noted that self-coordination is rather inadequately understood (Alsène & Pichault, 2004).

Finally, throughout the previous sections I cited works on both the organizational and group level. The starting point of this research is the organizational design literature; this thesis addresses individuals in workgroups for two main reasons. First, more and more organizations install workgroups and teams (Kozlowski & Bell, 2003) in the belief that it is the most effective way of organizing (Tjosvold, 1991). Second, for organizations to become effective, group members' interdependencies need to be aligned (i.e., coordinated). I believe, however, that insights from this study can be valuable for organizational level issues as well. Individuals and groups are the building blocks for organizations and understanding the mechanisms at the level of individuals in groups will aid the understanding of such complex processes as coordination at organizational level.

A set of individuals in an organization is defined as a group when it involves at least two individuals in face-to-face interaction, each aware of his or her membership in the group, each aware of the others who belong to the group, and who share resources to achieve common tasks and goals (Campion, Medsker & Higgs, 1993; Shea & Guzzo, 1987). The definition of a team is similar to the definition of a group: "a team is a collection of individuals who are interdependent in their tasks, who share responsibility for outcomes, who see themselves and who are seen by others as an intact social entity embedded in one or more larger social systems, and who manage their relationships across organizational boundaries" (Cohen & Bailey, 1997: p. 241). In the empirical sections of this thesis, the term workgroup is used in chapter three. In that chapter, a department is studied that has a clear objective, namely making a transportation plan. Individuals in this department are seen as a group. In chapter four, I used a dataset that contains data on research and development teams. These are groups that have a clear-cut goal and are a group for a specific time and for

that specific goal. The third dataset I used in this thesis (chapter 5) are student workgroups. These groups also have a limited life span and clear-cut goals following the definitions of a group.

2.5 Outcomes

In past research, different definitions of performance are used. In one paper, for instance, by Campion et al. (1996) performance is the effectivity of a group and of the individuals. In others, such as Gooding & Wagner (1985), performance is seen as the efficiency, and in a third paper (Gittel, 2002) performance is defined as effectiveness and efficiency. Authors have stated that performance is a multidimensional concept (e.g., Chang & Bordia, 2001). Therefore, I conceptualize performance as effectiveness and I consider in this thesis four aspects of effectiveness: the level of goal attainment (i.e., actual performance), extra-role behavior, satisfaction, and learning-goals achievement.

Katz (1964) identified three types of behavior that are essential for a functioning organization: (a) people must be induced to enter and remain within the system; (b) they must carry out specific role requirements in a dependable fashion; and (c) there must be innovative and spontaneous activity that goes beyond role prescriptions. In this thesis the first type of behavior is treated as a given, that is, there are people working within organizations. The second type of behavior Katz identified is in this current research defined as the level of goal attainment (see Van de Ven and Ferry, 1980) and refers to the production goals and the extent to which individuals in groups have reached those goals. Concerning the third type of behavior, extra-role behavior, Katz noted that if an organization depends solely upon its blueprints of prescribed behavior, that organization is a very fragile social system. Therefore, performance is more than just task goal attainment (Arvey & Murphy, 1998). Roethlisberger and Dickson (1964) made a similar distinction between two sides of performance: productivity and cooperation.

They regarded productivity as a function of the formal organization (the authority structure, role specifications, technology) and the 'logic of facts'. Cooperation on the other hand referred to acts that served more of a maintenance purpose, to 'maintain internal equilibrium'. Cooperation thus included the day-to-day spontaneous pro-social gestures of individual accommodation to the work needs of others, whereas productivity was determined by the formal or economic structure of the organization. Roethlisberger and Dickson viewed cooperation as a product of informal organization and, significantly, the 'logic of sentiment'. The latter was seen as influenced both by the quality of work experience and by previous social conditioning. Thus, for a functioning group, it is not only important that people carry out their specific role requirements in a dependable fashion, but also that there must be innovative and spontaneous activity that goes beyond one's specific task-role description (Katz, 1964). Citizenship or extra-role behaviors are important because they lubricate the social machinery of the organization. They provide the flexibility needed to work through many unforeseen contingencies; they enable participants to cope with their interdependence on each other. This type of behavior is discretionary, not directly related or explicitly recognized by the formal reward system, and in the aggregate promotes the efficient and effective functioning of the organizations (cf. Organ, 1988).

Satisfaction is an important aspect of individuals' effectiveness (Hackman, 1987). In this study satisfaction is defined as (depending on the boundaries the different datasets have) job satisfaction (Locke, 1976) and member satisfaction – the extent to which group members' experience with the group is satisfying- (Jehn & Chatman, 2000).

Finally, learning is also an important outcome of individuals in groups (Edmondson, 1999). This is why in the student workgroups the level of learning-goal achievement is also accounted for which is an individual outcome seen as being closely related to learning.

2.6 Overview of the dissertation

In this dissertation I focus on the question of how coordination influences both individual and group performance. This question is investigated by examining how three different interdependency types (functional, cognitive and affect-based) both separately, as well as integratively, influence performance. Furthermore, I also investigate how the alignment of these three interdependency relationships among group members affects four aspects of effectiveness (goal attainment; extra-role behavior; satisfaction, and learning-goal attainment).

For this thesis research, I tested my hypotheses using three different datasets, resulting in three empirical studies. In chapter three, the main effects of the different interdependency types on individual performance are investigated within a Dutch railroad company. The study reported in chapter three made use of data that were collected specifically with this current research in mind. The different interdependency types and their (main and integrative) effects on performance of research and development teams are studied in chapter four. This chapter focuses completely on the network theory aspect of interdependency. The data used to test the hypotheses were collected by Kratzer (2001). In chapter five the interdependency types and their relationship with performance are studied using student workgroups. These data were collected in collaboration with others at the business school of Groningen University.

Using datasets that were constructed with other research questions in mind than the current ones (chapter 4 and 5) has its positive and less positive side effects. On the positive side, these examinations can thus be considered conservative tests of the theory. In addition, they allow me the ability to triangulate constructs across multiple methods and measurement techniques (Bateman & Ferris, 1984). The minor drawback is that I am not able to test all hypotheses in each dataset.

Finally, a note to the reader. Chapters three and four are based on papers that were written for and presented at different conferences,

and chapter five is based on a working paper. Because I use separate papers as the basis for the different empirical chapters, you may find some repetition between the chapters. If you want to avoid that as much as possible, I would suggest you read chapter three and then skip the introduction and theoretical framework in the following chapters four and five. In chapter six, the overall findings of this research are discussed, limitations are identified, and suggestions for future research are made.

CHAPTER THREE

Interdependency and Individual Effectiveness in a Railroad Company[3]

3.1 Introduction

Much of the organizational literature on coordination stems from researchers and scholars of organizational design. Scholars in this tradition have focused on how to coordinate interdependencies between (sub)tasks by means of several coordination mechanisms (e.g., Galbraith, 1973; Thompson, 1967; Van de Ven, Delbecq & Koenig, 1976). In the organizational literature, the generally held belief is that when organizational units or members can work independently (i.e., there are no task dependencies) then there is nothing to coordinate and, consequently, coordination will not affect performance (Espinosa, Lerch & Kraut, 2004; Malone & Crowston, 1994; Thompson, 1967; Van de Ven et al., 1976). This belief however, is something we dare to challenge. In this paper we use insights based on social psychology literature in which coordination is more fundamentally viewed as an interactive process among the involved individuals. Despite the amount of research in the organizational literature, there is still little known about the process of coordinating individuals and how it relates to performance. Following Lindenberg (1997), we think that even in situations in which task interdependencies are low or even absent, there are other, more social types of interdependence among individuals that need consideration and coordination as well in order for a team, group or even organization to perform effectively. In this paper we present our theoretical ideas about three different interdependency types (i.e.,

[3] An earlier version of this chapter: Rispens & Jehn (2004) "Do we know everything there is to know about coordination? An exploration of the influence of different interdependency types on performance in the Dutch rail", was presented at the WAOP conference, November 2004, Utrecht, The Netherlands.

functional, cognitive, and affect-based interdependence) and their effect on individuals' effectiveness and test these ideas on data collected in workgroups of a Dutch railroad company. Additionally, we explore in this chapter different measurements to empirically capture the different types of interdependence among group members.

3.2 Theoretical Background

More and more organizations install teams and workgroups in the belief that is the most effective way of organizing (Katzenbach and Smith, 1993; Nijstad, 2000; Tjosvold, 1991) and this way of organizing is believed to benefit the organization as a whole, although only anecdotal evidence exists of this latter conviction (cf. Delarue, Gryp & Van Hootegem, 2003; Hackman, 1998). The question that is of interest here is therefore under what conditions individuals in workgroups will be effective. The topic that is inherently related to this question is coordination. Coordination in general refers to the alignment of individuals' actions (Heath & Staudenmayer, 2000). Coordination is necessary due to the division of labor in organizations that creates task interdependencies (Crowston, 1997; March & Simon, 1958; Thompson, 1967; Galbraith, 1973; Gittel, 2000). Already in 1938 Barnard stated that coordination is at the heart of organizations. To go even further, coordination is believed to be essential for effective performance (Gittel, 2002; Hage, 1980; Heath & Staudenmayer, 2000). Even though it still is critical to understand how coordination relates to effectiveness because misunderstanding it might endanger the very existence of organizations (Heath & Staudenmayer, 2000), there has not been a lot of attention devoted towards the relationship between coordination and effectiveness within organizations in the recent organizational literature (Gittel, 2002; Heath & Staudenmayer, 2000) and how this affects individual effectiveness.

A few decades ago some researchers examined the relationship between coordination and performance empirically (e.g., Birnbaum,

1981; Cheng, 1984). Since the 1980s little empirical organizational research has been devoted to empirical examine and hence to explain the complex relationship between coordination and performance within organizations[4] . The general opinion was that the coordination mechanisms developed to manage interdependencies within organizations were sufficient even though there is hardly empirical evidence supporting the effectiveness of the coordination mechanisms (Gittel, 2002).

In the 'classic' literature on coordination in organizations (e.g., Thompson, 1967) the division of work is seen as the most important reason why coordination is so important within organizations. Therefore a lot of attention has been paid to the coordination of work input-output flows in the organizational design literature (e.g., Galbraith 1973; Thompson 1967; Van de Ven, et al., 1976; Woodward, 1965) focusing on standardization, planning, hierarchies of authority, and direct supervision. We refer to this type of interdependence as functional interdependence (cf. Lindenberg, 1997). What is less examined in this classical literature, however, is the attention to the more social and spontaneous side of coordination (Gittel, 2002; Larsson, 1990); there is a lack of knowledge of the group processes involved in coordination. Although, for instance, Thompson (1967) mentions "mutual adjustment" and Van de Ven, et al. (1976) refer to "teamwork" to acknowledge the social side of coordination, the conceptual clarity is not as well developed as the formal coordination mechanisms (cf. Larsson, 1990). Some scholars have stressed the existence of this social side of coordination; for example Kiesler (1979), who mentioned the coordination by social roles and expectations. A more recent example is the work done by Gittel (2000, 2002; Gittel & Weiss, 2004) that focuses completely on the social side of coordination, that is, relational coordination. In sum, some organizational scholars have indeed looked at the social side of

[4] There are, of course, exceptions to this assertion. Since the 1980s studies in which coordination and its link with performance has received more attention have been done in the information systems and software development area (e.g., Espinosa, et al., 2004; Kraut, et al., 1999; Malone & Crowston, 1994; Von Martial, 1989).

coordination but either ignored the work processes or did not fully explicate the process of coordination among organizational individuals or units. In this study we are considering both the coordination of the work as well as the social side of coordination.

In social psychological research, coordination is perceived more fundamentally as an interactive process among participants (e.g., Thibaut & Kelley, 1959). It is in this literature that diverse types of interdependency among group members are distinguished that need to be aligned. Lindenberg (1997) reviewed this literature and raises the importance of studying different interdependencies within groups integratively if the desire is to understand group processes, such as coordination. We follow this call for integrative interdependence research, especially because we view organizations as conglomerates of individuals occupying different positions and jobs. When focusing only on the functional or task interdependencies, a large part of the individuals performing those tasks and their behaviors are ignored, resulting in an incomplete understanding of the coordination-performance relationship. We therefore suggest that in addition to functional (task) interdependence, cognitive (Lindenberg, 1997; Wittek, 1999), and affect-based interdependencies need to be taken into account to enable a better understanding the coordination-effectiveness relationship.

In this study we examine individual effectiveness. Effectiveness has three components: 1) the level of goal attainment or in-role behavior (e.g., Van de Ven & Ferry, 1980); 2) extra-role behavior (Katz, 1964); and 3) satisfaction (Jehn & Chatman, 2000; Hackman, 1987). All three components are considered in this chapter. In the next section we define the different interdependency types and describe their expected relationship with effectiveness.

3.3 Theoretical framework and hypotheses

As we described in the previous section, coordination is about interdependencies. It is the interdependencies that need coordination

(Crowston, 1997) and it is interdependence that makes groups interesting (Lindenberg, 1997). In this research interdependence is defined as a state of being in which a person is determined, influenced, or controlled by some other person (DeSanctis, Staudenmayer & Wong, 1999). We define coordination as the alignment of interpersonal interdependencies. In addition to functional interdependence (task interdependence) we consider cognitive and affect-based interdependence. Group members do not only experience some division of labor, but it is highly likely that group members (to a more or lesser extent) share a common perspective about the work and their group. Cognitive interdependence refers to a shared frame of reference (Wittek, 1999) and reflects that group members are interdependent upon each other for defining the situation they are in (Lindenberg, 1997). People tend to create an image of the situation they are facing and of other people involved as well. Information concerning such an image gets shared among group members (whether good or bad) and in that sense individual group members are influenced by the mental model of other group members. Cognitive interdependence is defined in this paper as the sharing of task-related knowledge (Cannon-Bowers & Salas, 2001).

Affect-based interdependence refers to the exchange of feelings of social well-being and social acceptance. Being involved in a relationship in which such feelings are exchanged, means that individuals are likely to be influenced by those, since a person's feelings of social well-being and acceptance are (at least partly) determined, influenced or even controlled by some other party, and vice versa.

3.3.1 Interdependence and effectiveness

How does each of these different interdependency types influence individual effectiveness? Functional interdependency reflects the degree to which individuals are dependent upon other group members to perform their tasks. Studies have demonstrated that in comparison to individually performed tasks, higher levels of

functional interdependence result in more cooperation because of the increased communication, helping, and information sharing (Crawford & Haaland, 1972; Johnson, 1973). As people become more and more functionally dependent upon one another, it means that they need to cooperate more and need to coordinate their actions in order to reach an effective level of performance. This reasoning is also apparent in the early studies on the coordination-performance relationship (e.g., Cheng, 1983), in which Cheng hypothesized and found a positive relationship between the coordination of task interdependencies and performance of research units. If cooperation increases due to functional interdependence, why does this mean that performance increases as well? According to Johnson and Johnson (1989) more functional interdependence in a group increases learning and achievements, which is beneficial for the entire group and its individual members. In addition, a high level of functional interdependence within a group means that the group members are highly- or well-connected in the sense that there are a lot of interpersonal relationships reflecting this type of interdependence. People that are well-connected are more likely to see their contribution to group performance (Katz, 1964) and will be more committed to the group task (Kratzer, 2001). Likewise, individual autonomy decreases because each group member is dependent upon others to perform well and therefore people are more likely to feel responsible for the groups' task (Van der Vegt, Emans & Van de Vliert, 1998; Van der Vegt & Janssen, 2003). The higher the functional interdependence, the more group members are connected, and the higher the commitment of group members to perform well (Kratzer, 2001). Similarly, task interdependency may raise the interaction among group members (Campion, Medsker & Higgs, 1993), individual contributions become more evident, the care for the quality of intra-group social processes expands (Wageman, 1995) resulting in the display of extra-role behaviors (Allen, Sargent & Bradley, 2003; Ramamoorthy & Flood, 2004). So based on previous research, we propose that:

Hypothesis 1: *Functional interdependence is positively associated with individual effectiveness.*

Regarding cognitive interdependence, the knowledge of one individual about how to perform a certain (sub) task or the best solution for a task-specific problem is likely to be transferred to other people when this person is asked for advice, or even gives advice without being asked. When such knowledge gets shared, it means that most (all) group members think about (a certain aspect of) the task in a very similar way (Cannon-Bowers, Salas & Converse, 1993). Consequentially, team members have compatible expectations for performance (Cannon-Bowers & Salas, 2001) and this gives group members the opportunity to anticipate each other's actions and needs (Weick & Roberts, 1993). It has also been found that experiencing cognitive interdependence increases the motivation of group members by increasing the sense of responsibility for the job (Campion, Papper & Medsker, 1996; Van der Vegt, et al., 1998; Van der Vegt & Janssen, 2003), and enhancing motivation increases effectiveness (Campion & Medsker, 1992; Shea & Guzzo, 1987).

In addition, the more cognitive interdependence among group members, the more group members give each other advice or help. Being involved in advice relationships suggests good communication and cooperation within the group, and can result in extra-role behavior (Gladstein, 1984). Cognitive interdependence also motivates individuals because it increases the sense of responsibility for the job (Campion, et al., 1996). Enhancing motivation increases effectiveness in individual jobs (Campion & Medsker, 1992; Shea & Guzzo, 1987). Therefore, individuals who have cognitive interdependence relationships are likely to perform their individual tasks better than those who do not.

In sum, people who have cognitive interdependence relationships are more likely to show extra-role behavior then people who do not have such relationships. Giving advice and helping colleagues to solve task-related problems are behaviors motivated

people will often perform. Therefore, we expect that individuals who have cognitive interdependence relationships are likely to have a higher level of effectiveness than those who don't have such relationships, which is reflected in the following hypothesis:
Hypothesis 2: *Cognitive interdependence is positively associated with individual effectiveness.*

Feelings of social well-being refer to positive affect, which is a major topic in organizational psychology and is found to enhance performance (e.g., Isen & Baron, 1991; Staw & Barsade, 1993; Podsakoff, MacKenzie, Paine & Bachrach, 2000). For example, Isen and Baron (1991) found that (positive) affect enhances cooperation. Staw and Barsade (1993) found that positive affect facilitates decision quality and interpersonal performance. Knoke (1990, p.42) states that affective bonding to the group results in a sense of oneness between a person and the group that strengthens the member's motives for contributing personal resources to the organization (Bennett & Kidwell, 2001).

The exchange of feelings of social well-being and acceptance is very likely to take place among friends. Friendship among group members may enhance interdependence with respect to feelings of social well-being, social acceptance, and positive affect (Baumeister & Leary, 1995). Jehn and Shah (1997) demonstrated that friendship enhances open communication and information sharing, not just for nontask-related topics but as well as for task-related topics. These authors also argue that the cooperation among friends is higher than among acquaintances. Friendship among coworkers reduces stress (Isen & Baron, 1991), is negatively related to absenteeism (Argyle & Henderson, 1985), increases communication, helps employees to accomplish their tasks (Berman, West & Richter, 2002), reduces conflict, and facilitates cooperation (Krackhardt & Stern, 1985). It was found that groups experiencing positive affect, inducing a positive mood, are more focused on the task in comparison to groups experiencing negative affect (Grawith, Munz & Kramer, 2003).

Furthermore, research indicated that negative affect in the sense of hindrance relationships, is detrimental for performance (Sparrowe, Liden, Wayne & Kraimer, 2001).

Having none or a few friends among group members can be marked as a low level of affect-based interdependence, whereas being friends to most or all group members can be marked as having a high level of affect-based interdependence. Then, based on the above, it can be hypothesized that individuals experiencing high levels of affect-based interdependence will be more effective than individuals with no or low levels of affect-based interdependence.

Hypothesis 3: *Affect-based interdependence is positively associated with individual effectiveness.*

In this chapter we also examine the influence of individual deviation from the mean perception in regards to the interdependency types and what effect that might generate on individual effectiveness. Research in social psychology suggests that individuals conform their opinion to that of the majority (Deutsch & Gerard, 1955; Festinger, 1950). People are attracted to others with similar attitudes and opinions (Byrne, 1971, 1997; Newcomb, 1961) or what is even more so, people keep away from those having different attitudes (Rosenbaum, 1986). Being a deviate – having a different opinion regarding the level of interdependence in the group – may be associated with the consequences of feeling dissimilar from other group members (Hobman, Bordia & Gallois, 2003). Studies regarding dissimilarity have made a distinction in dissimilarity regarding values (e.g., Jehn, 1994; Jehn, Northcraft & Neale, 1999), demographics (e.g., Tsui, Egan & O'Reilly, 1992), and information (e.g., Jehn, Chadwick & Thatcher, 1997). To our knowledge the dissimilarity of opinions about interdependency levels has not been studied, but it nevertheless refers to dissimilarity among group members, which like previous diversity research have found, can lead to decreased effectiveness (see Williams & O'Reilly, 1998 for a review). Therefore, we predict the following:

Hypothesis 4: *Perceiving the group differently than other group members regarding the level of interdependency has a negative association with individual effectiveness.*

We investigated our expectations on data that were collected among employees of two departments of a Dutch railroad company. In the next section we will first briefly describe that data and the measurements we used, after which we will present the results we have found.

3.4 Method

3.4.1 Data collection and participants

Data were gathered via questionnaires. These were handed out to employees and supervisors of the Dutch railroad company from the material planning departments at two different geographical locations. The planning departments studied are engaged in what is called material planning; to be more precise, these departments plan the material used for transportation (trains). The departments are located at and preoccupied with the material planning in different geographical areas. In the first department the response rate was 63.2%; whereas in the second department response was 100%.

In department 1 (N=19) 89.5% the employees are male. The mean number of months people have worked with the Dutch railroad company is 243 (20.25 yrs). This is quite high, and can be attributed to the unique character of this company (until very recently state-owned and now when operating independently there is hardly any competition). Respondents' tenure with the specific job ranges from 6 months to 8 years, with an average of almost 3 years. On average most people work full time. In department 2 (N=17) 82.4% of the employees is male. The tenure with the organization ranges between 6 months to 30 years, with an average of well over 3 years. Job tenure is on average 3.5 years. All people worked full time.

Two different kinds of data were collected: attribute and relational data (Scott, 2000). Attribute data included items about the attitudes, opinions and behaviors of individuals. This type of data is collected in our survey using Likert-type questions. Relational data are the contacts, relationships, or ties that relate one individual to another. Relational data are gathered using name-roster type questions, which is also described in the measurement section. We decided to measure our independent variables in both ways –mainly to prevent common method bias- with some of our dependent variables (e.g., satisfaction).

3.4.2 Measures

To measure functional interdependence we used items of the scale constructed by Pearce and Gregersen (1991). This scale, consisting of 3 items about work roles, has a Cronbach alpha of .79. Cognitive interdependence was measured using 2 items that reflected the exchange of task-related knowledge. This scale proved to be reliable as well; however it is a bit lower then the other 2 interdependent scales, Cronbach alpha is .64. Affect-based interdependence was measured with 2 items reflecting the affective component of relationships among group members. The Cronbach alpha for this scale is .79. We performed a factor analysis (see table 3.1), and found that the interdependence items loaded on three different components and together they explain 71.4% of the variance.

Table 3.1 Factor analysis results interdependence items[a]

Item	Functional Interdependence	Affect-based interdependence	Cognitive interdependence
1. I work closely with my co-workers to be able to do my work	.82		
2. I need to regularly adjust my work with my co-workers	.88		
3. How I perform my task is a major influence on the tasks of my co-workers	.80		
4. Co-workers regularly ask for my advice in order to improve their task performance			.88
5. My co-workers are able to perform my tasks			.88
6. In our department there is no-one with whom interaction is strained (reverse coded)		.80	
7. In our department co-workers regularly undertake leisure activities together		.81	

[a] We used oblique rotation; factor loadings under .40 were suppressed

CHAPTER THREE

The relational data on the interdependency types were collected using name roster-type questions. Using self-reports by respondents is the main data collection method used in social network research (Marsden, 1990). Respondents were asked to place a check after the name of their group members if they were (during the last six months):

1) dependent upon that person for necessary information without which they could not perform their task (functional interdependence);
2) asking advice from that person in order to improve their individual task performance (cognitive interdependence);
3) friends with that person and regularly undertake leisure activities with that person (affect-based interdependence).

It is very common to use just one question to represent a variable in network studies (e.g., Borgatti & Cross, 2003; Sparrowe, et al., 2001), not in the least because asking such questions is quite an endeavor for the respondents.

Because analyzing relational data requires a (very) high response rate (Wasserman & Faust, 1994), we only used the data of department 2 in which the response rate was 100%. Because of the small sample size we use these data in a descriptive manner, in addition to the results of the attribute data. We calculated Freeman's (1978/79) degree centrality scores for each individual at department 2, which reflects the "connectedness" of each individual relative to the others in this network. This measure tells us how many relationships each individual has related to a particular type of interdependence.

To establish individuals' effectiveness we measured several individual outcomes. We asked the supervisors to rate their employees' in-, and, extra-role behavior, and performance in general. Additionally, we asked all group members to rate each other on these performance outcomes as well. We also asked respondents to indicate their own job satisfaction using the items: "I am content with my job" and "I enjoy doing my job" (Cronbach alpha= .94).

3.5 Results

To analyze the attribute data, we combined the data of both departments, and, despite the small sample size, we performed regressions after calculating correlations to test our expectations (table 3.2a and b; table 3.4a and b). With respect to the relational data; after calculating the centrality scores of all individuals (except the supervisor) for each relationship type (functional, cognitive and affect-based interdependence) we used these scores to calculate Pearson correlation coefficients with satisfaction, and the other outcome variables rated by their supervisor (Tziner & Vardi, 1982). In table 3.3 these correlations are presented.

Our first hypothesis predicted a positive association between functional interdependence and individual effectiveness. As can be seen in table 3.2a, this hypothesis is partly confirmed by the attribute data. The level of functional interdependence is positively associated ($r = .51$; $p < .01$) with the level of satisfaction. We found the same effect in a regression analysis (table 3.2b); functional interdependence positively affects satisfaction ($\beta = .53$; $p < .01$). The results of the relational data in table 3.3 also provide empirical evidence: being highly functional interdependent is positively associated with in-role behavior ($r = .60$; $p < .05$). The higher group members are dependent upon one another their task, the higher their satisfaction and in-role behavior.

In table 3.2a, the results of the attribute data do not confirm our second hypothesis in which we expected a positive effect of cognitive interdependence on individual effectiveness. However, the analysis of the relational data shows, consistent with previous research (Sparrowe, et al., 2001), that high cognitive interdependence is beneficial for the general and the in-role performance; getting advice on how to improve one's job enables the task execution and performance.

Hypothesis 3 predicted a positive association between affect-based interdependence and individual effectiveness. The results

displayed in table 3.2a partly confirm this expectation. A high level of affect-based interdependence is associated with a high level of satisfaction (r= .38; p< .10). This effect is confirmed in the regression analysis (table 3.2b): β=.34; p<.05. Our hypothesis gets even more confirmation by the relational data, as can be seen in table 3.3. Being highly affect-based interdependent is not only positively associated with one's job satisfaction, but it is also associated with high general performance and extra-role behavior.

Additionally, we formulated in hypothesis 4 a negative association between perceiving the group differently regarding the interdependency types than the other group members and individual effectiveness. We tested this hypothesis on the attribute data. The correlations in table 3.4a show that rating oneself different than the mean score on functional interdependence shows a significant negative correlation with the level of satisfaction (r= -.39; p< .05), general performance (r= -.53; p< .01), and in-role behavior (r= -.61; p< .01). A high deviation from the average perception of functional interdependence is associated with a lower level of satisfaction, a lower level of general performance, and a lower level of in-role behavior. The regression analyses (table 3.4b) do not confirm that divergence form the general opinion on functional interdependence is negatively associated with satisfaction (β=-.22; n.s.), but do show significant negative associations with general performance (β=-.58; p<.05) and in-role behavior (β=-.62; p<.05). With respect to the cognitive interdependence measure, we found a negative correlation with the level of satisfaction (r= -.41; p< .05), but this finding was not confirmed in the regression analyses (table 3.4b). Although a high deviation from the general opinion about affect-based interdependency is nearing significance in the correlation with the general performance measure (r= -.31; p= .10) and shows a negative association, this finding was not confirmed by the regression analyses. Having a different opinion about the level of affect-based interdependence within the group is negatively correlated with extra-role behaviors (r= -.45; p< .05), which is confirmed by the regression

analyses (β=-.39; p<.05). The more an individual differs in opinion with other group members about affect-based interdependence in the group, the less extra-role behavior this person displays.

Table 3.2a Attribute interdependence measures and effectiveness Means, standard deviations and correlations[a]

Variable	M	Sd	1	2	3	4	5	6	7
1.Functional interdependence	3.57	.98	-						
2.Cognitive interdependence	3.20	.86	.28	-					
3.Affect-based interdependence	2.88	.75	.01	-.08	-				
4.Satisfaction	3.88	.84	.51**	-.03	.38†	-			
5.General performance	3.75	.40	.06	-.30	-.10	.15	-		
6.In-role behavior	3.80	.38	.08	-.21	-.22	.27	.87**	-	
7.Extra-role behavior	3.77	.39	-.13	-.04	-.05	.00	.58**	.46**	-

†p<.10; * p<.05; **p<.01

[a]n=36

Table 3.2b Attribute interdependence measures and effectiveness Regression analyses[a]

	Satisfaction	**General performance**	**In-role behavior**	**Extra-role behavior**
Functional interdependence	.53**	.14	.14	-.10
Cognitive interdependence	-.15	-.32	-.23	-.01
Affect-based interdependence	.34*	-.12	-.21	-.04
F-value	6.68**	1.25	1.08	.13
Adj. R^2	.33	.02	.01	-.08

†p<.10; * p<.05; **p<.01

[a]n=36

Note: entries are standardized Beta coefficients

Table 3.3 Relational interdependence measures and effectiveness
Means, standard deviations and correlations[a]

Variable	M	Sd	1	2	3	4	5	6	7
1.Functional interdependence	5.63	2.25	-						
2.Cognitive interdependence	12.13	8.41	.45†	-					
3.Affect-based interdependence	1.25	1.30	.61*	.19	-				
4. Satisfaction	3.97	.81	.17	.37	.52*	-			
5. General performance	3.62	.37	.38	.45†	.57*	.80**	-		
6. In role behavior	3.91	.69	.60*	.55*	.37	.57*	.72**	-	
7. Extra-role behavior	3.63	.59	.21	.11	.57*	.36	.48†	.44†	-

†p<.10;*p<.05;**p<.01

[a]n=16

Table 3.4a Deviations from the average perspective on interdependence and effectiveness
Means, standard deviations and correlations[a]

Variable	M	Sd	1	2	3	4	5	6	7
1.Functional interdependence	0.62	.49	-						
2.Cognitive interdependence	0.60	.64	.47*	-					
3.Affect-based interdependence	0.58	.51	.36†	.32	-				
4.Satisfaction	3.88	.84	-.39*	-.41*	-.26	-			
5.General performance	3.75	.40	-.53**	-.01	-.31‡	.15	-		
6.In-role behavior	3.80	.38	-.61**	-.06	-.29	.27	.87**	-	
7.Extra-role behavior	3.77	.39	-.15	.04	-.45*	.00	.58**	.46**	-

‡p=.10; †p<.10; * p<.05; **p<.01

[a]n=36

Table 3.4b The relationship between deviations from the average perspective on interdependence and effectiveness Regression analyses[a]

Variables	Satisfaction	General performance	In-role behavior	Extra-role behavior
Functional interdependence	-.22	-.58**	-.62**	-.08
Cognitive interdependence	-.27	.31	.28	.19
Affect-based interdependence	-.07	-.17	-.11	-.39*
F-value	2.76†	4.90**	5.36**	1.96
Adj. R^2	.13	.25	.27	.08

†p<.10; * p<.05; **p<.01

[a] n=36

Note: entries are standardized Beta coefficients

3.6 Discussion

Past research on coordination in organizations has focused on the assumption that only task interdependence needs to be coordinated to have an effect on performance (e.g., Birnbaum, 1981; Cheng, 1983; Galbraith, 1973; Thompson, 1967; Van de Ven, et al., 1976). In this paper, we questioned that belief by presenting coordination as a group process that influences individuals, and introducing two more interdependency types in addition to task interdependence, i.e. cognitive and affect-based interdependence. We analyzed the influence of the different interdependency types on group members' individual outcomes with two types of data: attribute and relational data (Scott, 2000).

We hypothesized positive associations between the interdependency types and individual effectiveness. Our first hypothesis, the main effect of functional interdependence, was largely confirmed by the data. Analyzing the attribute data, we found that functional interdependence is positively associated with individual job satisfaction. Additionally, the relational data showed a positive association between functional interdependency and in-role behavior. Hypothesis two -in which we predicted a positive association between cognitive interdependence and individual effectiveness- was largely confirmed by the relational data. Centrality of individuals in their group regarding cognitive interdependence relationships is positively correlated with general and in-role performance. Prior research on social networks in organizations has associated the centrality of individuals in a network with power (Brass, 1984; Brass & Burkhardt, 1992). Powerful individuals are in the center of the task-related information exchange that occurs within the group. It is likely that these central individuals are important influencers to the other group members which is in line with the theory that individuals are not only influenced by their social environment (in this study the workgroup) but also themselves can influence their the workgroup (Lindenberg, 1997). The main effect of affect-based interdependence (hypothesis 3) also got confirmed in our analyses. Having friends among workgroup members is positively associated with job satisfaction, and the analysis of the relational data indicates that it also affects general performance and extra-role behavior in a positive manner. To conclude, these findings refute the general belief in the organizational literature that only task interdependencies affect effectiveness. This study showed that more interdependency types exist among group members and each one of them influences (a part of) individuals' effectiveness.

Unlike we had hoped the attribute, and relational measures of the interdependencies do not affect the same outcomes which makes it hard to prove that our study did not suffer from common method bias. However, it is also no proof that our study is biased (Jick, 1979), and,

therefore it is relevant to think about what might explain the different outcomes affected by the different interdependency measures. When taking a closer look, we think that both measures actually measure slightly different aspects of intragroup interdependency. The *attribute* measures of the interdependency types reflect the individuals' perception of the level of interdependency in the group, whereas the relational measure in this study reflects the position of a workgroup member in the network of interdependence relationships. This latter measure is relative and depends on all existing relationships among group members; as such the relational measure of interdependence takes the situation into account.

In addition, we hypothesized about the divergence of individuals regarding the level of interdependence in their workgroup, from the rest of the group members (hypothesis 4). We predicted a negative association between functional interdependence and individual effectiveness and found partial support. The more individuals diverge from the general opinion on functional interdependence, the lower their general performance and in-role behavior. Individuals who evaluated the affect-based interdependence differently than their group members got significantly lower scores on extra-role behavior. Regarding the dissimilarity in perception of cognitive interdependence we found, in contrast to what we predicted, a marginally significant *positive* relation with general performance. Further investigation of the data regarding this point, reveals that among those member who perceive the level of cognitive interdependence *lower* than the group average (n=12); the cognitive interdependence is negatively correlated with general performance (r=-.60; p=.04). Which is not found by those who perceive the amount of cognitive interdependence to be higher than the average (n=15); however among those individuals the cognitive interdependence is modestly positively correlated with extra-role behaviors (r=.46; p=.09). Divergence from the general or mean perception on interdependence can be an indication that an individual is either peripheral or more central to the team. Peripheral if the individual

perceives less interdependence than do other team members, and central if individuals perceive the same interdependence than do other team members (assuming that this self report measure is correct). In the latter case, we would expect (given the general rationale for the effect of cognitive interdependence on performance) that those individuals who feel more interdependence then the general opinion would perform better and feel more satisfied.

A third contribution of this study is the methodology used to measure the interdependency types. To measure the three interdependency types among workgroup members we gathered attribute as well as relational data. Analyzing these two data types showed different results that are generally complementary in regards to the effect of interdependence on individual effectiveness. Existing research on interdependencies mainly used attribute measures (e.g., Gittel, 2000, 2002; Levesque, et al., 2002; Thompson, 1967), with the exception of social network studies (e.g., Krackhard & Stern, 1985; Sparrowe, et al., 2000) that only used relational measures. With this study we showed that in addition to attribute measures, relational measures on the interdependency types provide additional information.

3.6.1 Limitations and future research

More empirical research on the topic presented here is needed. First of all, the dataset we used for testing our expectations is very small and it is necessary to test the hypotheses again using a larger dataset. Second, in this paper we investigated and found support for the influence of the different interdependencies on individual outcomes; future research should also examine how the interdependencies might influence group level outcomes. As many authors have argued, the group is not merely the sum of all its parts (e.g., Katzenbach & Smith, 1993), therefore it is likely that the effect of the interdependency types on group level outcomes appear via different mechanisms than we suggested in this paper for individual effectiveness.

Furthermore, although we found significant results associating individuals' positions in their relational structure and their effectiveness, future research needs to examine the relational aspect of interdependence using more than one group to verify these associations. Because we analyzed only one workgroup we cannot deny nor confirm that the found associations are a coincidence or not.

Finally, time is also an interesting variable that future research might want to take into consideration when studying the process of coordination in workgroups. In this study we collected data on one point in time and it is possible that if the data were collected a year earlier or later, results would have been different. Therefore, to get a full understanding of how the interdependencies influence effectiveness, longitudinal research is needed. Also comparing the different interdependencies in groups that already exist for a long time with newly formed groups may give us more information about the process of coordination. Notwithstanding the importance a longitudinal design would have for assessing the causality among the interdependence types and effectiveness.

Another aspect that deserves closer examination is the profile of the different interdependency types and its consequences for individual and group outcomes. In this study we presented the main effects of the different interdependency types. However, managing just one interdependence type does not guarantee effective outcomes (Wittek, 1999). It may be the profile of interdependencies that can lead to optimal group and individual effectiveness (Lindenberg, 1997). With respect to the interrelationship among the interdependencies, it is assumed that functional interdependence is shaped (to a certain but considerable extent) mainly by the organization (Wittek, 1999), and is the basis on which employees develop cognitive and affect-based interdependencies. According to the organizational design literature (e.g., Thompson, 1967; Van de Ven, et al., 1976) in situations with high levels of functional interdependence, the proposed coordination mechanisms in that literature (e.g., feedback, mutual adjustment)

suggests high levels of interaction. Consequently, this creates opportunities to develop cognitive and high affect-based interdependency. This is also apparent in Wageman's (1995) study in which she discovered that when the level of functional interdependence increases, groups function better with respect to cooperation, quality of interpersonal processes, learning, and work satisfaction. However, cooperation refers to the "level of social interaction in groups" (Wageman, 1995: p. 150). We propose that this social interaction in a group refers to cognitive and affect-based interdependence. In other words, groups with high functional interdependence need high levels of cognitive and/or affect-based interdependence to realize in high effectiveness levels. Suppose a group of 10 members in which every member is functionally dependent on the other 9 members. Such a group, in which all possible functional interdependence relationships are present (45 in this example), can be labeled as inefficient because for the group to be able to finish the task takes a lot of time mainly due to the complex structure of the functional interdependence. Because of the existence of this type of interdependence, there is already a huge amount of interaction and, it is highly likely that cognitive and affect-based interdependencies will develop. In that case, the cognitive and affect-based interdependencies might reduce the inefficiencies of functional interdependence and make that network more efficient by bypassing the functional interdependence structure. Both cognitive and affect-based interdependence facilitate the effect of formal task interdependencies. This reasoning is not only in line with Wageman's (1995) findings addressed above, but also with studies that find a positive effect of informal relationships on performance (e.g., Lazega, 1999), because the informal relationships (such as cognitive and affect-based interdependence relationships) reduce the transaction costs.

For low functional interdependence situations, the organizational design literature suggests coordination mechanisms (such as standardization of work and processes) that assume a low

level of and hardly any necessity for interaction (Galbraith, 1973; Gittel, 2002; Thompson, 1967; Van de Ven, et al., 1976). In such a situation there should be little opportunities for group members to develop cognitive and affect-based interdependence relationships. These latter two would not be desirable, especially because these type of interdependencies are thought to stimulate extra-role behaviors (see earlier arguments) which are not adding to overall effectiveness in the case of routine jobs, characterized by a low functional interdependence level (cf. Hunt, 2002). Combining the reasoning of both examples, leads to the conclusion that the different interdependency levels need to be congruent to ensure effectiveness. In high functional interdependence situations, the cognitive and affect-based interdependency need to be of a high level as well to realize effectiveness, whereas in low functional interdependency situations, the literature suggest that cognitive and affect-based interdependence need to be low as well. This very interesting hypothesis deserves further examination.

Do we now know all there is to know about coordination? The answer is obviously not affirmative. In this study we have shown that in addition to functional interdependence, cognitive and affect-based interdependence both influence the effectiveness of workgroup members as well. At the same time we also pointed out that there are still a lot of questions that need answers to enable a full understanding of interdependencies and their alignment in workgroups.

In the next chapter, the interdependency types and their influence on group performance are investigated from a relational perspective. In addition, in the next chapter we examine our congruency hypothesis in addition to the main effects of the three interdependence types.

CHAPTER FOUR

R&D Teams and Interdependence[5]

4.1 Introduction

Coordination refers to the alignment of individuals and their behaviors and actions (Heath & Staudenmayer, 2000). Coordination is necessary in organizations because of the division of labor that causes interdependence among organization members (March & Simon, 1957). Moreover, coordination is assumed to be necessary for effective organizational performance (Hage, 1980; Wittenbaum, Vaughan & Stasser, 1998). Because of that assumption, the generally held belief is that when team members can work independently (i.e., there are no task dependencies), there is nothing to coordinate. Consequently, interdependence and its coordination will not affect performance (Espinosa, Lerch & Kraut, 2004; Thompson, 1967; Van de Ven, Delbecq & Koenig, 1976). This belief is exactly what we challenge in this paper. Following Lindenberg (1997), we think that even in situations in which task interdependencies are low (or even absent), there are other types of interdependency that need consideration and coordination as well in order for a team, group, or even organization to perform effectively.

The main concern of the classic writings on organizational design (e.g., Thompson, 1967; Galbraith, 1976; Van de Ven et al., 1976) is the coordination of the interdependency caused by the division of labor. Task interdependencies - recently re-labeled as "functional interdependencies" by Lindenberg (1997) - are formal in nature, referring to the fact that to a certain but considerable extent

[5] This chapter is based on Rispens & Jehn (2004) "Congruent interdependencies and performance: an examination of formal and informal coordination structures", paper presented at the European Group on Organization Studies (EGOS) colloquium 2004, Ljubljana, Slovenia.

this type of interdependence is caused by, and its coordination designed by, the organization itself (Wittek, 1999). Functional interdependence refers to dependence among team members for necessary resources in order to be able to perform and contribute to the groups' task. In other words, the output of one team member's task is the input for another team member's task. In the classic organizational literature, several coordination mechanisms are suggested to align this interdependency (Galbraith, 1973; March & Simon, 1958; McCann & Galbraith, 1981; Mintzberg, 1979; Thompson, 1967; Van de Ven et al., 1976), such as standardization, planning, feedback, and mutual adjustment. These coordination mechanisms are almost all *formal* mechanisms; that is, they are specified and sanctioned by the organization. The suggested coordination mechanisms such as plans and schedules are stable over time, which can make them inadequate at least in unique, instable, complex, or uncertain situations (cf. Larsson, 1990). They are especially designed for routine tasks and routine situations. Even though feedback and mutual adjustment are more flexible, they too are designed beforehand, to be used especially in more uncertain, less routine situations. In this study, we include in addition to the functional interdependence, interdependencies that are informal in nature and emerge when individuals are working together.

Our main critique of the classic literature on coordination in organizations and the suggested coordination mechanisms is that the informal, and more social aspect of coordination, is ignored (Larsson, 1990). In every formal organization, an informal organization emerges (Blau & Scott, 1963), but the official blueprint, plan, or organizational chart can never completely determine the informal relationships of the organizational members. Organizations are seen as conglomerates of individuals occupying different jobs and positions (Simon, 1947/1997). Therefore, we suggest that if only task interdependencies are considered the relationship between coordination and performance is not fully explained since the actors occupying the jobs and positions, and a large part of their behaviors are ignored.

Several scholars do mention that informal or spontaneous coordination can and does occur (e.g., Kiesler, 1979). Coordination mechanisms on the group level do consider the more social side. For example, Davis (1979) noted that positions, roles, norms, and status are coordination mechanisms within groups. Coordination can also be established via expectations: "individuals' roles in the group are a function of expectations from themselves, from other group members, and from nongroup members" (Alderfer & Smith, 1982: p. 38). However, these initiatives appear to lack conceptual development compared with the formal coordination mechanisms in the organizational design literature (cf. Larsson, 1990) and hence are considered to be of little or no use for organizational practice. In other words, the missing attention and the lack of conceptual clarity regarding spontaneous informal coordination are valuable reasons to re-investigate the coordination-performance relationship. These same reasons clearly must have inspired recent studies in which the social and informal side of coordination gaines new attention (e.g., Gittel, 2000, 2001, 2002) as does the role of shared cognition in the coordination process (e.g. Levesque, Wilson & Wholey, 2001; Mohammed & Dumville, 2001; Olivera & Argote, 1999). In line with this recent trend, we consider in this paper the informal side of coordination. Unlike these new initiatives – in which interdependencies are not explicitly discussed (e.g., Gittel, 2000) - we specifically investigate the influence of different interdependency types on group performance. Since interdependence is a key concept in the discussion on coordination, we argue that the concept deserves more attention than it momentarily gets in the organizational literature and that it will enhance our understanding of the coordination-performance relationship.

Lindenberg (1997) discusses multiple interdependencies that coexist among group and team members. According to Lindenberg (1997), we can understand group processes such as coordination better if researchers simultaneously investigate multiple types of interdependence instead of just one, as is the case in most

organizational theories and studies (e.g., Gittel, 2002; Thompson, 1967; Wageman, 1995). In other words, we claim that managing interdependencies involving tasks and goals alone does not guarantee effective outcomes (Cohen & Cohen, 1991; Gittel, 2002; Van der Vegt, Emans & Van de Vliert, 1998; Wittek, 1999). We therefore comply with Lindenberg's call for an integrative approach when studying interdependencies and hence, coordination processes. We introduce, in addition to functional interdependence (i.e., task interdependence) which is the type of interdependency most referred to in the organizational literature, cognitive and affect-based interdependence. Cognitive interdependence (Lindenberg, 1997) refers to the dependence among team members with respect to the exchange of task-related information (Cannon-Bowers & Salas, 2001) and affect-based interdependence refers to the exchange of feelings of social well-being and social acceptance. Cognitive interdependence is different from functional interdependence in that it does not refer to the actual exchange of task inputs, in that sense it is not task-specific but rather task-related. In addition, the exchange of this type of information informally emerges among group members and is not formally designed by the organization. The model we present in this study extends past work on coordination by considering multiple types of interdependency that require coordination within groups and organizations. In addition, we investigate the integrative effect of the interdependency types on the performance of groups. Gaining more knowledge about this complex relationship between coordination and performance in the context of teams might be especially interesting since organizations increasingly install teams (Kozlowski & Bell, 2003), which are thought to be a more productive and effective way of organizing (Nijstad, 2000).

This chapter is organized as follows. In the next section, the theoretical framework is described in which we use a relational approach and formulate hypotheses about how the different interdependence types are expected to affect performance, both the main effects as well as the integrative effect. We tested these

hypotheses on data from 51 R&D teams. These data are described in the third section of this chapter, including the measurements we used. The fourth section describes the results of testing the formulated hypotheses. Finally, we discuss the implications of our results for future research and theorizing.

4.2 Theory and hypotheses

Based on DeSanctis, Staudenmayer and Wong (1999), interdependence is defined as a state of being in which a person is determined, influenced, or controlled by some other person. Since interdependencies are carried through interpersonal relationships, they are relational by nature, which is why we choose to use a network theory approach to study the influence of the interdependency types on performance. Using a network approach offers us the possibility to integratively study both the formal interdependence relationships (i.e., task interdependence) and the informal interdependence relationships (i.e., cognitive and affect-based interdependence). The latter are said to possibly be the key mechanisms for coordinating complex business processes (Kraut, Steinfield, Chan, Butler & Hoag, 1999), but are quite understudied compared to task interdependence. The different interdependence types are conceptualized as different networks, and those networks can be seen as coordination mechanisms, meaning that those network *structures* serve as an instrument for managing different interdependencies (e.g., Sitkin & Roth, 1993; Uzzi, 1997; Zucker, 1986). First, we present the reasoning per interdependence type, the so-called main effects. Second, we present our congruence model of interdependence.

4.2.1 Functional interdependence and performance

As we mentioned in the introduction, functional interdependence assumes that groups experience some level of labor division, that members share common tasks and goals, and that they

need each other to accomplish those tasks and goals (Lindenberg, 1997; Wittek, 1999). We define functional interdependence as those relationships among group members in which necessary resources are exchanged in order to be able to perform one's task. In other words, group members are dependent upon the output of fellow group members to be able to perform their task.

Studies have demonstrated that in comparison to individually performed tasks, higher levels of functional interdependence result in more cooperation because of the increased communication, helping, and information sharing (Crawford & Haaland, 1972; Johnson, 1973). As people become more and more functionally dependent upon one another, they need to cooperate more and need to coordinate their actions in order to reach an effective level of performance. This reasoning is also apparent in the early studies on the coordination-performance relationship (e.g., Cheng, 1983), in which Cheng hypothesized and found a positive relationship between the coordination of task interdependencies and performance. According to Johnson and Johnson (1998), when group members are all contributing to and responsible for completing a group task (i.e. high functional interdependence situation) group members encourage and facilitate each other's efforts to finish the group task. In high functional interdependent groups members exhibit higher quality reasoning, more frequent improvements in process, and greater transfer of learning to others (Johnson & Johnson, 1989). In addition, a high level of functional interdependence within a group means that the group members are well-connected with respect to the task. People that are well-connected are more likely to see their contribution to group performance (Katz, 1964) and, therefore, will be more committed to the group task (Kratzer, 2001). Likewise, individual autonomy decreases because each group member is dependent upon others to perform well and therefore people are more likely to feel responsible for the groups' task (Van der Vegt et al., 1998). Therefore, we hypothesize:

Hypothesis 1: *Functional interdependence is positively associated*

with group performance.

4.2.2 Cognitive interdependence and performance

Cognitive interdependence is defined as informal relationships among team members in which task-related knowledge is disseminated (Cannon-Bowers & Salas, 2001; Druskat & Pescosolido, 2002). The construct of cognitive interdependence is closely related to what is labeled in the organizational psychology literature as shared mental models (e.g., Druskat & Pescosolido, 2002), team situation awareness (e.g., Liang, Moreland & Argote, 1995), transactive memory systems (e.g., Endsley, 1995) and collective mind (Weick & Roberts, 1993). Although conceptually different, these terms all refer to a socially constructed cognitive structure that represents shared knowledge or beliefs about an environment and its expected behavior (Druskat & Pescosolido, 2002).

The sharing of task-related knowledge, for example via the exchange of advice, guidance, or the discussion of new ideas, gives form and coherence to the experience of group members and helps them with the completion of their work (Sparrowe, Liden, Wayne & Kraimer, 2001). The more task-related knowledge gets shared among team members, the more nonredundant pieces of information are likely to be shared (Sparrowe et al., 2001) which benefits the quality of decision making in groups (e.g., Henningsen & Henningsen, 2003; Larson, Christensen, Franz, & Abbott, 1998). When most (or all) group members share nonredundant task-related information, the anticipation of each other's actions and needs is enabled (Weick & Roberts, 1993), which in turn improves the alignment of individual actions and hence, facilitates coordinated action (Klimoski & Mohammed, 1994) and group effectiveness (Levesque et al., 2000). In addition, the more cognitive interdependence in a group (i.e., the more task-related knowledge is disseminated via advice or discussion) the more each group member learns about other group member's tasks, roles and responsibilities (Sparrowe et al., 2001). Knowing what fellow team members do enhances the visibility of individual

contributions to the group task (Katz, 1964) and at the same time clarifies expectations and accountability (cf. Sparrowe et al., 2001). Increased visibility and accountability counteract social loafing (Wagner, 1995), increase feelings of responsibility for the group task (Van der Vegt et al., 1998) and thus enhance group performance. Therefore the hypothesis with respect to the main effect of cognitive interdependence on performance is formulated as follows:
Hypothesis 2: *Cognitive interdependence is positively associated with team performance.*

4.2.3 Affect-based interdependence and performance

We define affect-based interdependence as relationships in which feelings of social well-being and social acceptance are exchanged (Baumeister & Leary, 1995). Positive affect can enhance performance and is a major topic in the social and organizational psychology literature. According to Knoke (1990), affective relationships among group members result in a sense of oneness which in turn strengthens the motives of individuals to contribute personal resources to the group. For example, Isen and Baron (1991) found that (positive) affect has a positive effect on helping behavior and cooperation. Staw and Barsade (1993) found empirical evidence for the hypothesis that positive affect facilitates decision quality and interpersonal performance.

Previous studies on friendship in the workplace have also produced empirical evidence that positive affect relationships are beneficial for effectiveness. Feeling socially accepted by your friend(s) at work is negatively related to absenteeism (Argyle & Henderson, 1985), and the affect produced by having friends among coworkers reduces stress (Isen & Baron, 1991), increases communication, helps employees to accomplish their tasks (Berman et al., 2002), reduces conflict (Shah & Jehn, 1993), and facilitates cooperation (Krackhardt & Stern, 1988). Jehn and Shah's (1997) study compared workgroups where members were friends to workgroups where members were just acquaintances and found that

the groups consisting of friends performed better. Friendship enhances open communication and information sharing for non-task related but also for task-related topics. In addition, groups whose members like each other tend to feel pride in their group and share commitment to their task which positively affects performance (Mullen & Copper, 1994). Based on the above, it can be hypothesized that when group members experience a feeling of belonging from their team members and have friends among their team members, they are likely to perform better as a group than a group consisting of members who do not have friends among their team members.

Hypothesis 3a: *Affect-based interdependence is positively associated to team performance.*

Alternatively, not all research is consistent with respect to the positive outcomes of affect and interpersonal attraction. Zaccaro and Lowe (1988) for example, found that interpersonal attraction increases activities that are not related to task completion, which in turn is detrimental for performance. This finding is consistent with other research and theory that finds friendship to be an impediment because the social focus increases and task commitment decreases (e.g., Bramel & Friend, 1987; Homans, 1951; Lott & Lott, 1965). More recent research found that teams of friends performed less effectively compared to teams existing of non-friends with respect to decision-making tasks (Thompson, Peterson & Brodt, 1996). Thompson et al.'s (1996) research suggests that non-friends make more accurate judgments than friends because friends are more focused on solidarity and agreement instead of accurately understanding the issues. Acknowledging these different findings in prior research we therefore propose, in contrast to hypothesis 3, that:

Hypothesis 3b: *Affect-based interdependence in a group is negatively associated with team performance.*

4.2.4 Congruence of interdependencies

Within teams it is very likely that members experience several types of interdependence at the same time (Lindenberg, 1997). The

level of task interdependence is to a more or lesser extent set by the organization and is the foundation for other interdependence types (Wittek, 1999), meaning that functional interdependence (what makes a team a team in organizations) serves as the basis for cognitive and affect-based interdependence to develop. Functional interdependence among team members –like we hypothesized before- is likely to have an impact on the group outcome. We hypothesize that both cognitive and affect-based interdependence facilitate the effect of formal task interdependencies. This reasoning is in line with studies that find a positive effect of informal relationships on job performance (e.g., Lazega, 1999) because the informal relationships reduce the transaction costs. Suppose for instance a team in which every member is task interdependent with every other member. The existence of cognitive and affect-based interdependence relationships within that team might help the coordination in that team by facilitating understanding and navigating the complex task interdependence structure.

Second, when functional interdependence in a team is very low (or even absent), we expect that the existence of cognitive and/or affect-based interdependence will distract members from executing their task(s). Establishing and maintaining informal task-related knowledge exchange relationships and friendship relationships costs time and energy that cannot be devoted to task execution. Moreover, unlike the situation described above in which all team members are functionally interdependent, in this case it is unlikely that the team's job performance will benefit from the cognitive and affect-based interdependence relationships. In fact, cognitive interdependence and affect-based interdependence may detract from performance in this situation. This implies that in situations of low (or absent) levels of functional interdependence the cognitive and affect-based interdependencies need to be low (or absent) as well in order to reach effective performance levels. We therefore expect that the different interdependencies need to be congruent within a team (i.e. either high levels of all interdependence types or all low levels) to enable a team

to reach effective performance levels:

Hypothesis 4: *Congruency of functional, cognitive, and affect-based interdependence is positively associated with group performance.*

4.3 Method

4.3.1 Data collection and participants

The data are from a study by Kratzer (2001) and while not designed specifically for this research, the data provide adequate, and in some cases excellent, operationalizations to test the theory presented in this paper. The usage of data that were constructed with other research questions in mind than the current ones suggests that the tests of the hypotheses are conservative tests of the theory (Bateman & Ferris, 1984). Fifty-one teams in eleven Dutch companies participated in this study. Of the 264 team members in total, 252 responded resulting in a response rate of 95.5 percent. Data were gathered between 1998 and 1999 with use of a questionnaire developed at the University of Groningen. The teams in this dataset are research and development (R&D) teams. R&D teams are "groups that conduct innovation activities (e.g., new product development), have at least three members, are social systems with boundaries so that members recognize themselves as a group and are recognized by others as one, have one or more common tasks, and operate within one organization" (Kratzer, 2001: p.53).

4.3.2 Measures

The *performance of teams* was measured by asking respondents to evaluate their team's effectiveness. Team members were asked to evaluate their team's creativity and the team's productivity on a response scale ranging from 1 to 7. The reliability of this four item measure is 0.80. Although conceptualized on the group level, performance is initially measured on the individual level as is considered good practice in innovative group studies (Kratzer, 2001).

Since our hypotheses are at the team level, we calculated the eta squared to see if aggregation was justified. The eta squared is a measure that indicates whether people in the same group are more similar than people who are members of different groups. In our analyses the eta squared equals 0.72 and exceeds the minimum criterion of 0.20 (Georgopoulos, 1986), so aggregation was justified using this criterion.

The *interdependencies* were measured by self-reports by respondents, which is the main data collection method used in social network research (Marsden, 1990). For each interdependency type one name-roster type question was used. Respondents were asked to indicate with whom they frequently mutually exchanged work outputs throughout the course of the work, which is used as an operationalization of *functional* interdependence. *Cognitive* interdependence was measured by asking team members "how often and with whom they discuss, develop or evaluate new ideas or approaches to technical problems, to get technical or scientific help or advice, to use as a 'sounding board' for ideas, or to distribute information" (Kratzer, 2001: p.61). The frequency of communicating was permutated into two values: never to several times a month, and, several times a week to several times a day. *Affect-based* interdependence in a team is operationalized as friendship, people were asked to indicate whom they considered their friends (friendship was described as relations outside the company context, for example the jointly undertaking of leisure time activities).

We used UCINET 5 (Borgatti, Everett & Freeman, 1999) to prepare and analyze the relational data. All relational data matrices were first symmetrized which is common in social network research (Wasserman & Faust, 1994). This means that if person *i* denotes to have a relationship with person *j* (value 1 in the matrix) but person *j* did not report this relationship with *i* (value 0 in the matrix), both entrances were replaced with their average (0.5). The *level of interdependence* of a group can be established simply by counting the number of existing ties relative to the number of possible ties (i.e.

density). Density represents the degree to which the members are connected with each other. It is a proportion with values running from zero to one. If density equals one, it means that every member has a relationship with every other member of the group. And opposite, if density equals zero it means that there are no relationships among the group members. Density is calculated as follows:

l / (n(n-1)/2)

where l is the number of relationships present and n the number of team members (Scott, 2000).

To test our *congruency* hypothesis, we constructed a new variable based on the three density measures (resembling the level of functional, cognitive, and affect-based interdependence). We divided the densities on all three interdependency types into 3 categories: a low, medium or high density level. We did so for all 51 teams. Then we combined the three density categories of the three interdependency networks and constructed the variable congruency, whose value ranges between 1 (low congruence) to 3 (high congruence). A team that scores 3 on this congruence variable is a team in which the levels (densities) of all three interdependency relationships are all high or all low; they are similar.

We included the following *control variables*: team members' age, team tenure, and multiple team membership. Sex is not accounted for here, because in the entire dataset only 6.4% of the team members are women. Age was measured asking respondents one question in which respondents could place a check in the correct category (1=under 30 years old, 2=30-39 years, 3=40-49 years, 4=50-59 years, 5=over 60 years). Team tenure is included as a control variable because previous research showed that familiarity is positively related with productivity (e.g., Guzzo & Dickson, 1996), plus some familiarity is important if not necessary for establishing informal social relationships. Newcomers are not likely to have well-established relationships with coworkers. Therefore it is necessary to control for the fact that teams are composites with different levels of tenured members. Respondents were asked (1 question) how long

they have been a member of this team. Multiple team membership is included as a control variable here because being a member of more than one team enables individual team members to bring information and knowledge from other team experiences into their current team, which might enable performance processes in the team (Brown & Eisenhardt, 1995; Kane, Argote & Levine, 2005). Respondents were asked (1 question) in how many teams they participated at the time of the questionnaire.

4.4 Results

Variable means, standard deviations, and correlations are shown in table 4.1. Of the control variables, team tenure and multiple team membership show significant correlations with the dependent variable. Table 4.1 further shows that the independent variables are uncorrelated with one another, and that one of the independent variables – affect-based interdependence - is significantly correlated with performance.

To test our hypotheses systematically we used hierarchical regressions (OLS). The results are displayed in table 4.2. First we tested the effects of all the control variables (step 1) on our dependent variable. Both multiple team membership and age are significant predictors in this first step. In step 2 we entered all interdependency main effects to see whether or not that makes a difference in predicting the performance. Recall that hypothesis 1 states a positive association between functional interdependence and performance. This hypothesis was not confirmed by the data. We also did not find confirmation of our second hypothesis in which we predicted a positive effect of cognitive interdependence on group performance. The data did confirm hypothesis 3a: affect-based interdependence is positively associated with group performance (β=.42; $p<.01$). This finding inherently rejects hypothesis 3b in which we formulated a negative association between affect-based interdependence and performance. Hypothesis 4, in which we predicted that congruent

interdependence levels positively influence performance, is tested in step 3. Although this model tested in step 3 was significant in its own right ($F=3.90$; $p<.01$) it does not explain significantly more variance than the model tested in step 2. The congruency hypothesis therefore was not confirmed.

Table 4.1 Correlations of control, independent and dependent variables

Variable	M	*SD*	1	2	3	4	5	6	7	8
1. Team tenure	2.02	1.26	1.00							
2. Multiple team membership	2.95	2.45	-.33*	1.00						
3. Age	2.11	.47	.28*	-.19	1.00					
4. Functional interdependence	.63	.23	.04	.09	.35*	1.00				
5. Cognitive interdependence	.60	.27	.25†	-.28*	.07	-.20	1.00			
6. Affect-based interdependence	.27	.21	-.12	.43**	-.21	-.11	.19	1.00		
7. Congruence	1.59	.64	-.15	.37*	-.21	-.31*	-.19	.46**	1.00	
8. Performance	4.46	.81	-.27†	.33*	.12	-.09	-.10	.46**	.19	1.00

†p<0.10; *p<.05; **p<.01

N=51

Table 4.2 Hierarchical regression results for team performance

Variable	**Step 1**	**Step 2**	**Step 3**
Team tenure	-.24	-.24	-.24
Multiple team membership	.30*	.30*	.30*
Age	.24†	.24†	.24†
Functional interdependence		-.20	-.20
Cognitive interdependence		.11	.11
Affect-based interdependence		.42**	.42**
Congruence			-.11
F-value	3.72*	4.50**	3.90**
Adj. R-Square	.14	.30	.29
R-Square change	.19**	.19**	.01

†p< 0.10, *p<0.05, **p<0.01

N=51

Note: entries are standardized Beta coefficients

4.4.1 Additional analyses

Another way to examine congruency with network data is the overlap between the three interdependency networks. Therefore, a next step we undertook was establishing the effect of overlapping patterns of the three interdependence relationships on performance. This approach differs from the congruency measure we used earlier in that here we can take into account the actual overlap of interdependency relationships between the team members. The density measure we used, describes the overall level of the three

interdependency relationships reported by network members. That measure did not take into account if ties between team members are consistent in each interdependency network. The overlap of the interdependency networks measures if team members Jane and Ruth are mutually task interdependent, and/or dependent upon each other for task-related information, and/or consider each other as friends. This overlap was calculated using the QAP correlation procedure in UCINET 5 (Borgatti, Everett & Freeman, 1999). With this procedure, the correlation between two different matrices is calculated, using all elements in the matrices. The QAP procedure compares the observed correlation with a distribution of random correlations generated according to the null hypothesis of no relationship between the matrices. This procedure works by permuting the rows and columns (together) of one of the input matrices, and then correlating the permuted matrix with the other data matrix. This process is repeated hundreds of times to build up a distribution of correlations under the null hypothesis. The p-value is given by the proportion of random correlations that are as large as or larger than the observed correlation. Using this procedure we can only assess the overlap between patterns of two interdependence relationships at a time. The three correlation coefficients for each team were then regressed on team performance. The results are shown in table 4.3. We find a marginally significantly negative effect with respect to the overlap between functional and affect-based interdependence. The results reveal that the more the pattern of functional interdependence relationships shows an overlap with the pattern of affect-based interdependence relationships (regardless of the overall *level* of this type of interdependence in that team), the more negative the team performance. The overlap between functional and cognitive interdependence and between cognitive and affect-based interdependence showed no significant results.

Table 4.3 Hierarchical regression results: overlap in patterns

Variable	**Step 1**	**Step 2**	**Step 3**
Team tenure	-.30†	-.30†	-.30†
Multiple team membership	.34*	.34*	.34*
Age	.24	.24	.24
Functional interdependence		-.06	-.06
Cognitive interdependence		-.06	-.06
Affect-based interdependence		.41**	.41**
Overlap functional and cognitive			.12
Overlap functional and affect-based			-.28†
Overlap cognitive and affect-based			-.10
Adj.R^2	.21	.31	.33
R^{-2} change		.15	.07
F-value	4.44	4.02	3.20

†p< 0.10, *p<0.05, **p<0.01

N=51

Note: entries are standardized Beta coefficients

4.5 Discussion

We investigated whether three different interdependency types (functional, cognitive and affect-based) each have an effect on team performance, as well as their integrative effect. The results show that of the hypothesized main effects the positive impact of the level of affect-based interdependence is confirmed by our analyses. This indicates that affect-based interdependency plays an important role in teams with respect to performance, contrasting with research and theorizing that find friendship is an impediment for effective performance because of the increased social focus and behaviors that are not task related (e.g., Homans, 1951; Thompson et al., 1996; Zaccaro & Lowe, 1988). The findings of this study suggest that friendship positively influences performance by facilitating cooperation (Krackhardt & Stern, 1988) and that friends perform better due to open communication and information sharing (Jehn & Shah, 1997).

Our analyses further revealed that the level of formal task interdependence in teams did not have an influence on performance in this study. This finding seems to contradict the assumption that coordination of functional interdependencies is necessary for effective performance (Hage, 1980). However, we used a very stringent definition of functional interdependence. We only considered the relationships among team members representing mutual task dependence. In future research, it would be very interesting to differentiate between specific types of functional interdependence within teams (e.g., mutual and sequential task interdependence).

The level of cognitive interdependence in teams shows no effect on performance. Before concluding that sharing task-related knowledge does not directly affect team performance at all, we suggest future research take into consideration the frequency of problem solving communication. A current limitation of this study is that we simply dichotomized the variable by appointing a 1 to relationships that consisted of a high frequency and a 0 to low and no

levels of this type of communication.

We did not found confirmation for the congruency hypothesis (H5) in the regression analysis. However, further investigating the relationship between performance and the level of congruency, we made a (simple) plot in which the mean of performance is shown for the levels of congruency (see figure 4.1). According to this graph, the data do behave as we expected in our congruency hypothesis. Based on this, future research should replicate this research on a larger sample.

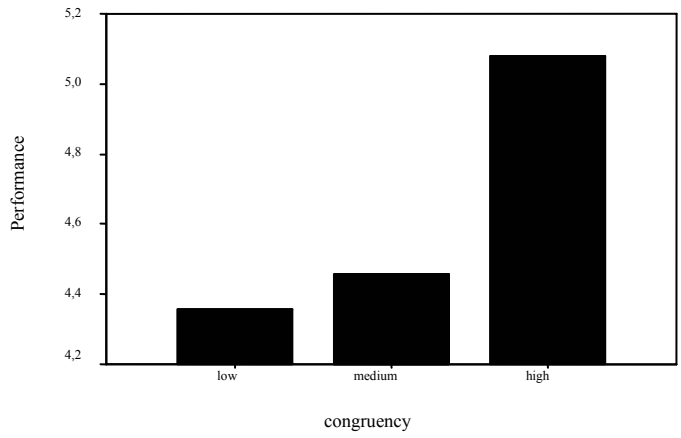

Figure 4.1 Mean performance and level of congruency

In addition, we found proof that the overlap in patterns of the interdependence relationships (i.e., functional and affect-based) that indicates a level of congruence among team members is important. We found a negative effect of the overlap between functional and affect-based interdependence on performance. Team members who are functionally interdependent with other team member as well as affect-based interdependent with those same team members report lower group performance than members whose functional and affect-based interdependence relationships do not overlap. Seemingly, mixing pleasure and work entails a process loss to some degree (Steiner, 1972). We found a significant β-value for the overlap

between functional and affect-based interdependence, however, adding the overlaps of the interdependence networks to the main effects is not significant which leads us to conclude that the process loss is of lesser importance than the positive effect associated with affect-based interdependency.

Finally, we want to point out one limitation of this study, and that is the measurement of team performance. Our hypotheses explicitly focused on predicting actual, objective team performance. As we have described in the measurement section of this paper, team performance in this study reflects the individuals' *perception* of team performance (i.e., creativity and productivity). Creativity is an important factor in R&D teams but a general accepted operationalization is still missing (Leenders, Van Engelen, & Kratzer, 2003), which justifies the use of subjective self-report measures. However, to measure team productivity it is possible to use additional measures such as supervisory ratings. In addition, as is shown in table 4.1, there is not much variation in the perception of how the team performs (sd=0.81). Therefore, we propose that future research should examine the model we presented in this study on objective performance measures and multiple subjective measurements (such as supervisory ratings, expert judgments, peer ratings).

To conclude, the results of this study add to the discussion of different interdependence types involved in coordination. The analyses presented here do show that informal interdependence (i.e., affect-based interdependence) is important for R&D team outcomes.

CHAPTER FIVE

Student workgroups and Interdependence

5.1 Introduction

A few decades ago some researchers examined the relationship between coordination and performance empirically and concluded that it is neither a simple nor a straightforward relationship (Cheng, 1984; Birnbaum, 1981). Recently some authors have mentioned that coordination is comparable with learning-by-doing and can increase performance (Sorenson, 2003). However, according to other researchers, coordination is not always important for effective team performance (Espinosa, Lerch & Kraut, 2004). The question of how the concepts of coordination and effective performance are related, therefore, remains seemingly unanswered.

How organizations and groups can obtain coordination (i.e., the alignment of individual actions) is well-described (e.g., Galbraith, 1973; Hage, 1980; Thompson, 1967; Van de Ven, Delbecq & Koenig, 1976). This is certainly true for those mechanisms that are designed to coordinate interdependencies that are created by the division in tasks (Larsson, 1990; e.g., Faraj & Sproull, 2000; Galbraith, 1973; Malone & Crowston, 1994; Thompson, 1967; Van de Ven et al., 1976), such as standardization, planning, hierarchies of authority, and direct supervision. Less attention is given to the more social and spontaneous side of coordination (Gittel, 2002; Larsson, 1990); there is a lack of knowledge of the group processes involved in coordination. Although Thompson (1967) mentions "mutual adjustment" and Van de Ven et al. (1976) refer to "teamwork" to acknowledge the social side of coordination, the conceptual clarity is not as well-developed as are the formal coordination mechanisms (cf. Larsson, 1990). While some scholars have mentioned the occurrence of this social side of coordination (e.g., Gittel, 2000, 2002, 2004;

Kiesler, 1979), no discrimination is made between different types of interdependency corresponding to either the formal or the informal side of coordination and the interrelationship of different interdependence types is not studied.

The reason both aspects of coordination need attention is because working as a group implies that there are two issues involved. The first is the *task* and the problems involved in getting the job done. The second is the *process* of the group work itself (Campion, Medsker & Higgs, 1993): the mechanisms by which the group acts as a unit and not as a mere collection of individuals. We propose that only if both issues are aligned groups will be effective. Gaining more knowledge about the complex relationship between coordination and performance in workgroups is especially interesting since organizations increasingly install teams, which are thought to be a more productive and effective way of organizing (Katzenbach & Smith, 1993; Nijstad, 2000; Tjosvold, 1991).

In social psychological research, coordination is more fundamentally discussed as an interactive process among participants (e.g., Kelley & Thibaut, 1959; Wittenbaum, Vaughan & Stasser, 1998). In that literature that diverse types[6] of interdependency are distinguished. Interdependencies are an important aspect when studying coordination, since it is interdependencies that require coordination (e.g., Galbraith, 1973; Malone & Crowston, 1997; Thompson, 1967). Lindenberg (1997) reviewed the social psychological literature on interdependencies and stressed the importance of studying different interdependency types within groups integratively to understand group processes, such as coordination. We follow this call for integrative interdependence research and suggest that in addition to task interdependencies (re-labeled by Lindenberg as 'functional' interdependence), cognitive (Lindenberg, 1997; Wittek, 1999), and affect-based interdependencies need to be taken into

[6] Although researchers such as Thompson (1967) did distinguish several interdependence types (in Thomspon's case sequential, pooled and reciprocal interdependence), these are all subcategories of 'functional' interdependence: interdependence that has to do with the (group) goal and task.

account to enable the understanding of the coordination-performance relationship. In this study, functional interdependence refers to the interdependence group members experience regarding the workflow among them; task performance of one member depends on the performance of another team member (Brass, 1981; Van der Vegt, Emans & Van de Vliert, 1998; Wageman, 1995). Cognitive interdependence in this study is defined as the sharing of team-related values among team members (Cannon-Bowers & Salas, 2001). Affect-based interdependence refers to the interdependency people experience regarding a feeling of social well-being and social acceptance (Baumeister & Leary, 1995). Studying these three interdependency types is especially important since organizations are conglomerates of individuals occupying different positions and jobs (Simon, 1947). This means that if research focuses only on the functional or task interdependency, a large part of the interaction of the individuals performing those tasks and their behaviors are ignored.

Authors have stated that performance is a multidimensional concept (e.g., Chang & Bordia, 2001) and that performance is more than just the goal attainment level (Arvey & Murphy, 1998; Roethlisberger & Dickson, 1964). Therefore, we consider different aspects of individual and group effectiveness (Hackman, 1987) in this study using a sample of student workgroups. We investigated the effect of each of the interdependency types on four different outcomes of the students (teams): the individual perception of team performance, learning-goal attainment, member satisfaction, and both individual and group task performance (grades). Since researchers have mentioned that only managing functional interdependencies does not guarantee effective outcomes (Cohen & Cohen, 1991; Gittel, 2002; Van der Vegt et al., 1998; Wittek, 1999), we also examine the integrative effect the interdependencies may have on performance.

In the next section, we briefly review the relevant literature and present our hypotheses regarding both the main effects as well as the integrative effect of the diverse interdependence types on the several individual outcomes. In the following sections, we present our

methods and results, ending this chapter with a discussion of our findings.

5.2 Theory and hypotheses

Interdependence is a state of being in which a person's behavior is determined, influenced, or controlled by some other person or persons (Heath, Staudenmayer & Wong, 1999). Task or functional interdependence stems from the division of labor (Simon, 1947) and is connected with the groups' goal and tasks. That is, members are interdependent to complete their group task. However, there are additional bases for interdependence among group members which are more informal and social by nature that need to be considered to obtain a clear picture of coordination (Crowston, 1997; Larsson, 1990; Lindenberg, 1997). Therefore, we additionally distinguish cognitive interdependence and affect-based interdependence. Both interdependence types reflect the informal and social process more than the formal task interdependency does (Larsson, 1990). Group members not only experience some division of labor, but it is also highly likely that group members (to a more or lesser extent) share a common perspective about their group (Lindenberg, 1997). Cognitive interdependence refers in this paper to the sharing of values or mental models among individuals with respect to the group of which they are members (Cannon-Bowers & Salas, 2001; Wittek, 1999). Affect-based interdependence refers in this study to the exchange of feelings of social well-being and social acceptance often exhibited in friendship relationships (Baumeister & Leary, 1995). Being a member of a team with high levels of functional, cognitive, and affect-based interdependence implies that you are performing your task well because your team members perform well and you are dependent on their efforts. It also implies that you and your group members have similar values regarding the group and group work. In addition, you would be a happy person because you are surrounded by people who give you a feeling of social acceptance

and well-being.

5.2.1 Functional interdependence and effectiveness

Functional interdependence enhances group performance for several reasons. First, as people become more and more functionally dependent upon one another, they need to cooperate more and need to coordinate their actions in order to reach an effective level of performance. Previous research demonstrated that more functional interdependence is accompanied with more cooperation (Crawford & Haaland, 1972; Johnson, 1973; Johnson & Johnson, 1989; Wageman, 1995). This reasoning is also apparent in the early studies of the coordination-performance relationship (e.g., Cheng, 1983), in which Cheng hypothesized and found a positive relationship between the coordination of task interdependencies and performance. Moreover, high functional interdependency within a group also decreases individual autonomy because each group member is dependent upon others to perform well (e.g., Kiggundu, 1983; Van der Vegt et al., 1998; Wittek, 1999). In addition, individual contributions become more visible to all group members in highly functional interdependence situations. As a consequence, group members are likely to feel more responsible for the groups' task (Pearce & Gregersen, 1991; Van der Vegt et al., 1998) and are more likely to see the work as challenging (cf. Campion, Papper & Medsker, 1996) which we expect to result in more individual efforts enhancing performance. Based on this previous research and theorizing on how functional interdependence influences both individual and group performance, we formulated the following two hypotheses:

Hypothesis 1: *Functional interdependence is positively associated with individual performance.*

Hypothesis 2: *Functional interdependence in a group is positively associated with group performance.*

A high level of functional interdependence among group members is also expected to increase learning of the group members. Learning is a process (Argyris & Schön, 1978; Edmondson, 1999) and

encompasses several behaviors such as feedback seeking, experimentation, and discussion of errors (e.g., Asfhord & Tsui, 1991; Henderson & Clark, 1990; Sitkin, 1992). In high functional interdependence situations, group members can only perform well if their fellow group members perform well (e.g., Kiggundu, 1983; Van der Vegt et al, 1998; Wittek, 1999). Individual contributions are noticeable to all group members, which can enhance the motivation and willingness of individual group members to contribute to the group task because of the felt responsibility and the challenging nature of the work (Campion et al., 1996; Van der Vegt et al., 1998). Therefore, as a consequence of the heightened motivation, group members are more interested in and are open to develop learning behaviors and reaching their learning goals. Additionally, past research suggests that in high functional interdependent groups, members exhibit greater transfer of learning to other group members (Johnson & Johnson, 1989). This suggests the following hypothesis:
Hypothesis 3: *Functional interdependence is positively associated with learning-goal attainment*.

Past research found that experiencing functional interdependence, that is, working in a group, enhances individuals' satisfaction with the group (Shaw, Duffy & Stark, 2000). This finding suggests that the more cooperation individuals display, the more joyful and pleasant work becomes. The more group members' performance is dependent upon the performance of other group members (e.g., Kiggundu, 1983; Van der Vegt et al, 1998; Wittek, 1999), the more individual contributions to the group task become visible to everyone. Therefore, members increasingly feel responsible, not only for one's own task but also for the work of others (e.g., Van der Vegt et al., 1998). When group members are all contributing to and feeling responsible for completing a group task, group members encourage and facilitate each other's efforts to finish the group task (Johnson & Johnson, 1989). We expect that because of the mutual encouragement in high functional interdependent situations, individual group members are happier being a member of a group than they will

in situation characterized by low functional interdependency. This leads to the following hypothesis:

Hypothesis 4: *Functional interdependence is positively associated with member satisfaction.*

5.2.2 Cognitive interdependence and effectiveness

How can shared values about the group processes lead to effective performance? According to Druskat and Pescosolido (2002), if group members share the belief that team actions and outcomes are under their responsibility (i.e., psychological ownership), it increases performance by motivating the members to increase their knowledge and control over the team's work. Weick and Roberts (1993) and others (Cannon-Bowers & Salas, 2000; Druskat & Pescosolido, 2002) suggest that a shared mental model about "heedful" (i.e. attentive, purposeful, conscientious and considerate) interrelating increases effectiveness by improving members' ability to work together. In this current research, cognitive interdependence is defined as sharing the value of heedful interrelating behaviors, following Weick and Roberts (1993) and is related to the concept of organizational culture. When a mental model of what a good atmosphere or culture is within which tasks are performed is shared, it means that most (all) group members think about a phenomenon or situation in a very similar way (e.g. Cannon-Bowers, Salas & Converse, 1993). Shared mental models enable group members to anticipate each other's actions and needs (Weik & Roberts, 1993), which in turn improves the alignment of individual actions and is found to be associated with a high level of group effectiveness (Levesque, Wilson & Wholey, 2001). Therefore, the first two hypotheses with respect to cognitive interdependence and performance are formulated as follows:

Hypothesis 5: *Cognitive interdependence is positively associated with individual performance.*

Hypothesis 6: *Cognitive interdependence is positively associated with group performance*.

Cognitive interdependence can influence learning-goal

attainment as follows. When group members share values on group processes, that is, on how to operate or act as a group, 'heedful' interrelating allows members to interact more efficiently (Matthieu, Goodwin, Heffner, Salas & Cannon-Bowers, 2000). Being surrounded with like-minded group members makes it easier for individuals to voice their opinions, to ask questions, and to give or receive feedback (Asch, 1952; Edmondson, 1999). Those behaviors enable the encoding of new information (Hinsz, Tindale & Vollrath, 1997; Levine, Higgins & Choi, 2000) because new information is discussed within the group and the knowledge gets shared among the group members, which in turn increases the learning of individuals in groups (Zarrage & Bonache, 2005). This reasoning results in the following hypothesis:

Hypothesis 7: *Cognitive interdependence is positively associated with learning-goal attainment.*

Individuals will be more satisfied with their group members if there is no discrepancy between the perceived group values and group processes. Sharing the same ideas and values about group and group-work allows group members to cooperate well (Jehn, 1994; Weick & Roberts, 1992). The chance of being an unhappy workgroup member increases if group members differ in their opinions about their group's processes (Jehn, 1997; Jehn & Mannix, 2001), which negatively affects cooperation (Jehn, Northcraft & Neale, 1999) and can lead to feelings of frustration (Jehn & Mannix, 2001). We therefore predict:

Hypothesis 8: *Cognitive interdependence is positively associated with member satisfaction.*

5.2.3 Affect-based interdependence and effectiveness

Affect-based interdependence refers to the interdependency people experience regarding a feeling of social well-being and social acceptance (Baumeister & Leary, 1995). The exchange of such feelings and hence the experience of positive affect is likely to take place among friends. We expect affect-based interdependence to positively influence group performance. Group members who are

friends communicate more (Berman, West & Richter, 2002), their communication and information sharing is more open (Jehn & Shah, 1997), and they experience less conflict (Krackhardt & Stern, 1985) in comparison to group members who are not affect-based interdependent. These behaviors that accompany friendship are important for cooperation (Jehn & Shah, 1997; Krackhardt & Stern, 1985) and help group members to accomplish their tasks (Berman et al., 2003). In addition, the experience of positive affect –which is likely among friends - facilitates group members to focus on their task (Grawith, Munz & Kramer, 2003). Moreover, psychological research suggests that positive affect is associated with increased dopamine levels in the brain that enhances the ability of individuals to retrieve information from memory, making the recall easier and more likely (Ashby, Isen & Turken, 1999), and thus allowing individuals to be more efficient in their tasks. Based on this, we hypothesize affect-based interdependence to positively influence both individual and group performance:

Hypothesis 9a: *Affect-based interdependence is positively associated with individual performance.*

Hypothesis 10a: *Affect-based interdependence is positively associated with group performance*.

Alternatively, not all research is evenly positive with respect to the outcomes of affect and interpersonal attraction. Zaccaro and Lowe (1988), for example, found that interpersonal attraction increases activities that are not related to task completion, which in turn can be detrimental for performance. People might be socializing instead of completing their task (Bramel and Friend, 1987; Jehn & Shah, 1997; Homans 1951; Lott and Lott 1965). To cite Steiner (1972: p. 126): "sociability does not necessarily breed productivity". Acknowledging these different viewpoints and findings in prior theorizing and research we therefore propose, in contrast to hypothesis 9a and 10a, that:

Hypothesis 9b: *Affect-based interdependence is negatively associated with individual performance.*

Hypothesis 10b: *Affect-based interdependence is negatively associated with group performance*.

People need affectively pleasant interactions –such as between friends- in order to be happy (Baumeister & Leary, 1995). Friendship between individuals is based upon mutual liking and attraction and has, in general, many outcomes of a positive nature that contribute to a person's happiness. To name a few, friendships are an important resource for psychosocial support (Ibarra, 1995). In addition, having friends is positively correlated with health (Reis, Wheeler, Kernis, Spiegel, & Nezlek, 1985). In a work context, we expect that the experience of affect-based interdependence is accompanied with feeling happy and hence, satisfaction with the other group members.
This is reflected in the next hypothesis:
Hypothesis 11: *Affect-based interdependence is positively associated with member satisfaction.*

The more group members are friends, the more they experience affect-based interdependence which in turn may enhance individual learning. Affect-based interdependence increases the willingness and motivation of individuals to invest time, energy, and effort in sharing knowledge with others (Reagans & McEvily, 2003). In a high affect-based interdependent group, members are not afraid to raise questions and welcome feedback from other group members (Gibson & Vermeulen, 2003; Edmondson, 1999).These attitudes and behaviors enable the encoding of new information (Hinsz et al., 1997; Levine et al., 2000). In addition, past research found that positive affect is associated with increased dopamine levels in the brain. High dopamine levels enhance the ability of individuals to retrieve information from memory, making the recall easier and more likely (Ashby et al., 1999), which can enhance individual learning. We therefore expect that individuals benefit from a friendly environment in this respect, and hence are better able to successfully reach the learning goals, so we hypothesize that:
Hypothesis 12: *Affect-based interdependence is positively associated with learning-goal attainment.*

5.2.4 The integrative effect of the interdependencies on effectiveness

We suggested in the introduction that managing just one interdependency type does not guarantee effective outcomes and that it is most likely that it is the profile of interdependencies that leads to optimal group and individual performance. With respect to the interrelationship among the interdependencies, it is assumed that functional interdependence is the basis on which employees develop cognitive and affect-based interdependencies (Wittek, 1999). This means that the functional interdependencies among group members are designed up front by the organization; jobs and tasks and their interrelations are designed to reach specific goals specified by the organization itself *before* people are hired to occupy the jobs. The existence of functional interdependence is therefore the basis on which cognitive and affect-based interdependencies can evolve. Of course, jobs and tasks are not static and are to a more or lesser extent influenced by the people performing those jobs (Wrzesniewski & Dutton, 2001). However, we assume that the functional interdependency is shaped (to a certain but considerable extent) mainly by the organization (Wittek, 1999). We developed two different theoretical rationales for this integrative effect, which we labeled the cohesion and the congruency rationales. Both are described below.

5.2.4.1 Cohesion

When group members experience high levels of all three types of interdependence we argue that such a group is more cohesive than a group that is characterized by high levels of only one or two interdependency types. If members experience a high level of functional interdependence, and at the same time have high levels of cognitive and affect-based interdependency, there is a strong connection among those members on several dimensions. Past research implies that when functional interdependence relationships are lubricated by social relationships, information and knowledge

sharing benefits (e.g., Wittek, 1999). According to Wech, Mossholder, Steel and Bennet (1998), cohesion promotes more within-group communication that in turn facilitates the task accomplishment. Group members who experience high levels of all three interdependency types are argued to be more socially integrated, which reflects the extent to which group members experience cooperative social interactions with other members, attraction to the group, and satisfaction with the other group members (O'Reilly, Caldwell & Barnett, 1989; Van der Vegt, 2002). Socially integrated group members are known to experience higher morale and exhibit greater efficiency in the coordination of tasks (Shaw, 1981; Smith, Smith, Olian, Sims, O'Bannon & Scully, 1994). This leads to following hypothesis:

Hypothesis 13: *A high level of cohesion in a group, in the sense that group members experience in addition to functional interdependence also cognitive and affect-based interdependence, is positively associated with effectiveness (group performance, individual performance, member satisfaction, and learning-goal attainment).*

5.2.4.2 Congruence

We develop our congruency argument by considering variations in the level of functional interdependence, which is the basis for the development of cognitive and affect-based interdependence. What will happen for instance when group members' level of functional interdependence is quite low? Take for example an organizational unit whose members do not experience functional interdependency. Within such a unit all employees get their task-specific information and inputs from outside the unit they are working in; members perform their task independently from others inside the unit and send their output outside the unit. Earlier we argued that a high level of interdependence increases cooperation and communication among group members. Inverting that argument means that in the absence of functional interdependence, cooperation is absent (and not necessary; there is no group task) and communication among group members would be absent or very low.

But people seek belonging and acceptance and since the members are located near each other within the same unit, it is very likely that cognitive and affect-based interdependencies would develop in this situation. These interdependencies can interfere with the effectiveness because they are not consistent with the low or null level of functional interdependence. The time people spend on maintaining their relationships concerning their cognitive and affect-based interdependence will not be spent on their task execution. Moreover, cognitive and affect-based interdependencies are positively associated with extra-role behaviors, which may also interfere with performance in a situation of absent or low levels of functional interdependence (Hunt, 2002). Therefore, spending time and exerting effort on these types of interdependence relationships means, in this situation of no (low) functional interdependence, developing unnecessary behaviors that are negative for performance.

Another extreme situation is when the level of functional interdependence is high: every group member is functionally dependent upon every other group member; that is, each members' performance is dependent upon the performances of all other group members. Such a group can be labeled as inefficient because for the group to be able to finish the task takes a lot of time mainly due to the complex structure of the functional interdependence. Because of the existence of this type of interdependence, there is already a huge amount of interaction and it is highly likely that cognitive and affect-based interdependencies will develop. In that case, the cognitive and affect-based interdependencies might reduce the complexities of the functional interdependence and make group functioning more efficient by assisting the functional interdependence structure. This reasoning is consistent with empirical research in which informal relationships enhance performance because they reduce transaction costs by decreasing information asymmetries and opportunism (e.g., Lazega, 1999). These arguments lead to the following hypothesis:

Hypothesis 14: *Congruency of the three interdependency types is positively associated with effectiveness (group performance, member*

satisfaction, learning goal attainment, individual performance).

Where the cohesion argument reads that high levels of all interdependency types is better for performance, the congruency argument suggests that the levels of interdependence need to be consistent (all low, all medium, or all high) for the effective performance of individuals and groups.

5.3 Method

5.3.1 Data collection and participants

A questionnaire was sent to all second-year students (fourth semester) that participated in a course on organization design. A total number of 289 students received the questionnaire, resulting in 89 respondents (response rate 30.8%). Of these respondents, we only included those individuals of which at least 2 students in the workgroup responded, following the procedure of DeChurch & Marks (2001), resulting in 83 respondents representing 22 work groups. Among the respondents, 36.1% are women. The students' age ranged between 19 and 25 years old, the mean age is 21 years.

5.3.2 Measures

We constructed scales to measure the three interdependency types (see table 5.1). *Functional interdependence* was measured using a three-item scale. *Cognitive interdependence* was measured using a six-item scale and finally, we used a two-item scale to assess the *affect-based interdependence* among group members. All scales had acceptable reliabilities (DeVellis, 1991). On all items, respondents were asked to indicate if the item corresponds not al all (1) to totally corresponds (5) with their situation.

The above mentioned scales were constructed after performing a factor analysis. Using the oblique rotation method, we found four factors, as you can see in table 5.1. The items of the different scales all load on a different factor and together explain 60.66% of the variance.

In our analyses we decided not to include factor 3 (labeled in table 5.1 as cognitive interdependence 2) for several reasons. First of all, the reliability of this factor is relatively low (Cronbach α=0.51) and second, in the light of the previous chapters, we would like to explore another aspect of cognitive interdependence, in this case the sharing of values about the group processes (Cannon-Bowers & Salas, 2001). According to Rentsch and Hall (1994), team members need to have similar knowledge about teamwork (what it is, how it operates, etc.).

The *cohesion* of the three interdependency types – the more interdependence the better - was simply created by adding the scores on the interdependency types. To create the *congruency* variable, we first ranked the raw scores of each interdependency scale into (if possible) three categories: low, medium, and high scores. The original scores could range between score 1 (totally inappropriate) to 5 (totally appropriate). Based on this range we decided that scores lower than 2.5 indicated a low level of that type of interdependence (indicated by a score 1), a score between 2.5 and 3.5 indicated a medium level (indicated by a score 2), and scores above 3.5 a high level of interdependence (indicated by a score 3). The raw scores on the functional interdependence scale ranged between 2.67 and 5. For this variable two categories were constructed; a medium and a high interdependence category. The same yields for the cognitive interdependence scale. Raw scores on the affect-based interdependence scale fell into all three categories. After doing so, all rankings of the interdependency type were considered, in the end resulting in a variable of congruence which had four categories: 1) incongruence (the level of each interdependency type differs from the other), 2) low congruence (two interdependency types have the same level, but the third is either very low or very high), 3) medium congruence (two interdependency types show the same level, the third type is slightly higher or lower), and 4) congruence (all interdependency levels are the same: all high, medium, or low).

The dependent variables were measured as follows. *Member satisfaction* was measured using four items reflecting the satisfaction

of individuals with their work group (e.g., I am satisfied with my work group). The reliability of this scale, Cronbach α, has a value of 0.89. *Group performance* was measured in two ways. First, using four items on which individuals reported on their perception of the group's performance (e.g., our group products (assignments) meet the requested criteria). This scale proved to be reliable as well; Cronbach α=0.82. In addition, group performance is assessed by the grades groups received. *Learning-goal attainment* was measured using a five-item scale. Participants were asked to indicate in how much they felt they accomplished the learning goals of the course. The reliability of this scale is sufficient: α=0.78. The *individual performance* is the grade students received on an individually written paper. These grades range from 3.5 to 9 with a mean grade of 6.3 (s.d.=0.97).

We included task certainty as a control variable in the analyses on the individual. The relationship between uncertainty and organizational performance has been a popular topic in organizational studies, most of them conducted in the contingency research tradition (e.g., Cheng, 1984; Donaldson, 1996; Lawrence & Lorsch, 1976, Thompson, 1976). According to this theory there is no best way to organize, but efficient organization is contingent upon several factors of which task uncertainty is one. We constructed three items about the assignment students had to perform during this course (e.g., it is clear what the requirements of the assignments are). The reliability of this scale is high: Cronbach α=0.85.

We analyzed the data on both the individual level and the group level. Some of the variables are meaningless on the group level or on the individual level. Therefore, we included individual performance and satisfaction only in the analyses on the individual level and group performance only in the group level analyses. For the group level analyses, we aggregated the necessary variables. All dependent variables had eta-squares higher then the minimum value of 0.20 (Geourgopolos, 1986) (see table 5.2) so aggregation was justified based on this criterion. Finally, because of the decrease in sample size when analyzing the data on group level (N=22), we decided not to

include task certainty as a control variable in those analyses to preserve a reasonable ratio between the number of predictors and the number of subjects (Stevens, 1992).

Table 5.1 Factor loadings and reliability scores

Items	**Cogn. Interd. 1**	**Funct. Interd.**	**Cogn. Interd. 2**	**Aff. Interd.**
We have a good time working on the assignments	.71			
We trust each other	.73			
We respect each other	.61			
In my group we often talk cross-purposes (reverse coded)	.59			
I trust my group members' expertise	.76			
We can convince each other using arguments and reach an agreement	.76			
In completing the assignments you are heavily dependent upon one another		.77		
The assignments request intensive cooperation		.63		
To get good grades I am dependent upon my group members		.73		
Group members regularly ask for my advice			.80	
I regularly ask my group members for advice			.80	
Several students in my group are actually my friends				-.87
My group members and I regularly undertake leisure activities				-.80
Cronbach α	.80	.56	.51	.68

Note: We used the oblique rotation method. Factor loadings <.40 are suppressed

5.4 Results

In tables 5.2 and 5.3 the means and standard deviations of the variables of concern in this study and their correlations are displayed. The interdependence types correlate significantly with several of the outcome variables, except for individual performance. We used multiple regressions to test our hypotheses and the results are displayed in tables 5.4 through 5.6.

5.4.1 Main Effects

Recall that in hypothesis 1 and 2, we hypothesized a positive effect of functional interdependence on individual and group performance respectively. Both hypotheses were not confirmed. Our third hypothesis –functional interdependence is positively associated with learning-goal attainment- was partly confirmed at the individual level of analysis. In addition to task certainty, functional interdependence is marginally significant (β=.21; $p<.10$) and adds 7% in explaining the variation. The results did not support the prediction that functional interdependence is positively associated with member satisfaction (H4).

We predicted a positive effect of cognitive interdependency on individual (H5) and group performance (H6). As can be seen in table 5.4, cognitive interdependence is positively associated with the perceived group performance, both at the individual level (β=.26; $p<.05$) and at the group level (β=.60; $p<.05$), but not with the actual individual and group performance (grades). Hypotheses 5 and 6 are hence partially supported. Our expectation that learning-goal achievement benefits from cognitive interdependence (H7) was not confirmed on the individual level of analysis. However, on the group level, the hypothesis was supported (β=.60; $p<.05$). Cognitive interdependence showed no effect on individual performance. Finally, in hypothesis 8 we predicted a positive effect of cognitive interdependence among group members on member satisfaction. This

expectation was confirmed (β=.76; p<.01).

Affect-based interdependence has a significant negative effect on the individual perceptions of group performance (β=-.30; p<.01), providing partial support for H9b, but this interdependency type showed no significant effect with actual individual performance. No significant effects were found on the group level concerning perceived performance and the actual group performance. Both hypothesis 11 – affect-based interdependency is positively associated with the satisfaction of individuals with their group – and hypothesis 12 – affect-based interdependency is positively associated with the learning-goal attainment of individuals and groups - were not confirmed.

To summarize, the results regarding our main effect hypotheses showed that functional interdependence is (marginally significantly) positively associated with individual learning-goal attainment. The more group members perceived task interdependence among themselves, the more group members felt they attained the learning-goals of that course. We found a positive effect of cognitive interdependence on the perception of group performance and with member satisfaction. The more group members shared values about their group, the more they perceived they performed well. Cognitive interdependence is also positively associated with group learning-goal attainment. Finally, the results revealed that affect-based interdependence has a negative effect on individuals' perception of group performance.

Table 5.2 Means, standard deviations, eta-squares and correlations individual level data

Variable	Mean	SD	Eta^2	1	2	3	4	5	6	7	8	9	10
1. Task uncertainty	3.19	.74	.70	-									
2. Functional interdependence	3.93	.48	.59	.00	-								
3. Cognitive interdependence	4.01	.53	.77	.25*	.21	-							
4. Affect-based interdependence	2.86	1.19	.85	.10	.05	.41**	-						
5. Cohesion	10.80	1.61	.82	.16	.41**	.69**	.89**	-					
6. Congruence	2.88	.92	.79	.21†	.13	.43**	.82**	.78**	-				
7. Perceived group performance	3.85	.70	.71	.37**	.12	.24*	-.15	.00	.09	-			
8. Learning-goal	3.68	.51	.48	.34**	.23*	.26*	.14	.26*	.11	.24*	-		
9. Member satisfaction	3.90	.79	.74	.32**	.10	.79**	.35**	.54**	.41**	.37**	.25*	-	
10. Individual performance	6.26	.97	.42	-.10	.06	.10	-.03	.03	-.03	-.12	.10	-.03	-

N=83. †p<.10, *p<.05, **p<.01

Table 5.3 Means, standard deviations and correlations of group level data

Variable	Mean	Sd	1	2	3	4	5	6	7
1. functional I	3.94	.34	-						
2. cognitive I	3.94	.47	.13	-					
3. affect-based I	2.68	1.00	.22	-.05	-				
4. cohesion	10.57	1.36	.27	.77**	.91**	-			
5. congruence	2.73	.99	.00	.79**	.86**	.91**	-		
6. perceived group performance	3.82	.53	-.03	.37†	-.07	.07	.27	-	
7. group performance	7.09	.83	.07	.24	-.14	.00	.18	.57**	-

†p<.10, *p<.05, **p<.01

N=22

Table 5.4 Results of the main effects of the interdependency types on the performance variables

	Individual level [i]				*Group level* [ii]		
	Perceived group performance	**Learning-goal attainment**	**Individual performance**	**Member satisfaction**	**Perceived group performance**	**Learning-goal attainment**	**Group performance**
Task certainty	.37**	.34**	-.10	.37**			
Adj. R^2	.13	.10	-.00	.09			
F-value	12.68**	10.53**	.74	9.16**			
Funct. Interd.	.08	.21†	.03	-.06	-.12	.11	-.01
Cogn. Interd.	.26*	.12	.16	.76**	.60*	.70**	.44
Aff. Interd.	-.30**	.05	-.08	.02	-.39	-.16	-.37
ΔR^2	.10*	.07†	.02	.54**			
Adj. R^2	.20	.15	-.02	.62	.13	.34	.01
F-value	6.15**	4.07**	.52	34.69**	2.03	4.64*	1.09

† p<.10; * p<.05; ** p<.01
[i] N=83 ; [ii] N=22;
Note: entries are standardized beta-coefficients

5.4.2 *Integrative effect*

We found a number of significant main effects but what about the integrative effect of the three interdependency types? The cohesion hypothesis (H13) stated that the more people experience all three interdependency types the better their effectiveness will be. With respect to perceived performance, we did not find an overall cohesion effect, meaning that higher levels of all three interdependency types did not explain perceived group performance (both at the individual level and the aggregated data level). For learning-goal attainment, cohesion is indeed a significant predictor (see table 5.5.). The higher the levels of the three interdependency types, the higher the learning-goals attainment ($\beta = .21$, $p<.05$). Cohesion in the sense that individuals experience high levels of all interdependency types appears also to be important with respect to member satisfaction ($\beta = .50$; $p<.01$). However, when looking at the amount of variance explained by the model, the cohesion model explains far less (i.e., 33%) then the main effects model (i.e., 62%). Finally, for individual performance, cohesion was not significant.

For the congruency of the interdependency types (H14) we expected a positive effect on the five performance variables. On the individual level of analysis, we found a significant positive effect of congruency on perceived group performance and on member satisfaction, above and beyond the main effects of the interdependency types. Additionally, we found on the group-level of analysis that congruency is positively associated with perceived group performance and actual group performance. Hypothesis 14 was partially confirmed by these results.

Table 5.5 Regression results of the cohesion effect on performance

	Individual level [i]				*Group level* [ii]		
	Perceived group performance	**Learning-goal attainment**	**Individual performance**	**Member satisfaction**	**Perceived group performance**	**Learning-goal attainment**	**Group performance**
Task certainty	.37**	.34**	-.10	.36**			
Adj. R^2	.13	.10	-.00	.09			
F-value	12.68**	10.53**	.74	9.16**			
Cohesion	-.06	.21*	.05	.50**	.07	.42†	.00
ΔR^2	.00	.04*	.00	.25**			
Adj. R^2	.12	.14	-.01	.33	-0.5	.14	-.05
F-value	6.45**	7.52**	.45	21.44**	.10	4.36†	.00

† p<.10; * p<.05; ** p<.01
[i] N=83 ; [ii] N=22;
Note: entries are standardized beta-coefficients

Table 5.6 Hierarchical regression results of the congruence effect on performance

	Individual level [i]				*Group level* [ii]		
	Perceived group performance	**Learning-goal attainment**	**Individual performance**	**Member satisfaction**	**Perceived group performance**	**Learning-goal attainment**	**Group performance**
Task certainty	.37**	.34**	-.10	.37**			
Adj. R^2	.13	.10	-.00	.09			
F-value	12.68**	10.53**	.74	9.16**			
Funct. Interd.	.08	.21†	.03	-.06	-.12	.11	-.01
Cogn. Interd.	.26*	.12	.16	.76**	.60*	.70**	.44
Aff. Interd.	-.30**	.05	-.08	.02	-.39	-.16	-.37
ΔR^2	.10*	.07†	.02	.54**			
Adj. R^2	.20	.15	-.02	.62	.13	.34	.01
F-value	6.15**	4.07**	.52	34.69**	2.03	4.64*	1.09
Congruence	.49**	-.26	-.05	.16	1.38*	.74	1.46*
ΔR^2	.07**	.02	.00	.01	.20*	.06	.22*
Adj. R^2	.27	.16	-.03	.63	.32	.37	.23
F-value	7.00**	4.07**	.52	28.29**	3.49*	4.14*	2.56†

† p<.10; * p<.05; ** p<.01; [i] N=83 ; [ii] N=22; *Note: entries are standardized beta-coefficients*

5.5 Discussion

With this study, we contribute to the existing literature on the coordination-performance relationship within organizations by distinguishing three different types of interdependence and how they affect several aspects of effectiveness. In the organizational design tradition, there is a preference for investigating the functional interdependence that stems from the division of labor (e.g., Galbraith 1973; Hage 1980; Thompson 1967). Some studies do consider the social side of coordination (e.g., Espinosa et al., 2004; Gittel 2000; 2002) but without specifying the interdependencies that are in play. The findings of this study suggest that there are indeed other interdependency types in play among group members in addition to task interdependence. The results indicate that the different interdependency types affect different aspects of performance.

Functional interdependence was found to be (marginally) positively associated with learning-goal attainment at the individual level of analysis. The motivation to contribute to the group and to develop learning behaviors is affected by the perceived task interdependency of individuals, which is consistent with research that studied the effect of group experience on individual learning (Brodbeck & Greitemeyer, 2000). The reason that we only found a marginal positive effect might be that group members could decide to divide the group task into several individual tasks and then could combine the different individual outputs into a group output. In these situations, there is not much group experience in which individuals interact and consequently may learn from each other (Olivera & Straus, 2004). Nevertheless, group members indicated that they experienced task interdependence. This can be explained by the fact that we did only ask for task interdependence and made no differentiation to task-, goal-, or outcome interdependence. We suspect that if respondents were exposed to more (sub) types of functional interdependency, we would have been more able to distinguish between the groups that acted as groups and groups that

decided to break up the group task into individual tasks.

As predicted, cognitive interdependence – shared values concerning the group and its processes – positively contributed to perceived group performance at both the individual and group level, and member satisfaction. Sharing ideas or values concerning the group helps individual group members to foresee and act upon each others' actions or needs (Cannon-Bowers & Salas, 2000; Druskat & Pescosolido, 2002; Weick & Roberts, 1993) and makes group members feel satisfied with their fellow group members. In addition, we found cognitive interdependence to be of importance for predicting learning-goal attainment of the group. In groups with high cognitive interdependency, there was more consensus among members that they indeed attained the learning goals of the course they attended. This finding is consistent with prior research on 'psychological safety' in which a shared belief about the safety within a team for interpersonal risk taking was associated with team learning (Edmondson, 1999).

Having high affect-based interdependence decreased the individual perception of group performance. We suspect that individual team members might feel 'guilty' for mixing work with pleasure. Instead of working, those group members with friends might enjoy talking amongst themselves or joking or any other non-work related actions during work hours (Jehn & Shah, 1997). So when asked about how they think their group actually performed, individuals may perceive their team performance lower if they have friends in that team than individuals who do not experience affect-based interdependence.

Work group members not only experience task interdependency but are also likely to develop cognitive and affect-based interdependency, which is why we found it necessary to study the integrative effect of the three interdependency types. We developed two rationales that might explain the integrative effect. First, the cohesion model stated that the more task interdependence group members experience, the more values about the group and how it works are shared, and the more affect-based interdependence, the

better it is for performance. We did find cohesion to be of significance for predicting learning-goals attainment (at the individual and group level) and member satisfaction, which is consistent with social integration studies (O'Reilly et al., 1989; Van der Vegt, 2002). However, it should be noted that the amount of explained variance is lower than the amount explained by the main effects model. The cohesion model therefore did not substantially add to our understanding of how the three interdependencies integratively affect performance. Second, we formulated a congruency hypothesis and predicted that when the levels of task interdependence are compatible with the level of cognitive and affect-based interdependence (e.g., low-low-low or high-high-high) would lead to effective performance. We found a positive effect of congruence on the perception of group performance. This is a very interesting finding, given the results of the main effects model in which sharing values about the group increases group performance perception whereas having friends as group members decreases the perception of performance. We therefore propose that feeling guilty for mixing work and fun only happens if the interdependencies among group members are not aligned. Congruency is beneficial for the groups' learning-goal attainment and the groups' performance. In both cases, the congruency variable explains at least 20 percent of the variance in addition to the main effects of the interdependence types. These results seem to imply that congruence of the interdependencies is even more important for group performance then for individual performance.

Even though studies have found that group experience is salient for individual performance because it may improve the skills of individuals (Littlepage, Robinson & Reddingron, 1997), being task interdependent, sharing values about the group and how it works, and/or friendship were in this study not significant for the objective individual performance (individual grade). However, the standard deviation of the individual grades is not very large which may be one reason for the lack of a significant effect.

This study also has other limitations. One limitation is the

specific nature of the groups studied in this paper. University students served as the participants in this study, a subject of much dispute in organizational research. However, the students did operate in groups for a few weeks, working on multiple tasks and assignments. Still, these student groups might differ from workgroups in actual organizational settings. We do have confidence in the findings reported here because we used different self-report evaluations as well as an objective measure for both individual and group performance. Future research should be done to replicate the findings of this study with organizational groups and teams. If the same patterns are found, this means that the current discussion about coordination and interdependencies is more universal than often thought. Another limitation of this study is the small sample size. Future research should therefore re-test our model using more workgroups. Additionally, we cannot draw any conclusions regarding the causality of findings although we assume that the interdependency types and their integration lead to several performance outcomes. Future research needs to be of a longitudinal nature in order to draw any conclusions regarding the causality of effects.

To summarize, this study investigated the main and integrative effects of functional, cognitive, and affect-based interdependence on individual and group performance. The results suggest that research on the coordination-performance relationship within organizations will benefit by examining cognitive and affect-based interdependence simultaneously in addition to functional interdependence.

CHAPTER SIX

General conclusion & discussion

6.1 Introduction

In the chapters thus far I tried to find an answer to the question how multiple interdependency types affect both individual and group effectiveness in order to gain more insight in the complex relationship between coordination and performance into organizational groups. In this chapter I synthesize the empirical findings and discuss the contributions of this thesis research. After that, the limitations of this research are discussed and suggestions are given for future research. Finally, I give some thoughts about the practical implications of this research.

6.2 The empirical findings: Synthesis of the 3 studies

To fully understand the coordination-performance relationship in organizations I proposed to study three different types of interdependency: functional, cognitive, and affect-based interdependence. Functional interdependence is the dependency individuals experience regarding the workflow in their group or organization; one employee can only perform well if her/his colleagues perform well. Cognitive interdependence, in general, refers to the interdependency people experience for creating a shared understanding of the situation they are facing. Affect-based interdependence refers to the interdependency people experience regarding feelings of social well-being and social acceptance. In the three empirical studies, the effect of the three interdependency types on effectiveness was studied. In all three empirical studies, we investigated the main effects of the interdependency types, and in two of the three studies we also investigated the integrative effects the

interdependency types had on effectiveness. I first discuss the main effects (section 6.2.1) and after that I discuss the integrative effect (6.2.2) on effectiveness. All empirical findings are summarized in table 6.1.

6.2.1 Main effects

In each of the three empirical studies, I investigated the main effects of the three interdependency types on several aspects of effectiveness. An overview of the main effect findings on the effectiveness of individuals is presented in the first three rows of table 6.1. In the railroad study (chapter 3), we found that functional interdependence did affect the (actual) performance of individuals (as rated by the supervisor). This finding is in line with the learning literature in which it is suggested that group experience –which is thought to be higher when task interdependence is perceived to be high – enhances individual performance because group experience improves individuals' skills (Littlepage et al., 1997; Olivera & Straus, 2004). Functional interdependence was found to positively affect job satisfaction (in the railroad study – chapter 3), but for member satisfaction (student workgroups – chapter 5) we did not find a significant effect. Functional interdependence also marginally positively influenced learning-goal attainment (in the student workgroups –chapter 5), which is consistent with prior research (Brodbeck & Greitemeyer, 2000; Johnson & Johnson, 1989). Recall that cognitive interdependency was operationalized differently in the railroad study (chapter 3) then in the student workgroups (chapter 5). In the railroad study, cognitive interdependency was defined as interdependency concerning task-related knowledge and in the student workgroups this concept reflects the interdependency with regard to the shared values about the group processes (Cannon-Bowers & Salas, 2001). In the railroad study, we found that the higher the cognitive interdependence, the higher the performance (as scored by the supervisor) of the group members. This effect was not found in the student workgroups. Regarding perceived performance, we found no

effect of cognitive interdependence in the railroad study whereas in the student workgroups we found a positive effect. Interdependence concerning sharing values about the group and its processes - allowing 'heedful interrelations' (cf. Weick & Roberts, 1993) - had an effect on member satisfaction and learning-goal attainment of the students. Being interdependent for feelings of social well-being and social acceptance had a positive effect on the performance of individuals (as scored by the supervisor) in the railroad study (chapter 3). Having friends did lower the perception of the students regarding their group performance (chapter 5). Friends are likely to spend time on and to enjoy talking, joking, or any other non-work related behavior during work hours, which might result in lower performance perceptions if individual members feel guilty for mixing work and pleasure. Overall however, affect-based interdependence increased effectiveness; affect-based interdependence was found to positively influence job satisfaction as well as extra-role behaviors (railroad study – chapter 3).

Some of these findings were strengthened by additional analyses we performed on deviations from the general level of perceived interdependency (railroad study – chapter 3). The effect of functional interdependence on performance was strengthened by the finding that deviation from the generally perceived level of functional interdependence was associated with lower performance levels. In addition, those individuals who perceived less cognitive interdependence then the group on average showed a (marginal) negative association with performance. We also found that deviation from the generally perceived level of affect-based interdependence was negatively associated with extra-role behavior, which strengthened the positive result between the relational measure of affect-based interdependence and extra-role behavior.

In the bottom half of table 6.1, the results of the interdependencies on group effectiveness are presented. Whereas functional interdependence had a positive influence on several aspects of individuals' effectiveness, on group outcomes we did not find any

significant results. This might be due to the relatively small variance of functional interdependence in both the R&D teams (chapter 4) and the student workgroups (chapter 5). Consistent with the findings on the individual level, there was a positive effect of cognitive interdependence on the perceptual performance and learning-goal attainment (student workgroups - chapter 5). The more group members agreed upon what values they find important for their group and working as a group, the better those groups perceived their performance and the more they felt they had met the learning goals of the course they attended. Finally, affect-based interdependence had a positive effect on the performance perception in the R&D teams (chapter 4).

With respect to comparing individual and group effectiveness, cognitive interdependence was positively associated with individuals' and groups' perceived performance and learning-goal attainment. In addition, comparing the main effects found on individual outcomes with group outcomes does show some differences. Functional interdependence showed no association with the different aspects of group effectiveness, which can be a resultant of small variance. In addition, cognitive and affect-based interdependence showed no association with groups' performance but did so with individual performance levels.

In sum, the overview of the main effects (table 6.1) shows several interesting findings. The results clearly show that it is not just functional interdependence that affects several aspects of effectiveness, but that cognitive and affect-based interdependence are also of importance for individual and group effectiveness.

6.2.2 Integrative effects

Within organizational groups, members likely experience several types of interdependence at the same time (Lindenberg, 1997). Therefore, in chapters 4 and 5, we studied the integrative effects of functional, cognitive, and affect-based interdependency on effectiveness. We formulated and tested two hypotheses on this

integrative effect. First, we argued that the more interdependence individuals perceive, the better their performance would be – the cohesion hypothesis. When members experience a high level of functional, cognitive, and affect-based interdependence, there is a strong connection among those group members on several dimensions. Members of such groups are argued to be highly socially integrated (O'Reilly et al., 1989; Van der Vegt, 2002) with high within-group communication (Wech et al., 1998) which is expected to result in high effectiveness levels. We found significant effects of the cohesion of the interdependencies on member satisfaction and learning-goal attainment in the student workgroups (see table 6.1). These results suggest that high levels of all three interdependency types are associated with more satisfaction and more goal-attainment. However, a closer look at this integrative effect revealed that even though we found significant β-values, the explained variance of the cohesion model was the same or even less then the main effects model. According to social integration theory, the more socially integrated individuals become, the better their effectiveness (e.g., Smith et al., 1994). Our test of the cohesion hypothesis did not show that social integration theory is wrong, however, it illustrates the benefit of making a distinction between the types of interdependencies group members have. Testing the model with the relationships separately (the main effects model) shows a better fit with the data and explains more variance.

In addition to the cohesion model, we also formulated a congruency hypothesis, in which we expected the different interdependency types needed to be aligned for effective performance. For example, when group members experienced a low level of task interdependence, it was expected they would perform better when the level of cognitive and affect-based interdependency would be low as well. Indeed, congruency of the interdependency types was positively associated with perceived group performance and member satisfaction (student workgroups – chapter 5). In addition, we found congruency to be significantly and positively associated with performance of student

workgroups. The more the perceived interdependencies were aligned, the better groups performed.

Testing if congruency of the actual interdependency relationships positively influenced performance was possible at the group level using the relational data from the R&D teams (chapter 4). The congruency variable did not show any association with performance of the R&D teams. Plotting the congruency variable with performance did show a pattern consistent with our hypothesis. But we have also seen that most teams in that study were on the low end of the congruency variable and only a few teams were characterized by a high congruency. In addition to testing the overall congruency effect, we investigated the amount of overlap (i.e., correlation) between the three networks. This analysis revealed that the overlap of mutual task interdependency relationships with friendships had a marginally significantly negative association with performance (perceived performance). Since the performance measure was perceptual, we think that –like we argued before- mixing work and fun might lead to feelings of guilt, resulting in lower performance perceptions when individuals are confronted with such a question.

6.3 Contributions

Overall, the three empirical studies lead to the conclusion that functional interdependence is not the only interdependency type that is important for both individual and group effectiveness as past research in organizational design suggested (e.g., Thompson, 1967; Van der Ven et al., 1976). An interesting finding in this respect is that functional interdependence was positively associated with individual effectiveness but not with group effectiveness. This finding is interesting because several empirical studies did not find a direct effect of task interdependence on individual performance (e.g., Shaw et al., 2000; Van der Vegt et al.,1999). Second, the finding that task interdependence does not affect group performance at all in the three studies, as well as the different effects cognitive and affect-based

interdependence have on individuals and groups, may point to a more complex picture of group dynamics then past research and theory anticipated. To address this issue, we introduced the congruency hypothesis and examined if the three interdependencies need to be comparable in levels (all high or all low) to enhance effectiveness of individuals and groups. We found support for this effect on member satisfaction, perceived performance, and group performance.

This research also contributes to the literature by using both attribute and relational measures to study the interdependencies. Earlier we showed that the analysis of the main effect of each interdependency type on individual performance lead to different results (see tables 6.1 and 6.2). In chapter 3 - in which both methods were used - we argued that both measures actually measure slightly different aspects of intragroup interdependency. The individuals' perception of interdependence is captured when using the attribute measures. The relational measures reflect the position of each group member in the network of interdependence relationships. Hence, the relational measure is relative because it depends on all existing relationships among group members. Since they measure different aspects of interdependence, the results can be interpreted as being generally complementary.

In addition, we tested hypotheses on different datasets, including data that were gathered without this current research in mind, which implies that the tests are considered conservative. Another advantage in using existing data for this research is that the theory of the multiple interdependencies was tested in different organizational settings. The findings show in all three settings that it is not just functional interdependence that is important for performance. This suggests that the relationship between the multiple interdependencies and individual and group effectiveness is of importance despite the organizational setting. Future research should continue to examine multiple interdependencies in other settings and organizations.

Finally, this research contributes to the literature on

workgroups in organizations by examining the effect of the interdependencies on both individual and group effectiveness. Working in groups can have important implications for individual attitudes and behavior, but these individual level outcomes have not received as much attention as group outcomes have (Shaw et al., 2000). Not only did we show that group members individually benefit from group experiences, but also that the effects of the interdependency types might be different for group performance. This finding may be important for enhancing our knowledge about of the interplay between individual and group effectiveness and suggest that a more complex theoretical model is needed for explaining multiple levels of effectiveness in workgroups.

To summarize, this study is a starting point for future research to consider not just functional interdependence when studying the coordination-performance relationship within organizations. It appears that interdependence for task-related knowledge/shared group values and interdependence for feelings of social well-being and social acceptance are equally (if not more) important in predicting several outcomes of both individuals and groups. In addition, this research showed that a certain profile of interdependence within a group enhances the effectiveness of individuals and groups. That is, when functional, cognitive, and affect-based interdependence are congruent (all low or all high) individuals and groups are more effective than when the interdependency types show less congruence.

6.4 Limitations and future research

As in all research, this dissertation research has in addition to its strengths some weaknesses. The first limitation of this research is the small size of the three samples, which is problematic regarding statistical power for the hypotheses tests performed. Future research needs to retest the model using a larger sample. Related to this, not all data were gathered with this specific research in mind. Although this implies that we have conservative tests of our model, it also implies

that not all concepts could be measured in exactly the same way throughout the three studies. Doing so would lead to more comparable findings.

Second, the measurement of cognitive interdependence shows a clear difference between the studies. In the related literature on shared cognition up to four different categories are distinguished (Cannon-Bowers & Salas, 2001), but we only used two different definitions. In chapters 3 and 4 cognitive interdependence was defined as the interdependence with respect to the exchange of task-related knowledge. Cognitive interdependence was operationalized in chapter 5 as the interdependency regarding sharing values about the group and its processes. The measurement varies and both the studies reported in chapters 3 and 5 show different results. In chapter 3, the interdependence with respect to the exchange of task-related knowledge did not show any positive associations with performance whereas the attribute measure in chapter 5 revealed quite a few positive associations. These results seem to suggest that sharing values is more important for performance then the sharing of task-related knowledge. However, we used this operationalization in one study and it would therefore be interesting for future research to investigate whether this implication –one category of cognitive interdependence is more important for individual and team performance then another - is indeed true. In addition, throughout this research, cognitive interdependence was conceptualized as something positive. There are also instances that cognitive interdependence might have negative consequences. A group can become highly interdependent upon a shared definition of the situation but this definition can be wrong (i.e., groupthink) and faulty decisions made (Janis, 1972). Also, workgroups can create shared values that counteract with the organization's goals such as shirking (Roy, 1952). It would broaden and strengthen the theory of multiple interdependencies for which this research provided a first step if future research could take the *content* of the shared values or knowledge into account.

Third, future research might broaden the operationalization of

functional interdependence. In this thesis, I only considered task interdependence. However, functional interdependence is not only about task interdependence, goal and outcome interdependency are both aspects of functional interdependence as well. Past research has investigated these interdependency types on performance (e.g., Van der Vegt, et al., 1999, 2000; Wageman, 1997) and implies that all aspects of functional interdependence do not have the same effect on outcome measures.

Fourth, while testing the multiple interdependencies in different organizational settings is an advantage, it nevertheless also implies problems of comparison. The three interdependencies separately and/or integratively affected effectiveness in all settings, but it is likely that the difference in organizational settings is one of the reasons for the different results we found in the studies. In the railroad company, we investigated rather large workgroups and the group members only belonged to one workgroup. In contrast, we also studied research and development teams that –on average- were smaller in size and members could belong to more than one team at the same time. In addition, both the R&D teams and the student workgroups only functioned as a group for a specific time. These three settings do not represent the entire range of organizational workgroups and teams, which limits the generalizability of the results. The results of the studies presented in this thesis seem to suggest that for small groups, with a limited time-span, and whose members (can) belong to more than one group at the same time, only affect-based interdependence is important for their effectiveness. Furthermore, for large and stable groups the results suggest that each interdependency type positively affects individual performance whereas for small groups with a limited life-span the interdependencies seem to be unimportant for individual performance. In addition, the congruency of the three interdependencies affected effectiveness of both individuals and groups in the student workgroup data. This suggests that congruency might only be of importance for small groups with a limited time-span. Finally, all settings differed in their tasks as well. It

may be that for workgroups in which creativity is very important (such as R&D teams) it may be less critical for their members to integrate knowledge in order to perform well (Lewis, 2003). Therefore, all these variables –group size, life-span, multiple team membership, task type- are interesting moderator variables that future research should investigate in order to further specify the theoretical model presented in this dissertation.

Fifth, in this research, a number of the performance measures were perceptual measures. Although these measures are important as well, they do not represent the actual performance. Therefore, we suggest that future research investigates the influence of the interdependency types on performance by means of more objective measures of performance. In addition, using multiple methods to collect data about the same constructs adds more rigor to the results (Jick, 1979).

Finally, (most of) the concepts used in this dissertation are measured with a questionnaire at one point in time and all analyses are correlational, which makes it hard to say anything about causal relationships between the interdependency types and the different performance measures. Furthermore, the interdependencies are not assumed to be stable but are likely the change over time. Newly founded workgroup members need time to get used to the functional interdependencies, to get to know each other, and to form cognitive and affect-based interdependence. In established workgroups destructive events, for example conflict, might occur which are expected to influence the structure of interdependencies. It would therefore be interesting for future research to gather data on several points in time. Based on such longitudinal research, conclusions about causality could be made. In addition, it would provide more information about the process of interdependence alignment (i.e., coordination).

6.5 A note on the implications for organizational practice

The results of this thesis research have important implications for organizational practice. Amongst other things, this research showed that several aspects of individual and group effectiveness benefit from the three interdependence types. For each aspect of effectiveness that was addressed in this thesis, I will discuss the optimal profile of interdependency.

Group members' actual performance will benefit from higher levels of functional, cognitive, and affect-based interdependence. Not only are task dependencies important, members also need to share task-related information and preferably be friends, which contributes to the effective performance of individuals. Group members are more likely to show extra-role behaviors when they experience affect-based interdependence in their group. Group members are likely to feel more satisfied with their group when the three interdependency types are congruent, that is, when they are all high or low. Congruency of the interdependency types is also beneficial for perceived group performance. With respect to learning, it is likely that group members learn better when both functional and cognitive interdependency are high. The more group members are task dependent and the more they share the same positive values concerning the group processes, the more members are likely to feel secure and safe (Edmondson, 1999), and hence, the more group members will display learning behaviors such as asking questions or feedback.

So overall, managers should focus on the interplay of the three interdependency types to monitor the effectiveness of individuals in groups. When functional interdependence is rather low within a group, managers may not want to recommend high task-related information exchange and shared values concerning the group (Weick & Roberts, 1993). In addition, although management does not play a role in their employees' friendship choices, managers can actively intervene in groups that are actively engaged in socializing –such as gossiping and joking (Jehn & Shah, 1997) - instead of focusing on work. Likewise,

in situations in which the functional interdependency among group members is high, it is advisable to acquire high levels of cognitive and affect-based interdependency among group members as well. In those situations, managers might want to stress the importance of sharing (positive) team values on group processes. By means of job rotations or feedback programs, sharing task-related knowledge can be stimulated. With respect to affect-based interdependence, managers may indulge the increased socializing among friends as long as those groups continue to do their tasks.

Table 6.1 Summary of the empirical results

	Functional interdependence	**Cognitive interdependence**	**Affect-based interdependence**	**Cohesion**	**Congruence**
Individual level					
Performance	+ (r) railroad	+ (r) railroad	+ (r) railroad	n.s.	n.s.
Perceptual performance	n.s.	+ (a) students	- (a) students	n.s.	+ (a) students
Satisfaction	+ (a) railroad	+ (a) students	+ (a) railroad + (r) railroad	+ (a) students	+ (a) students
Learning	+ (a: marg) students	+ (a) students	n.s.	+ (a) students	n.s.
Extra-role behavior	n.s.	n.s.	+ (r) railroad	n/a	n/a
Group/aggregated level					
Performance	n.s.	n.s.	n.s.	n.s.	+ (a) students
Perceptual performance	n.s.	+ (a) students	+ (r) r&d teams	n.s.	+ (a) students -(r: marg) overlap functional and affect-based interdep. railroad
Learning	n.s.	+ (a) students	n.s.	+ (a: marg) students	n.s.

+: positive association; -: negative association; n.s.: non significant; n/a: not available (not studied); (r): relational data; (a): attribute data; marg: marginally significant

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SAMENVATTING

In deze dissertatie heb ik onderzocht of, en zo ja hoe meerdere typen interdependentie in werkgroepen bijdragen aan de effectiviteit van werkgroepen en van haar leden. Aanleiding voor dit onderzoek – zoals uitgebreid beschreven is in de hoofdstukken 1 en 2- is de relatie tussen coördinatie en *performance*. Coördinatie is een belangrijk onderwerp in de organisatieliteratuur en wordt van wezenlijk belang geacht voor het voortbestaan van groepen en organisaties (Heath & Staudenmayer, 2000). Het algemene idee is dat er tussen coördinatie en performance een positieve samenhang bestaat, met andere woorden meer coördinatie leidt tot een hogere performance. Hoewel deze aanname door menigeen voetstoots wordt aangenomen, is er weinig empirisch bewijs dat deze aanname kan staven (Gittel, 2002; Hage, 1980).

Belangrijke contributies op het gebied van coördinatie zijn van de hand van Thompson (1967), Galbraith (1973, 1977), en Van de Ven et al. (1976) die zich allemaal richtten op coördinatie mechanismen. De diverse mechanismen die worden aangedragen onder andere door de zojuist genoemde auteurs (zie tabel 2.1 voor een impressie) zijn allemaal instrumenten om de interdependentie die veroorzaakt wordt door de arbeidsdeling (functionele of taak afhankelijkheid) te coördineren. De gedachte hierbij is dat alleen het afstemmen van dergelijke taakafhankelijkheden voldoende is voor het welslagen van groepen of organisaties. Echter, wanneer men alleen deze functionele of taak afhankelijkheid in ogenschouw neemt, wordt een groot deel van de betrokken individuen en hun gedragingen genegeerd. Deze tekortkoming is mijns inziens debet aan het feit dat de coördinatie-*performance* relatie empirische onderbouwing mist en theoretisch ondoorzichtig blijft. Het is zeer aannemelijk dat naast de functionele interdependentie, die in beginsel formeel ontworpen is door de organisatie, ook andere typen interdependentie van een meer

informele of sociale aard, een rol spelen. Daarom onderschrijf ik de stelling van Lindenberg (1997) dat zelfs in situaties waarin de taak of functionele interdependentie laag is, andere vormen van interdependentie aanwezig zijn tussen de betrokkenen. Ook deze vormen van interdependentie moeten worden afgestemd wil een team, een groep of een organisatie effectief kunnen functioneren.

Interdependentie is in dit onderzoek gedefinieerd als "a state of being in which a person is determined, influenced, or controlled by some other person" (DeSanctis, Staudenmayer & Wong, 1999: p.82). Gebaseerd op het overzichtsartikel van Lindenberg (1997) en het klassieke artikel van Tichy, Tushman & Fombrum (1977) onderscheid ik in dit onderzoek drie verschillende typen interdependentie. Ten eerste de al eerder genoemde functionele interdependentie welke verwijst naar de afhankelijkheden van groepsleden die verbonden zijn aan de collectieve taak of het collectieve doel. Functionele interdependentie is in dit proefschrift gedefinieerd als een relatie tussen groepsleden waarin noodzakelijke hulpbronnen worden uitgewisseld zodat de taak volbracht kan worden. Het tweede type interdependentie is cognitieve interdependentie en is in deze dissertatie op twee manieren gedefinieerd. In de hoofdstukken 3 en 4 is cognitieve interdependentie gedefinieerd als relaties tussen groepsleden gericht op het creëren en/of in stand houden van een gedeeld referentiekader met betrekking tot de taak. In hoofdstuk 5 is deze interdependentie gedefinieerd als relaties tussen groepsleden gericht op het creëren en/of in stand houden van een gedeeld referentiekader met betrekking tot het groepsproces. Tot slot heb ik een derde type interdependentie toegevoegd namelijk die afhankelijkheid binnen groepen die gebaseerd is op positief affect. Dit type interdependentie is gedefinieerd als relaties waar mensen afhankelijk zijn van de ander(en) voor gevoelens van sociaal welzijn en sociale acceptatie.

Naast het feit dat ik drie in plaats van één type interdependentie heb onderzocht, is een andere bijdrage van dit onderzoek het relationele perspectief (i.e., sociale netwerk perspectief)

dat ik heb gebruikt. Deze benadering maakt het niet alleen mogelijk de verschillende interdependenties simultaan te onderzoeken, het theoretisch integreert de verschillende typen tevens. Ieder interdependentie type verwijst in netwerktermen naar een verschillende relationele inhoud. Functionele interdependentie bijvoorbeeld verwijst naar de relatie tussen twee of meer individuen van welke zij afhankelijk zijn voor het verkrijgen van noodzakelijke taakgerelateerde hulpbronnen zonder welke de taak niet gedaan kan worden. Het patroon van dergelijke relaties in een groep (sociaal netwerk) kan gezien worden als een vorm van coördinatie ('self-coordination'). Waar vorig onderzoek vooral heeft gekeken naar de effecten van formele coördinatiemechanismen, onderzoek ik de actuele, dagelijkse situatie door de verschillende interdependentierelaties in kaart te brengen. De effecten van de drie interdependentie typen alsook het simultane effect op de effectiviteit van individuele groepsleden en hele groepen zijn onderzocht in drie empirische studies.

Multipele interdependenties en individuele effectiviteit

Hoe de drie verschillende interdependentie typen de effectiviteit van individuele groepsleden beïnvloedt, wordt in hoofdstuk 3 empirisch onderzocht. In dit hoofdstuk is ten eerste onderzocht of functionele, cognitieve en affectgebaseerde interdependenties een positief effect hebben op de effectiviteit van individuele groepsleden. Voor deze studie zijn data verzameld bij twee planningsafdelingen van een Nederlands spoorwegenbedrijf. De resultaten van deze studie bevestigden het positieve effect van functionele interdependentie voor de effectiviteit van individuen. Hoe meer taakafhankelijkheid groepsleden percipieerden, hoe meer tevreden zij waren met het werk. Bovendien bleek dat mensen in een functionele afhankelijkheidsrelatie beter presteerden binnen hun werk. Ook wat betreft de cognitieve interdependentie werd een positief effect gevonden voor de effectiviteit van individuen: een centrale positie in het netwerk van dit type interdependentierelaties hangt

positief samen met individuele prestaties. Dit effect lijkt er op te wijzen dat de centrale personen belangrijke 'beïnvloeders' zijn binnen de groep wat betreft het beeld over de taak. Affectgebaseerde interdependentie heeft een positieve associatie met werk tevredenheid. Het hebben van affectgebaseerde interdependentierelaties had eveneens een positief effect op de prestaties en op *extra-role behavior*(gedrag dat werknemers spontaan vertonen en dat niet afgedwongen kan worden door de organisatie).

Ter aanvulling op de drie hoofdeffecten, heb ik in hoofdstuk 3 ook gekeken naar de mate waarin groepsleden verschillen in hun perceptie van de mate van interdependentie in de groep. Ik veronderstelde dat een verschil in perceptie negatief zou samenhangen met individuele effectiviteit. Deze veronderstelling werd grotendeels ondersteund door de data. Verschillen in perceptie over de functionele en affect gebaseerde interdependenties binnen een groep, hangen negatief samen met de prestaties alsook met *extra-role behavior*. Verschillen in perceptie over de mate van cognitieve afhankelijkheid in een groep had in tegenstelling tot onze verwachting een positief effect op de prestaties. Nader onderzoek van de data liet zien dat voor degenen die minder cognitieve afhankelijkheid percipiëren dan de rest van de groep, cognitieve afhankelijkheid negatief samenhangt met hun prestatie. Wanneer de mate van cognitieve afhankelijkheid hoger geschat wordt dan de rest van de groep, vinden we een marginale positieve samenhang tussen cognitieve afhankelijkheid en *extra-role behavior*.

Daarnaast heb ik in hoofdstuk 3 gebruik gemaakt van twee verschillende manieren om de interdependenties te meten. Ik heb een onderscheid gemaakt tussen relationele en attributie data. Relationele data bestaan uit de relaties tussen individuen, om precies te zijn uit afhankelijkheidsrelaties tussen twee of meer werkgroepleden. Daarnaast heb ik ook gebruik gemaakt van de meer traditionele attributie meetmethoden die de houdingen, gedragingen en percepties van de ondervraagden weerspiegelt. Op deze manier kon ik een vergelijking maken tussen de verschillende meetmethodes. De analyse

van deze twee typen data liet verschillende resultaten zien die in het algemeen complementair zijn. Bestaande onderzoeken naar interdependentie hebben voornamelijk attributie maten gebruikt, met de uitzondering van sociale netwerkstudies die alleen maar relationele maten hebben gebruikt. Met deze studie heb ik laten zien dat naast attributiematen, relationele maten van de interdependenties additionele informatie herbergen en goed naast attributiematen gebruikt kunnen worden.

Samenvattend laat de studie in hoofdstuk 3 duidelijk zien dat voor de individuele effectiviteit het niet genoeg is om alleen de functionele interdependentie in ogenschouw te nemen. In dit onderzoek is aangetoond dat ook de cognitieve en de affectgebaseerde interdependenties van belang zijn voor de effectiviteit van individuele groepsleden. Een gedeeld beeld of referentie kader over de taak in een groep, en het bestaan van relaties tussen groepsleden voor het verkrijgen van sociale acceptatie en sociaal welbevinden, verhogen de effectiviteit van de groepsleden.

Hoofd- en congruentie-effecten van multipele interdependenties op groepseffectiviteit: Een relationeel perspectief

In hoofdstuk 4 heb ik de hoofdeffecten van de interdependentie types getoetst, evenals het congruente effect van de drie interdependenties op de effectiviteit van teams. De hypothesen zijn getoetst met behulp van data van 51 R&D teams (Kratzer, 2001) en de interdependenties zijn in deze studie relationeel van aard. Dat wil zeggen dat ik alleen naar daadwerkelijke afhankelijkheidsrelaties tussen teamleden hebben gekeken. Functionele interdependentie is in deze studie gedefinieerd als een wederzijdse relatie tussen twee of meer personen die werk output uitwisselen gedurende het verloop van het werk. Cognitieve interdependentie verwijst in deze studie naar die relaties waarin taakgerelateerde informatie wordt uitgewisseld. De affectgebaseerde interdependentie verwijst naar vriendschap tussen teamleden. In deze studie is onderzocht hoe deze drie interdependentierelaties de perceptie van team prestatie beïnvloedt.

De resultaten van deze studie bevestigden de hypothese dat affectgebaseerde afhankelijkheid positief samenhangt met perceptie van teamprestatie. Van de functionele en cognitieve interdependentie werden in deze studie geen hoofdeffecten gevonden. Naast de hoofdeffecten had ik ook een congruentie hypothese opgesteld waarin ik verwachtte dat naarmate de interdependentierelaties meer congruent zijn, de perceptie van team prestaties hoger zijn. Dit werd echter niet gestaafd door de data, al lieten de data wel een patroon zien dat overeenkomstig is met de congruentie hypothese. Ter aanvulling heb ik tevens op een alternatieve wijze onderzocht of congruentie van belang is voor het presteren van teams. Met behulp van een bepaalde sociale netwerkanalyse techniek kan de overlap tussen twee verschillende relaties vastgesteld worden (QAP correlatie). Door vervolgens deze maten voor overlap te regresseren op teamprestaties vonden we een negatief effect van de overlap tussen functionele en affectgebaseerde interdependentierelaties. Dit effect suggereert enige mate van *process loss* (Steiner, 1972): mensen die taakafhankelijk zijn van elkaar en daarnaast ook een vriendschap delen, denken dat het team minder goed functioneert dan groepsleden die deze overlap in afhankelijkheid niet hebben. Dit effect voegde echter niets toe aan de verklaarde variantie van het hoofdeffecten model waarin affectgebaseerde interdependentie een positief effect had op de perceptie van team prestaties. Mijn conclusie luidt dan ook het negatieve effect van de overlapping tussen functionele en affectgebaseerde interdependentierelaties teniet gedaan wordt door het positieve hoofdeffect dat geassocieerd is met affectgebaseerde afhankelijkheden onder teamleden. Deze studie geeft aan dat affectieve afhankelijkheid een belangrijke variabele is in het voorspellen van team prestaties, en contrasteert daarmee onderzoeken en theorieën waarin vriendschap gezien wordt als een barrière voor effectief presteren vanwege de toegenomen focus op sociale aspecten en gedragingen die niet taak gerelateerd zijn. Deze studie suggereert dat affectieve afhankelijkheid het presteren van teams positief beïnvloedt doordat het coöperatie faciliteert (Krackhardt & Stern,

1988) en door de open communicatie en informatiedeling (Jehn & Shah, 1997).

Hoofd- en gelijktijdige effecten van multipele interdependenties op individuele en groepseffectiviteit: een studie naar percepties

Hoofdstuk 5 bevat de weergave van een studie met studenten werkgroepen. De interdependentie typen zijn in deze laatste studie gemeten met behulp van attributie vragen en reflecteren dus de perceptie van interdependentie van de betrokken groepsleden. Anders dan in de voorgaande studies verwijst cognitieve interdependentie in deze studie naar het ontwikkelen/onderhouden van een referentiekader aangaande de groep in tegenstelling tot een taakgerelateerd referentiekader.

In deze studie werd onderzocht wat de hoofdeffecten alsmede het samengestelde effect van de interdependenties zijn op diverse uitkomsten voor zowel individuele groepsleden als voor de werkgroep als geheel. Aangaande de hoofdeffecten verwachtte ik positieve effecten voor de individuele (groepsprestatie perceptie, individuele prestatie, leren en tevredenheid met de groep) en de groepseffectiviteit (groepsprestatie perceptie, groepsprestatie en leren). Functionele afhankelijkheid was positief gerelateerd aan het leren van individuen. Dat het belangrijk is om dezelfde ideeën te hebben betreffende het werken in een groep voor individuele groepsleden (cognitieve interdependentie), blijkt uit de positieve effecten die zijn gevonden voor de perceptie van groepsprestatie en de tevredenheid met de groep. Het derde hoofdeffect, de invloed van affectgebaseerde interdependenties op individuele effectiviteit, was negatief voor de perceptie van de groepsprestaties. Op het groepsniveau is er alleen een positief hoofdeffect gevonden van cognitieve interdependentie op de gepercipieerde groepsprestatie en het leren op groepsniveau.

Naast de hoofdeffecten heb ik in deze studie ook onderzocht of de cohesie (hoe meer hoe beter) danwel de congruentie van de interdependentie typen (alle types moeten van het hetzelfde niveau zijn: laag-laag-laag of hoog-hoog-hoog) van belang is voor de

effectiviteit van zowel individuen als groepen. De resultaten ondersteunden de congruentie hypothese. Wanneer de mate van functionele, cognitieve en affectgebaseerde interdependentie gelijk is (dat wil zeggen allemaal laag of allemaal hoog) heeft dit positieve gevolgen voor individuele en groepsprestaties. Individuele groepsleden hebben een hogere perceptie van de groepsprestatie naarmate de interdependenties meer congruent zijn. Daarnaast denken groepen niet alleen dat ze beter presteren, maar blijkt dat ook uit de daadwerkelijke beoordelingen van de groepsprestaties. Naarmate de interdependenties meer congruent waren, presteerden groepen beter.

Conclusie

In dit proefschrift wilde ik de coördinatie-*performance* relatie begrijpen en heb voorgesteld dat het daarvoor belangrijk is drie verschillende typen van interdependentie te bestuderen: de functionele, de cognitieve en de affectgebaseerde interdependentie. De resultaten van de drie empirische studies (tabel 6.1 biedt een overzicht) maken korte metten met het aloude idee dat alleen functionele afhankelijkheid van belang is en dat ook alleen dit type afhankelijkheid coördinatie nodig heeft. Sterker nog, in deze dissertatie zijn alleen positieve effecten van functionele afhankelijkheid gevonden op individuele effectiviteit in tegenstelling tot eerder empirisch onderzoek dat geen direct effect had gevonden. Bovendien, het feit dat functionele interdependentie de effectiviteit van groepen in de empirische studies niet beïnvloedt, alsmede de effecten van cognitieve en affectgebaseerde interdependenties op individuen en groepen, wijzen mogelijk op een complexer beeld van groepsdynamica dan onderzoek en theorie tot nu toe heeft laten zien. Om aan dit complexe beeld tegemoet te komen, heb ik de congruentie hypothese geïntroduceerd en onderzocht of de effectiviteit van individuen én groepen baat heeft bij gelijke niveaus van functionele, cognitieve en affectgebaseerde interdependentie (laag-laag-laag of hoog-hoog-hoog). De empirische studie met studentenwerkgroepen suggereert dat congruentie positieve effecten heeft voor de prestaties.

Curriculum Vitae

Sonja Rispens was born on December 10, 1972 in Leeuwarden. She received her secondary education diploma from the Lauwers College in Buitenpost. From 1992-1998 she studied Sociology at the university of Groningen. After graduating, she has worked for several years as a researcher at the Business School at the University of Groningen. In December 2003, she joined the Social & Organizational Psychology department at Leiden University as a PhD student. She is now working as an assistant professor in that same department.

Stellingen

behorend bij het proefschrift van Sonja Rispens

1. Percepties over afhankelijkheden zijn belangrijker dan daadwerkelijke afhankelijkheidsrelaties voor de effectiviteit van groepen *(dit proefschrift)*.

2. De sociale kant van coördinatie is een ondergeschoven kind in de management en organisatiekundige literatuur *(dit proefschrift)*.

3. There is more to work than just the work.

4. Groepen die intern goed coördineren zijn het best in staat om de externe competitie aan te gaan.

5. Het verdient aanbeveling dat het onderzoek naar teams profiteert van de inzichten en technieken uit het sociaal netwerk onderzoek.

6. En sociaal netwerk onderzoek toegepast op teams kan profiteren van de rijkheid aan sociale- en organisatiepsychologische theorieën.

7. Het ongrijpbare construct cognitieve interdependentie verdient een eigen proefschrift.

8. Het feit dat treinen niet altijd op tijd rijden is niet terug te voeren op een gebrek aan congruentie in de afhankelijkheidstypes op de planningsafdelingen.

9. Het verdient aanbeveling dat aio's niet alleen onderricht krijgen in het doen van onderzoek maar ook in het (academische) leven in het algemeen.

10. Vrouwelijke rolmodellen zijn onontbeerlijk in de wetenschap (en niet alleen voor andere vrouwen).