Why designers can't understand their users

Verhoef, L.W.M.

Introduction

In the beginnings of ergonomics, in the early years of the Twentieth Century, pioneers such as Taylor started to design work, and the tools that people had to use, in systematic ways. Taylor's major study began in 1898 at the Bethlehem Steel Co. with his study of how labourers handled pig iron (Fraser, 1951). Using a combination of common sense and the rigorous application of a systematic methodology this approach, then called 'Taylorism', made it possible to effect substantial improvements in human efficiency. However Taylor's approach, using his notion of Time and Motion measurement, made no use of insights about the human body that would have to perform the work being optimised nor any understanding of the mental functions that allowed the work to be performed. Jobs were optimised by measuring what happened and by reducing redundancy and inefficiencies to a minimum. What knowledge there was can best be described as common sense, admittedly a commodity that has never been in surplus.

A next great step to the improvements to human efficiency in the workplace was made by fitting work and tools to the human body. Initially the focus was on human bones and muscles, the 'hardware' of the human being. Knowledge of human psychophysiological characteristics followed later, adding understanding about more mental functions that could be applied to the increasing improvement in supporting human working conditions and increasing productivity. At that time systematic knowledge, as had been collected and used in medicine and the (physical) psychological sciences, provided sufficient basic information for use in the design for better chairs, improved lighting and increased readability of texts. The application of medical and physiological knowledge to the design for tools and the work situation was presented in handbooks for human factors and ergonomics. The two best known examples of this genre are Grandjean's (1963) 'Physiologische Arbeitgestaltung' (Physiological work design) in Europe and McCormick's (1964) 'Human factors engineering' in the United States.

Two decades later Grandjean published an updated version of his first book under the title 'Fitting the task to the man' (Grandjean, 1980). The title of this book reflects the spirit of that time. The focus had started to change from placing primary attention on the physical structure of the human body and the design for physical tools, to a more abstract interest in the tasks to be performed and the tools designed to support performance of those tasks. However, the contents of that revised book reflect the inability of ergonomics as a discipline to make the transition necessary to deal successfully with more abstract and complex tools, such as the computers that were by then making their inroads into daily life and with the mental cognitive tasks that users wanted to, and now could perform, using those computers. Medical and physiological themes continued to dominate the book. The word 'task' was found in the title of the book, but nowhere in the index nor even in the title of any of the chapters. The book does now have a chapter on 'Mental activity'; however, that chapter discusses much more basic physiological aspects such as channel capacity and vigilance. Concepts involving higher mental functions, like decision-making, problem solving, navigation and orientation cannot be found anywhere.

Although many practicing ergonomists and technicians did the best they could, the available practical, medical and physiological ergonomic knowledge did not provide information to allow them to design comprehensible interfaces. They lacked a body of knowledge and an applicable understanding of the mental processes to design interfaces for human users that would be effective and fit for purpose without considerable hands-on design and field-testing. The design process was still based more on the, hopefully, successful application of common sense by the designer than on any well articulated body of knowledge about human users and their capabilities. Research was often reduced to the comparison of alternatives supplied by the technology available, with simple measures of task performance determining which design 'won'. That kind of comparative research does not provide basic and generalizable knowledge ergonomists can use in the practice of everyday design. Technology was free to dictate the interface in ways convenient to the technologist, and human users were usually expected to adapt to the technology rather than vice versa. The norms, standards and requirements that ergonomists produced for the design of user-friendly computers are, consequently, haphazard lists of vague concepts[1] that

[1] Some of these concepts are:
aesthetics (Microsoft 1995); clarity (Preece 1994); consistency (Microsoft 1995;

cannot be related to fundamental psychological processes, at least not in any straightforward way. 'Real' ergonomics still involved giving useful advice about reachability, visibility under reduced lighting conditions and physical comfort for human users rather than providing clear guidelines to designers about how to construct devices that people could use effectively in their everyday life. That was the situation when I started my career as a graduate experimental psychologist.

The situation today is that we have increasingly rapid computers having a larger and more stable memory than humans. These computers are interactive and multimedia, they are able to present and accept information in visual, auditory and even tactile ways, they can easily communicate with any other computer in the world, but they can still not communicate effectively with their masters. People can now be seated comfortably before their computers, can avoid RSI if they follow the simplest of guidelines and use ergonomically designed keyboards etc, but they still fail to understand what their computer is doing or how to make it do what they want. Much has been written on the causes of this interface problem. Norman (1990, 1998), for instance, has blamed technology. Cooper blames management (1999). So far, nobody has pointed the finger at psychology.

It is an intriguing question; how is it possible that on the one hand there is an interface problem, whereas on the other hand, the common computer interfaces used today are in conflict with psychological knowledge that has been available for several decades? This applies to the frequent use of metaphors in today's graphic user interfaces (Verhoef, 2001b), menus (Verhoef, 2001d) and personal assistants (Verhoef, 2003b). Fortunately I have been involved in several design projects in which I did not need to

---

Preece 1994; Shneiderman 1993; Mandel 1997); controllability (Den Buurman et al. 1985; Mandel 1997); directness (Microsoft 1995); engineer for errors (Preece 1994); feedback (Microsoft 1995); forgiveness (Microsoft 1995); integration (Shneiderman 1993); intuitive; know the user (Preece 1994); look and feel; pleasureability (Norman 1998); portability, (Shneiderman 1993); reduce cognitive load (Preece 1994); reduce memory load (Mandel 1997); robustness (Den Buurman et al. 1985); self explaining (Weeda, in Voskamp, 1996); simplicity (Microsoft 1995; Norman 1998); standardization (Shneiderman 1993); symmetry (Den Buurman et al., 1985); tolerance for error (Weeda, in Voskamp 1996); transparency; usability (Landauer 1995); user centered design (Norman 1998; Landauer 1995); user comfort; user expectance (Weeda, in Voskamp 1996); usefulness (Landauer 1995); user in control (Microsoft 1995); user-friendly; versatility (Norman 1998).

accept interfaces dictated primarily by technology and as a result, had to compromise experimental psychological knowledge and methods. All too often psychological knowledge is used in hindsight to explain why an interface works, or fails to, and if the technology requires it, then the psychological demands take a second place, with the argument that people are very adaptable.

In several of the projects[2] that I was involved in, I have been fortunate that management understood that psychology should dictate technology and (graphical) design. Those managers understood that psychology should dictate and set the demands on technology and graphical design rather than the other way round. They did not want to be driven by the psychological prejudices of technicians, the opinions of users or even their own common sense psychology. They were professional managers who dared to strike out on an unusual but effective road. They gave me the opportunity to develop, to investigate and to design using experimental psychological knowledge. Earlier attempts to make this knowledge explicit had been evaluated by designers as being too far from design practice (Mijksenaar, personal communication) while psychologists evaluated these attempts as being too far from scientific psychology.

Schön (1983) observed that 'systems of knowing-in-practice may limit the scope and depth of reflection.' This thesis presents the story of how I applied fundamental experimental psychological knowledge to interface design *without* compromising psychology. In doing so I have attempted to understand how I arrived at designs that worked and reflected on what was necessary to achieve that result in order to distil principles that have considerable generalizable power. In a sense the theory is developed by the test in practice, in contrast to more common methodologies where the practice tests the theory. Nevertheless the cycle of theory and empirical test is still identifiable; even in practice, experimental psychologists can still ply their trade.

[2] Some of these projects are:

- Train ticket vending machines for Netherlands Railways, reported in several chapters of this thesis.
- ETCS, European Train Control System for European Rail Research Institute. See www.rks.nl/designprijs/97 /19.html .
- Coffee vending machine for Van Nelle, presented in Chapter 9.

Looking backward it was a simple, short and interesting voyage taking me over the borders of today's concept of psychology, science and methodology. This report of the voyage proved to be not simple and short but complex and long. Part I 'The Problem' shows that common vehicles for this trip provide little help. The way scientists and professionals are currently trying to improve interface design is not the right way, or certainly not a useful one. Part II 'The Solution' describes the vehicle built for this journey. How have interfaces been improved in this thesis? The four principles of the Solution I used to apply to design are described in Part III 'Experiments'. The first, 'visual size', is a quite simple one intended mainly to get used to the Solution used in this thesis. The last one 'cognitive structure' is, in my opinion, the most interesting one as it might show a new way of looking at the world of designing. An analysis of that principle is made in Part IV 'Testing the Solution' by comparing it with approaches from the old world of interface design. Is this way of looking new? Is it magic? Is it science? Is it applied? Is it engineering? Or is it merely common sense? An intriguing problem in doing this research emerged. A frequently given comment on the redesigns investigated is: 'Of course, the redesign is better. Why did you do the experiment at all?' These commentators neglect common design practice and seem to have forgotten the introduction of the experiment describing common designs in which the psychological principles tested are applied the other way around.

After having read the thesis carefully, taking into account common design practice and discussed the content, what will be the outcome? Will there be cognitive chaos which is inherently to the acquisition of new knowledge? If so, will that chaos be in the mind of applied cognitive psychologists, in the mind of the author or in the minds of both?