TOWARDS AN ERGONOMIC DESIGN OF SOFTWARE TOOLS

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INTRODUCTION

During the last decade there has been much research effort in the field of human factors of workstations with display terminals. In Germany some of the research findings have influenced the ergonomic standardization of display work stations. Strong recommendations have been made, for instance, for the display contrast of negative image displays, or for the relation between background luminance of the display and the greater surrounding luminance of the workstation. These human factors recommendations deal with hardware characteristics of the visual display. However, it is questionable whether an ergonomic design of the hardware-related features will satisfy the goal of a user-friendly workstation.

One cannot judge the influence of a software system on human task performance solely in terms of visual displays and keyboards. It is necessary to study different dialogue sessions and the composition of diverse software tools to get a first impression of how much the user will be kept dependent on the computer or to what extent the user retains control of planning and performing his tasks.

In order to evaluate software systems from the user's point of view, one has to focus on a well-defined part of the whole system in the scope of evaluation. Furthermore, one needs some criteria for judgement. An overgeneralization of judgements should be avoided. So, the judgement criteria introduced in this paper are suitable for certain kinds of user/machine interfaces. Instead of an evaluation the measurement of quality characteristics may be desirable. One example from literature will be cited and discussed.
Evaluation criteria can also be taken as objectives in the field of software design. Within this context they may inspire the system designer to think about prospective advantages or disadvantages of a design decision. The automation of human tasks by electronically controlled systems may have some undesirable human consequences, for instance, deskilling of work. That means, vocational experience might become useless due to the fact that essential parts of a user's tasks and duties have been delegated to a computer. However, some rationalization effects may vanish, if the user is not able to adapt a computer to an environmental change. The user may become totally expert-dependent. This may lead to cost-intensive situations because of an increasing lag between the pace of the environmental change and the limited pace of user response.

With some objectives and some potential disadvantages in mind, an ergonomic approach to the design of software tools is attempted. This approach is called a 'cognitive ergonomic' one. Software tools mainly influence cognitive processes, such as planning and manipulating intangible objects, rather than tangible ones which may challenge manual dexterity.

Cognitive Ergonomics lies somewhere between the traditional ergonomic approach and traditional cognitive psychology, the first dealing with the adaptation of hardware characteristics of working environments to human processing, the latter concerned with problem solving and related topics. However, the research on problem solving is solely concentrated on rule-based problems, although in the early days cognitive psychology also investigated tool-based problems, for instance, the "monkey-and-bananas" problem paradigm experimentally investigated by Koehler and published in "The Mentality of Apes", 1925. Cognitive Ergonomics has redetected tool-based problem domains and deals with the adaptation of tools to cognitive processes, such as learning and planning of task performance, the arousal of curiosity, and initiative, and creativity. Since software systems can be designed in such a way as to carry on a dialogue with the user we are faced with quite a unique ergonomic situation: The user's learning and planning, his initiative, and his creativity are determined by more than one interface between him and the machine. People sometimes use the term 'Software Ergonomics' in order to distinguish between the new ergonomic approach and the traditional one.

THE THREE MODE USER/MACHINE INTERFACE MODEL

In an IFIP workshop Hilary Williamson has presented a model that can be interpreted as a three mode user/machine interface model. An interactive system, as perceived by the user, has always three interfaces that define an actual state of user/machine interaction: