

Navigation and Learning

A Cognitive Analysis of User Tasks in Electronic Information Spaces

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1. INTRODUCTION

While the navigation metaphor has received widespread support from the HCI community, the views on the usefulness of the navigation approach have a very wide range. Benyon (1998, p 35) argues that “‘Navigation in Information Space’ is not (just) a metaphor, (...) [it] is a new paradigm for thinking about HCI.” On the other hand, Dillon and Vaughan (1997) claim that “navigation is a limited metaphor for hypermedia that potentially constrains our understanding of human-computer interaction” (p 91).

Even if one accepts the basic assumption behind the navigation metaphor, it is clear that the navigation is not an isolated task, but performed in order to complete some other task. Kim and Hirtle (ibid.) make an important distinction between three aspects of the user’s activities; *navigation work*, *information work*, and the *coordination* of these two activities. A consequence of this is that when a user has difficulties in performing the task, s/he is not necessarily ‘lost in hyperspace’. It could also be the case that it is the *use* of the information sought or obtained that is the major problem.

But how can we distinguish between tasks that are different because of navigation problems, and tasks that are difficult for other reasons? The method used in the present study was to find out which cognitive abilities that were most crucial for the performance of different tasks, and relate this to an independent analysis of the tasks’ characteristics (see Lönnqvist, 2000, for details).

Dahlbäck, Höök, Sjölander (1996) and others have shown that the ability that is required to navigate information spaces is subject to large variation, and that this variation is highly correlated with spatial ability (mental rotation). Gustavsson (1998) showed that task perform-

ance correlated only with spatial ability in a graphical interface, but not in a text based.

There are many different classifications of reasoning tasks and abilities. We have here focused on the factor called Sequential Reasoning (RG) by Carroll (1993). Pask (1976) makes a distinction between two learning styles; a local and global one. The holist learners try first to build a global view of the domain, trying to consider many aspects simultaneously. In the early phases the holist focuses on information high in the hierarchical structure, and uses a top-down approach. The serialist focuses initially on details before trying to arrive to a global picture. The learning is a bottom-up process, where learning takes place in small steps.

2. METHOD

21 undergraduates volunteered for the study. Median age 26 years (11 female and 10 male). For the hypermedia navigation task we wanted a domain where our participants lacked detailed knowledge, but where they knew the basic terms and concepts. We used the encyclopedia part of the CD-ROM *Sofies värld* (Sophie’s World) (1997). The participants were given 17 tasks. We strove to vary the task type from fact finding to comparison tasks of different complexity using different levels in the system.

The tests used were Plåtmodeller (paper folding) for *spatial visualization*; Mentala rotationer (mental rotation) for *mental rotation*; GRE (i), for spatially loaded logic reasoning; GRE (j) for classic logic reasoning; Planlösning (plan solving) for *spatial-logic reasoning*. Learning style was assessed using the ‘Study Preference Questionnaire’ (Ford 1985)

3. RESULTS

We correlated the performance on each task with the different cognitive tests. Most tasks only correlated with one test. The three major groups identified and the abilities they correlated with were the following: *Navigation* (mental rotation), where the user is required to search for one piece of information that is easy to assimilate once the correct location is found. A subset of these is cases where the user is required to compare two facts (correlated with spatial visualization). *Conceptual relation identification* (paper folding) where the user not only needs to find two pieces of information, but identify and make use of the type of relation that exist between the nodes. *Detailed reading/learning* where the particular information sought for is embedded in longer stretches of text and therefore cannot be found at a glance once the correct node is found. Performance here is not related to any spatial or problem solving ability, instead performance on these tasks is related to Pask's learning style, with serialists performing significantly better than holists (e.g. task 2 ($F(2,18) 10.501, p<.001$). There are also among our tasks some where successful performance requires both a high ability to navigate, and a high ability to sort through large sets of information.

4. DISCUSSION

Despite the small size of the study, we have been able to empirically support our initial hypothesis that navigation is a limited metaphor for explaining users' difficulties in large information spaces. There are also other problems for users. The importance of this study is that it demonstrates how we can study which other tasks that need to be catered for in the design of large hypermedia systems, if they are to be useful for all, regardless of their different cognitive abilities, and regardless of the different needs or tasks that they bring to the space.

By being able to find connections between the different task types and different basic cognitive abilities, we can also have some first suggestions for which basic kinds of support that are needed. It is for instance difficult to see how a better map could help users that have difficulties in finding detailed information in large texts or tables. Here instead a different design or a possibility to search for or ask in a natural language dialogue for this information would suggest itself as a better alternative. Navigation and dialogue has therefore probably better

seen as complementary, not opposing or alternative approaches.

5. ACKNOWLEDGEMENTS

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