

Cognitive difficulties and access to information systems – an interaction design perspective

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Introduction

In this paper we discuss our human computer interaction research on improving the accessibility and supportiveness of information systems for people with cognitive difficulties, whether these are developmental impairments, such as dyslexia, or acquired difficulties, most often an effect of the ageing process. The aetiology and symptoms of these conditions are diverse, yet the challenges they pose to the design of information systems can be addressed using a similar approach (see, for example, Dickinson *et al.*, 2003). The concept of accessibility for this group cannot be an extension of traditional accessibility approaches, which focus on the provision of opportunities to the technically adept: accessibility for this group demands new approaches and a reconsideration of the design of information systems.

There are both ethical and legal requirements for information systems to be accessible (e.g. Sloan, 2001). There is a division between the concept of accessibility as enabling theoretical access to the system, and accessibility in the wider sense, meaning that users should be able to experience the system as fully and as autonomously as possible. While most software developers are aware of the legal requirements, it is difficult to apply these to design for people with cognitive difficulties, not least because of a lack of guidance indicating how this might be done (Clark, 2002). The traditional approaches to accessibility tend to involve either the provision of “accessibility options” within the operating system to allow users to adjust visual and timing parameters, or the development of standards-compliant content (most often web content) to allow visually impaired users to access the information through assistive technologies like screen readers. In both cases, theoretical access is enabled and this has benefited many groups of disabled people, but such access does not take into account the holistic user experience. The enabling of access does not benefit those with cognitive impairments whose difficulties are not concerned specifically with visual or manual dexterity problems, and who are, anyway, unlikely to have the technical knowledge to find or apply assistive technologies or accessibility options if these did exist (Syme *et al.*, 2003; Microsoft, 2004).

Cognitive difficulties thus demand new approaches to software access. A central barrier to use is the tremendous complexity of software applications. In a recent study Dickinson *et al.* analysed the interface of Microsoft’s Outlook Express email system, finding 250 possible operations and 5 panels; using this interface 50% of a group of older beginners failed to complete basic email tasks; in one case, a novice user spent over 50 minutes unsuccessfully trying to open and reply to an email message (Dickinson *et al.*, 2005). Similarly, it is necessary to follow a sequence of 10 separate, not always intuitive,

operations to change the colour of text in Microsoft Word. A further complication is the use of metaphor in applications. This is not a problem at first glance: it is an aspect of information systems that most of us deal with everyday when we use a computer application. But consider what the user is asked to understand when asked to use, for example, a web browser:

that we are using a *television* set; that we are actually using a *computer* and we are to think about the television display as if it was like a *desktop*; that on this desktop there are *windows* (!) which we can look through to see the *application* which is *running*; that in this case this is a web *browser* which can be controlled by using *menus* and a *mouse*;

And all of that is implicit before we even begin to understand what operations are available to us through the complex menu and dialogue box system we are offered to control the system.

In the case of the web browser, there is the added cognitive load that individual sites often provide their own, frequently idiosyncratic, means of *navigation* (another metaphor) through the *hypertext* environment, and that these controls often duplicate facilities available on the browser interface (home and back being particularly common examples of this)

Is it any wonder then that users with cognitive impairments have difficulty making full use of information systems? Yet developers would claim that their applications are accessible because they are compatible with screen readers and you can alter the way they appear using accessibility options. This is clearly not true.

With this background we have been developing a number of ideas which are discussed below, along with their rationales. They are offered as possible different approaches to system design taking into account the needs of users who may have cognitive impairments.

A reading and writing aid for dyslexia

Dyslexia, a condition that affects reading, spelling and writing (BDA 2001), manifests itself in a wide variety of ways in the population. People with dyslexia tend to confuse letters, reversing letters (such as ‘b’ and ‘d’) and encounter problems with word recognition and overall comprehension of written text (Willows and Terepocki, 1993, pp. 34-35). One common difficulty experienced by people with dyslexia is in dealing with sequences (McKeown, 2000), which of course are a major feature of WIMP interfaces (see the example of changing font colour in Word, above).

We set out with the broad aim of seeing what pragmatic things we could do, using a computer, to alleviate the symptoms of dyslexia. Given the individual nature of dyslexia, a first requirement was that the system be readily configurable, and given the possibility of difficulty with memory and sequence, it had to rely on a radically simplified and direct interface. Reducing cognitive load by making changes immediately visible as the user made them, and equally easily reversed, was a fundamental aspect of the SeeWord system, and true “direct manipulation”. In SeeWord the user is presented with a dedicated, dramatically reduced, set of controls which allow access to functionality within MS Word.

Among the pragmatic considerations we addressed were the following:

- In some cases it has been found that colour filters or lenses (Wilkins, 1995) can make reading text on paper easier: this is technically easy to simulate on computer by enabling change of background colour;
- Similarly, formatting alterations like text size, word and line spacing, and margin width are likely to help reading; these changes can be made in MS Word but the interface presents a barrier: direct access to this functionality would support dyslexic readers.
- A specific difficulty, letter reversals, occur when the reader confuses similar characters (p & q, b & d for example). The shape is not sufficiently distinct to separate the letters so why not make them more different by using a different font, size or colour?

By implementing these (and other) features in an easily configurable interface and by taking away a lot of the “visual clutter” associated with WIMP controls, we produced a word processing environment for dyslexics. Trial dyslexic subjects were asked to find a visual appearance for text that they found comfortable, by “messaging around” with the settings until the text looked most readable. All found settings which were better than the default, with a few surprises, such as that subjects tended to choose low contrast foreground and background colours (e.g. dark green on dark brown). A further trial indicated that using the system improves reading ability. A full account is given in Gregor *et al.* (2003).

An emailing environment for older people

There is an inherent conflict, when designing for normally-ageing older adults, between onscreen complexity, which reduces comprehension (Newell *et al.*, 2003), and deep interface structures, which place a burden on memory (Zaphiris *et al.*, 2003). The Cybrarian email system was designed to address this by providing a radically simple interface with few onscreen options, a linear progression through the system, and page-specific help and instructions. The user’s memory was thus supported by the system. Similarly, text on buttons was as descriptive as possible, e.g. “send message” rather than “send”, making the outcome of a user’s action more predictable. Help and instructions were provided in non-technical language, much of which was suggested by older, novice computer users.

Evaluations of the Cybrarian system demonstrated that such a design dramatically improved user autonomy, understanding and confidence, compared to a control email system (Outlook Express). Details of the system and its evaluation are given in Dickinson *et al.* (2005).

A device to facilitate web browsing by older people

As discussed above, the interfaces to many applications are complex, with huge functionality all sitting near the surface; they also rely on the understanding, implicit or otherwise, of a large number of metaphors. We set out to see whether the experience of browsing the web could be simplified and improved by re-examining the whole process

to radically simplify it. Looking at metaphor, it seemed to us that one would be plenty, and that this might be of a device for looking at the web; what was most important was to design it to accommodate the experience and needs of older people (and possibly a much wider user constituency in the longer term).

So here are some questions we asked:

- Why in a typical browser are the controls at top when the browser is something you read and you have to move over the area to operate the controls?
- In any case, aren't older people more used to controls being under what they are using, be it a car, a cooker, a television, a radio and so on?
- Do we really need the view to be through a window? Why not get rid of all the borders, freeing up space for the displayed web content?
- Do we need all the application functionality available from the main interface, or can we save some space and reduce screen clutter by dispensing with much of it?
- How can we minimise the risk of a wrong button push leading to a lost person (lost in the controls, or lost in cyberspace)?

The upshot of addressing these questions was a device with the working title “the non-browser”, essentially and ideally a touch screen monitor whose screen has five on screen buttons along the bottom and which allows the user to browse the web. The rest of the screen is given over to web content, giving almost 20% more content than in traditional browsers. Initial studies of eye movement activity with older people using the non-browser suggest that this reduction of complexity facilitates the user's ability to access meaningful and unique page content, as opposed to non-meaningful “noise”. In addition, participants preferred the non-browser environment and perceived it as offering the user more information, when compared to the standard browser. We are encouraged to take this to a fully developed application for release and with which we can do further research. This work is described in Dickinson *et al.*, (2005, 1 & 2) and Milne *et al.*, (2005).

Conclusions

This paper argues that it is not enough for software designers to build in accessibility features. More design for access and use is needed, both to facilitate the optimum use of users' capabilities and to make interfaces simpler for everyone to operate. Supporting people with cognitive difficulties does not need to involve new or radical functionality changes, but different ways of accessing existing functions must be provided: SeeWord, for example, does not do anything that you cannot do with MS Word but by carefully considering the design of the interface, and by taking account of the challenges faced by the target users, the salient features were presented in such a way as to enable users to improve their own reading experience. Cybrarian provides basic email functionality but supports the user through the process of accessing it, providing instructions to overcome inexperience with computers and memory impairments. In the case of the non-browser, a redesign based on thinking about the users, their capabilities, and questioning the metaphor orthodoxy has led to a promising new research line and possible future application. These three examples illustrate how it is possible to radically improve the

experience of users by paying particular attention to users, design and purpose. It also illustrates the barriers to use which can be caused by adopting orthodox approaches to interface design.

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