10.6 . PROSTHETIC SOFTWARE FOR INDIVIDUALS WITH MILD TRAUMATIC BRAIN INJURY: A CASE STUDY OF CLIENT AND THERAPIST

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ABSTRACT

A year long case study explored the use of computer software as a prosthesis for a high functioning traumatic brain injury survivor. A substantial amount of customization to the software interface was required, and was attributed to user cognitive deficits. The software was able to restore functioning which had not been accomplished using manual techniques. Impact on therapy and therapist are described.

BACKGROUND

Previous work with cognitive prosthetic computer software focused on needs of individuals who required supervision in their daily lives (Cole and Dehdashti, 1990A). That work found that software could be effectively used for both relatively unstructured household and leisure activities, as well as well-structured activities, consistent with the work of Kirsch and Levine (1987) and of Steele (1989). It was found that the software interface was a primary barrier to use of commercial software. Our study applied theory from the computer science areas of human computer interaction and office automation, relating to increasing individual cognitive productivity. Anecdotes from TBI survivors and family members indicated that the computer interface was an insurmountable harrier to individuals who had successfully re-entered the community. Some had intellectually demanding vocations. These are high functioning survivors above Rancho Los Amigos Level Vlll.

The present study examines uses of cognitive prosthetics for individuals classified as high functioning, but whose deficits do not allow them to function at their pre-morbid level. However, these people can live independently, i.e., do not need a caregiver or companion to help them perform ' household or vocational tasks.

OBJECTIVE

This study extends the previous study in two major ways. First, the research addresses a high functioning population. Second, the study begins to explore the ways this technology changes the process of cognitive remediation therapy, and impact on the therapist. Specific research objectives were to:

1) identify the types of modifications to computer interface and application required for high functioning adult TBi survivors

2) identify the therapeutic impact of cognitive prosthetic software for these individuals, and

3) examine some of the needs of the therapist using this innovation.

METHOD

This is a single-subject case study, a methodology frequently used with traumatic brain injury subjects. A field study design was used to achieve the research objectives requiring substantial computer usage over time, and for activities which are relevant to the conduct of the subject's life. Data included observation of weekly therapy sessions, medical chart, computer state transition logs, and software specifications for interface and underlying application. A quasi-experiment was selected, and therapy sessions were observed for one month prior to the intervention. Interface design and testing sessions were incorporated into the therapy sessions. Interface performance was measured by training time and ability to understand commands and instructions. The software was used only during therapy sessions for two months. Then the computer system was introduced into the subject's home in April 1991. Data collection is still in progress as of this writing (January 1992).

The subject is a 40 year old college-educated male, 7 years post' injury. On the surface, he had successfully returned to the community because he had lived independently, worked at a supervisory job, and managed his household affairs, and he had no physical impairments. Furthermore, he masked his cognitive deficits quite successfully. He would forego parts of activities which were beyond him, rather than ask other people for assistance in carrying out the activity. In this way, his masking behavior successfully hid the impact of his deficits on vocational, household, and leisure activities.

Neuropsychological testing found diffuse cerebral dysfunction, with deficits in memory, attention and concentration, reduced mental p r i m i n g time, reasoning and problem solving, and functional integration. He had been receiving cognitive remediation therapy for 11 months prior being referred for cognitive prosthetic intervention.

Two applications were introduced, a basic text editor and a weekly Calendar/appointment reminder.

RESULTS

Results are presented in three sections.

Interface and application customization

The subject had substantial difficulty forming an accurate mental $_{model}$ of the' commands, but was able to understand the overall objectives of the applications. Text editor commands were implemented on bounce-bar menus, which reduces the memory burden on the user. The software interface required substantial modification,

particularly the command text which used the patient's phraseology. Even minor changes in command text had a substantial impact on interface comprehension and performance. Some of the text modification forced changes in the size of interface objects (boxes) containing the text. Document names were 60 characters to allow ample room for description; even so, the user requested time stamp information on the document retrieval menu.

The second application is a combination of personal scheduler and "To Do" list. A combination of interface styles were used: soft function-key, bounce-bar sub-menu, and fill-in-the-form (for the actual appointment). In this interface also, most of the modifications involved rephrasing commands and instructions so that they could be correctly understood. The calendar provides additional memory support, so the patient can provide himself with reminders and instructions for specific events or appointments.

Prosthetic Uses of Software

The prosthetic software has improved the patient's level of functioning in a number of areas. Perhaps the most dramatic change was in the area of reasoning and problem solving. The software provided him with a medium which supports a non-linear processing style: he is able to move from one facet of the problem to another. It also helps maintain focus on the dimensions of a problem, without loosing track. Problem solving and reasoning is substantially improved because of the complexity he is able to incorporate.

There were immediate improvements in the patient's ability to organize, attend to, and complete tasks during therapy sessions. (These tasks involved a job search). Using paper and pencil methods, he would work for 10 to 15 minutes, and the stop with the work unfinished. Using prosthetic software, he could work for 30 - 45 minutes continuously, as well as complete the activity. The therapist reported that before she had to introduce an activity in one session, and work at completing it in the next. From the patient's perspective, the process of using the prosthetic system allowed him to "concentrate on a specific item,. rather the on a complicated web of problems."

The computer significantly improved the patient's ability to track and monitor projects. Before, information was stored in a loose-leaf notebook, where information could not be easily located. In the area of communication, he began writing brief letters to friends with whom he had not corresponded in a long time.

The calendar application has been implemented only with limited functionality thus far. It helps track appointments and activities. The software enhancement allows extensive reminders to accompany appointment entries, and this feature has been useful for its memory support. A functional enhancement will link project monitoring to the scheduler.

In addition, the status-enhancing nature of computer use raised his self-esteem.

Impact on Therapist and Therapy Methods

Several effects on therapy and therapists have emerged thus far. First, the therapist has had to learn new skills in order to use prosthetic software. Some of these skills related to learning how to train patients in computer mechanics, and some skills involve therapeutic use of the software. Second, the data collected by the software allows the therapist to track the patient's computer usage in considerable detail. This data is used in planning therapy sessions as well as monitoring patient progress. The data provides clues to situations arising in the patient's life. Third, the preparation time for therapy sessions has increased, as a result of the availability of progress data. Fourth, the patient has been able to continue work on tasks which began during therapy sessions. And fifth, the clinician has been able to better assist the patient in-between scheduled therapy sessions.

DISCUSSION

The results of this study show point to three issues. First, and most important, that properly designed computer software can help restore function in brain injury survivors with mild deficits. Second, that the software interface can be a major barrier to successful computer use. and third, use of appropriately designed software can help restore functioning to a high functioning brain injury survivor. It was not expected that high functioning survivors would have continue to have disabilities which continued to interfere with their functioning in the community.

Furthermore, it was not anticipated that such a person would have substantial difficulty learning how to use novice-oriented software. Indeed, we had assumed that interface customization would be appropriate only for moderate to severely disabled survivors. However, after meeting a number of individuals at support group meetings, we began to question the assumption. Several of these individuals were college students who were unable to use any of the word processors available from campus support services for people with disabilities. (Recent studies by Glisky (1991) and Prevey et al (1991) demonstrate that even severe amnesties can be taught to use computer software, given enough time -- months and possibly years -- and specialized training.)

Computer software has been shown to be a successful orthotic for relatively structured activities (Kirsch and Levine, 1987; Cole and Dehdashti, 1990). This case study has shown how software can be used as an orthotic or prosthetic in relatively unstructured activities such as reasoning and problem solving.

Computer software is not currently viewed by the rehabilitation community as a compensatory strategy.

Software is and can be a powerful compensatory strategy, capable of restoring function when other techniques cannot. However, many 'superior technologies' have failed at technology transfer stage because of institutional factors. Among these factors are the structure of the therapy session and the impact on the therapist. These are not insurmountable barriers, but they do need to be addressed.

This is our second case study, and involves scores of hours of working directly with patient and clinician over the past year, as well as hundreds of hours modifying computer software. The case study methodology provides a detailed understanding of a problem in a field where mastering the details are critical to success. By the Annual Conference, we will be able to report preliminary findings on three additional patients who are part of a research project funded by NIH.

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