Assistive Technology For Persons With Cognitive Disabilities - Artifacts Of Distributed Cognition

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Abstract

This short position paper lists my possible contributions to the workshop and a history of my research as well as current work with persons with cognitive disabilities and caregivers. My contribution to the workshop would consist of pragmatic experience in conducting research developing assistive technology as well as a novel perspective on HCI frameworks.

Introduction

For the last four years, as a graduate student and researcher, I have worked on developing and evaluating socio-technical environments to aid persons with cognitive disabilities and their support communities. The aim of the research is to support more inclusive and independent lives. This work is grounded in HCI theory with the aim of implementing and extending them in design work. Towards these ends my research has spanned topics from the practicalities of obtaining approval from the local human research committee, to recruiting subjects, both persons with cognitive disabilities and caregivers, to understating the appropriate place of distributed cognition in existing practice and extending this framework into the design of computationally enhanced task support systems. There are two novel and powerful notions that have emerged from this research:

- Tools for living, tools for learning (an extension of distributed cognition) [1]
- The dual user interface deign framework for high functionality cognitive orthotics. [2]

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Pragmatics of Research

My dissertation project, MAPS (**M**emory **A**iding **P**rompting **S**ystem), is part of the CLever ("**C**ognitive **Lever**s: Helping People Help Themselves") research project. CLever, at the Center for Lifelong Learning and Design (L3D), University of Colorado, develops socio-technical environments to support caregivers and persons with cognitive disabilities and their caregivers.

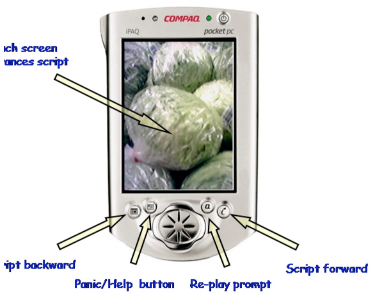
CLever has based its approach to assistive technology with multi disciplinary teams that support understanding the needs and opportunities inherent in the communities of persons with cognitive disabilities and their support communities. Further, these teams participate in the design of artifacts, leveraging existing knowledge and skills to best support increasing of inclusion and independence. Participating in the CLever project is an assistive technology professional with many years experience with the local school district's special education program. Additionally Clever has a collaborative alliance with a local organization (Imagine! Colorado [3]) in the field of group homes and providing support for persons with cognitive disabilities. Without the guidance of these domain experts our designs and ideas would have had to go many more iterations of failure before we found a correct fit. This is especially important due to the limited number of potential local participants, both persons with cognitive disabilities and also caregivers. They are also indispensable in recruiting and selecting participants in studies as well as helping with the rigorous human research protocol approval process for this special group from the university and others.

Because we came to this domain with little experience in assistive technology design, we were initially drawn to looking at the target population thru the handy and obvious lens of diagnosis. Since then we have learned that diagnosis is often more of a hook to place bureaucratic paperwork requirements than a generalizable pointer to needs. We have come over time to look at functional assessment as a more reliable indicator of needs and potential. Still the problem of generalization remains.

Research Frameworks

The approach MAPS has taken is to provide cognitive orthotics to persons with cognitive disabilities based on the frameworks of distributed cognition [4] and situated action [5]. This approach further divides the distributed cognition framework into 1) 'tools for learning' (tools which change your abilities) and 2) 'tools for living' (tools that extend your abilities); this division has help clarify the design and function of the resultant artifact, and it is possible to map these differences into the worlds of assistive and rehabilitative technologies.

This design process and the construction of the artifacts use time practices has resulted from the proper application of the notion of symmetry of ignorance [6]. By involving domain experts from the assistive technology and therapeutic side as well as computer and cognitive scientists, the traps of 'I've got a theory' and 'I've got a cousin' as design foundations can be avoided. Further, the process of preparing the prompting scripts for task guidance and their use in the world is an interesting example of metadesign [7]; the use of this tool is spread over time and across persons. The 'user' in this case consisting of both the person with cognitive disabilities and the caregiver as separate personas of one user, with interlocking needs and outputs. The resultant system is an example of what



ure 1 – MAPS handheld prompter

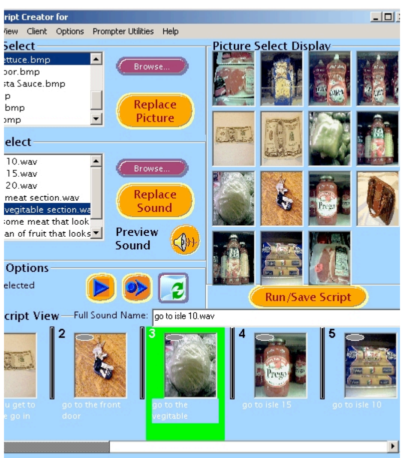


Figure 2 – MAPS script editor

we have come to call *active distributed task support* [8].

One of the thorny issues inherent in the MAPS project is the 'universe of one' problem. Persons with cognitive disabilities often have multiple disabilities as well as unique patterns of abilities and deficiencies: this leads to an emphasis on personalization of the application, much more so than 'off the shelf' software and systems. While this may be so, the question arises whether it is possible to generalize our studies of individuals using these types of technology, and more importantly can we develop tools that allow us to make valid predictions of fit and use of systems by *classes* of persons?

MAPS

MAPS [9] is a hand held prompting system (see Figure 1 and 2), that prompts a person with cognitive disabilities through tasks that were previously difficult or impossible for them to complete independently due to difficulties with memory or executive functions. MAPS is a script editing tool, designed to allow a caregiver with minimal computer skills to create, store and deliver scripts representing tasks, and a hand held prompter used by the person with cognitive disabilities.

The MAPS handheld prompter 'plays' the visual and verbal cues that guide the successful completion of a chosen task (see figure 1). The images that appear on the small screen are personalized for the user, usually a photograph of the task steps, accompanied by verbal prompt describing the action to be taken. The controls on the handheld computer have been simplified to a minimal set. The caregiver can modify the placement and function of these controls to fit the user.

The MAPS caregiver interface provides the tools and support for creating, annotating, modifying, and storing scripts to be used in the MAPS handheld prompter (see figure 2). The process of preparing the MAPS system for use by a person with cognitive disabilities consists of selecting appropriate task to be prompted, segmenting the task into appropriately sized cognitive chunks, collecting and preparing the images and verbal prompts to cue the segments of the task, and finally using the script editor to assemble, store and load the finished script to the hand held prompter.

The design process for the script editor emphasized re-using exiting computer skills, basing the applications cognitive model on a familiar metaphor (filmstrip and MS PowerPoint), and performing several iterations of user testing. Caregivers, selected for low computer skills, participated in user testing by being given terse instructions to perform typical tasks after being given minimal instruction in the use of the editor. Further, they were probed for their understanding of the applications conceptual model (which may vary from the actual data/program model). We did three iterations of user testing, each with between three and eight users. Each round resulted in non-trivial design changes. The over arching goal was to allow initial easy successful script generation while supporting complex annotated scripts as the user became more skilled.

Conclusion

Driving my work is both a heartfelt desire to work with these populations, to implement and understand the tremendous promise of computationally rich support *and* exploring the notion that the supporting HCI frameworks become themselves richer from the unique feedback that results. The need for high reliability, immediately successful user experience and extreme personalization are all attributes that are often conspicuous by their absence in the larger world of computer applications.

Here are my two questions:

1) I would like to dig deeper into the 'universe of one', user modeling and generalization issues.
2) I would like to discuss the differences and intersection of traditional 'scientific' evaluation of systems and an ethnographic approach.

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