

The Center for Research and Education on Aging and Technology Enhancement (CREATE): A program to enhance technology for older adults

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S.J. Czaja, J. Sharit, N. Charness, A.D. Fisk, W. Rogers, The Center for Research and Education on Aging and Technology Enhancement (CREATE): A Program to Enhance Technology for Older Adults, Gerontechnology, 2001; 1(1): 50 - 59. Technology is increasingly becoming integral to work, education, and routine tasks such as shopping and banking. At the same time technology is becoming more diverse and the variety of computer-based tools that are available are increasing at an unprecedented rate. In order to function independently and successfully interact with the environment people of all ages must learn how to assimilate technology into their lives. This may present a challenge for older adults given age-related changes in functional abilities such as psychomotor and cognitive skills. This paper describes a systematic, multidisciplinary research program that is directed towards making technology more useful and useable to older adult populations. The intent is to present information on current research in the field of gerontechnology and to demonstrate how a multidisciplinary approach can be used to address the problems of aging and technology. Finally, the paper presents examples of how findings from research can be translated into guidelines for system design.

Key words: aging, technology, Internet, training, interface design

The increased number of older people in the population and the increased reliance on technology in most societal contexts has created a need for the systematic study of technology and older adults. It is estimated that people age 65+ will represent 22% of the population by 2030. A large number of these individuals will be over the age of 75 years. At the same time that the population is aging information technology is becoming integral to work, education, and daily life. In 1997, about 40% of households in the U.S. owned a personal computer (PC) and approximately 79 million Americans accessed the Internet¹. Other forms of technology such as automatic teller machines, telephone-based menu systems, and information kiosks at shopping malls or in public buildings are also common. Simple tasks such as fueling an automobile, banking, or locating a book in the library increasingly involve interaction with some form of technology. Technology has also become more diverse and the variety of computer tools that are available have increased at an unprecedented rate. In the near future television, telephone, and other communication media will become integrated with computer network resources. In essence in order to function independently and successfully interact with the environment, people of all ages must learn how to assimilate technology into their lives. Although technology may ultimately benefit the lives of older people by enhancing their connectivity and ability to independently perform routine tasks, some technologies present a challenge for older adults. Several studies have shown that older people typically have more difficulty than younger people learning to use and operate current technologies such as computers^{2,3,4}.

Furthermore, although the number of older people who use technology is increasing, use of technology among this age group is low compared with other age groups. For example, Internet users over the age of 50 still lag behind younger age groups. Use of the Internet provides increased opportunities for

gaining access to a wide variety of information, increased communication, and enhanced ability to perform routine tasks. For many older people, especially those who are frail or isolated, access to the Internet would promote independence and reduce isolation. In fact, a recent report by the National Research Council stresses the importance of devising strategies to enable people of all strategies to assimilate to the "information age"⁵.

To a large extent older people have been ignored by system design as a viable user group and most older people have had less exposure to technology than their younger counterparts. To make technology available to people of all ages and abilities a challenge for the research and design community is to better understand: 1) why technology is difficult to use when it is; 2) how to design technology for easier and effective use; and 3) how to effectively teach people to use and take advantage of technologies that are available. In response to these needs, the Center for Research and Education for Aging and Technology Enhancement (CREATE) was recently established. CREATE is a multidisciplinary consortium that is sponsored by the National Institute on Aging. In essence CREATE hopes to address the challenges associated with the field of Gerontechnology and help ensure that current and future generations of older adults will be able to successfully use technology and that the potential benefits of technology are realized for older populations. The intent of this paper is to describe the CREATE program and present some preliminary findings from the on-going research activities. The overall goals of the paper are to demonstrate how a multidisciplinary approach can be used to address the problems of aging and technology and how findings from research programs can be translated into guidelines for system design.

CREATE

The specific objectives of CREATE are to develop a comprehensive database on aging

and technology that will consist of information regarding: user preferences and needs, problems with existing systems, and efficiency of design solutions. The intent is to explore these issues across a broad range of tasks and technologies. Representative design involves giving care and attention to the issue of sampling task environments as well as the issue of sampling subject populations. Thus research in gerontechnology must be broad-based and consider a variety of technologies and technical applications.

To achieve these objectives the investigators of the Center intend to develop comprehensive design guidelines for existing and emerging technologies and enhance the existing knowledge-base regarding how age-related changes in function impact the performance of everyday tasks. In addition, efforts will be directed towards the development of methodologies and protocols that can be used by other investigators to conduct practically relevant research. By defini-

tion, practically relevant research advances both theory and practice.

Other important goals of the Center are to promote new areas of research on aging and technology, promote research training and development of new investigators, and to disseminate the outcomes from the Center to the service and scientific communities and business/industry.

Conceptual Framework

The conceptual framework for CREATE is based on concepts from Human Factors Engineering and Cognitive Psychology. Human Factors Engineering offers a natural framework to study problems encountered by older adults in the use of technology. Human Factors is concerned with designing environments, products, and tasks to accommodate user populations and encompasses both research and application. It is concerned with understanding and explaining variables that affect human performance and using

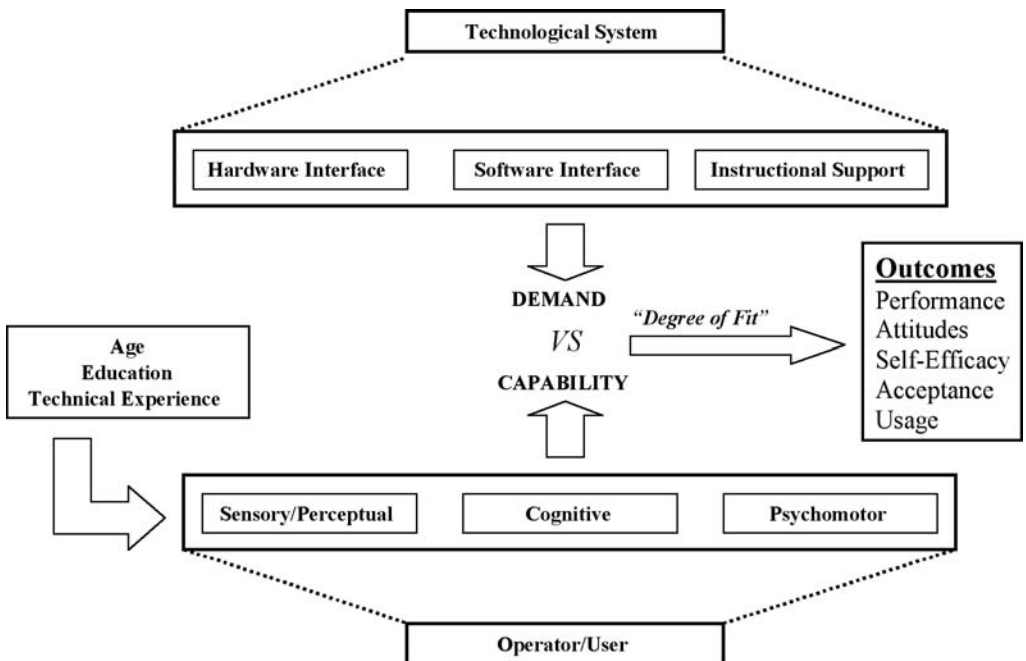


Figure 1. A human factors approach to studying problems of aging and technology

this information to optimize person/task/environment interactions. The relevance of cognitive psychology stems from the fact that the use of technology places a demand on cognitive processes. In order to derive system design principles that are responsive to the needs of older populations it is thus necessary to understand the interaction between the information processing capabilities of older people, the information processing demands associated with the characteristics of the system interface, and the goals associated with the use of the system. Although significant theoretical advances have been made in understanding aging and cognition, there exists limited insight and examples of how this knowledge can be applied to system design to help improve the productivity and quality of life for older adults.

Essentially the framework for CREATE (Figure 1) is based on models of person-environment congruity developed by Lawton⁶ and colleagues. It centers on understanding the fit between the sensory/perceptual, cognitive, and psychomotor capabilities of the operators/users of technology relative to the demands that are made by the technological systems. Human users have different abilities and attitudes that they bring to a task (e.g., as a function of their age, education, past experience with technology). Technological systems vary in the extent that they can accommodate to such individual differences. If there is an adequate fit, people will have success with the task, but if the fit is poor, they may fail. In this regard, the goal of CREATE is to maximize the fit between technology and older people so that they may successfully use these products and devices.

To help ensure that the research activities of CREATE are comprehensive and representative of real world tasks and environments, we developed a task/domain matrix (Table 1) that summarizes a variety of classes of technology and the demands that they make on processes such as system control, infor-

mation transmission, information retrieval, and information integration.

The intent of the matrix was to guide the selection of the research projects so that they encompass a broad range of technologies and activities. The intent is to investigate a representative sample of tasks, within each project, that cut across domains and vary in demands and technologies (e.g., telephone technologies, PC workstations). The complexity levels of the technical system will range from simple (e.g., remote control units) to complex (e.g., on-line databases for bill paying). The objective is to ensure that the results of the research projects are generalizable to a multitude of activities and technologies and to a broad range of users. It is recognized that there may be cultural differences in users and available technical systems; however, it is hoped that the research approach and general design principles will be transferable across cultural settings.

Organizational Structure

CREATE represents a consortium of three Universities with core administrative and data management support. CREATE encompasses three independent research sites at the University of Miami, The Florida State University, and the Georgia Institute of Technology. It also has common structures that span these institutions. A central concept is to share resources and expertise among the investigators and the three institutions. In addition, it is anticipated that the outcomes of each research project will be used to guide the development of subsequent projects. Furthermore, the investigators will collaborate in the development of design guidelines and principles.

The Research Core

The research core includes the research activities at each of the participating universities. It also includes a student research program. The intent of the student program is to fund student research in the area of aging and technology in order to increase the activities of the Center, prepare a future generation of

Table 1. Matrix of task domains and process demand

Domain	Task	System Control	Information Transmission	Information Retrieval	Information Integration	Technology
Work	Data Entry Clerk	+	+++	+	n	PC, Documents, Keyboard
	Customer Service Rep.	+	++	+++	++	PC, Mouse, Menus, Windows, Keyboard, Databases
Transportation	Wayfinding	++	n	++	n	Display Monitor, Information Kiosks, Touch-Screen Maps, Internet
Home Management	Appliance Control	+++	+	+	n	Digital Displays, Control Pads
Health Care	Medication Management	+	n	++	+	Voice Mail, PC Calendar, Beeper Alert, Internet
Financial Management	Bill Paying	+	+	++	+	Telephone, Menus, PC/Web, Mouse, Keyboard, Internet, Database
Leisure	Social	+	+++	++	n	Telephone Answering Machine, E-Mail, Fax, Internet, Videophone

Note. +, ++, +++ symbols give the relative emphasis of demands (number of + indicates emphasis), and n implies negligible demands

scientists to develop expertise in gerontechnology, and stimulate research interest in this area. For example, a recent student project (A. Melenhorst) is aimed at understanding older adults' preferences and usage patterns of communication tools such as telephones, fax machines, and e-mail. The project involved conducting a series of focus groups with seniors in Atlanta and Miami. Preliminary findings from this study suggest that one of the reasons that older adults do not use communication tools such as e-mail is that they do not understand the potential benefits of these types of communication tools. This finding has important implications for training older people.

The Management Core

The Management Core provides technical support for the research projects. In addition the Core strives to facilitate collaboration among the research sites, linkages between the Center and existing university programs, and linkages between the Center and the community. The Management Core also assumes responsibility for the administration of the student research program and facilitates the dissemination of findings/outcomes from the research program to the community agencies and programs, industry, and the scientific community.

The Data Management / Statistical Core

The intent of the Data Management/Statistical Core is to build an integrated data management structure for the core data battery, which consists of group-administered and individually administered individual difference measures (e.g. cognitive abilities) common across all site projects. The Core has also developed a protocol for the standardization of data collection and analyses across the sites. The core also provides assistance with statistical analyses, and research design.

The External Scientific Advisory Board

The External Scientific Advisory Board provides oversight for the science of the Center.

The Board is multidisciplinary and includes representatives from academia and the business community. The primary role of the Board is to provide assistance with queries regarding research protocols as well as help ensure that the activities of the Center are timely and the goals of the Center are being achieved. Members of the board also provide linkages to the community programs, industry, and the scientific community.

Resources Available

A unique advantage of CREATE is that it exists on three separate campuses, in three distinct regions of the country. This geographic dispersion provides access to large and ethnically diverse populations of older adults. CREATE also has strong linkages to community organizations, such as the Alliance for Aging and Institute of Retired Professionals and to industry including companies such as International Business Machines (IBM), Microsoft, Sun Systems, and Qwest. These linkages will help ensure that the outcomes from CREATE are disseminated to system designers and older people. These linkages also facilitate the recruitment of research participants. Finally, by being spread across three different sites, CREATE has access to a multidisciplinary faculty and student base.

SUMMARY OF RESEARCH PROJECTS AND PRELIMINARY FINDINGS

Table 2 provides a brief summary of the research projects at each site. Each project focuses on distinct but complementary aspects of the "human-machine interface". Generally, the interface to a system can be operationalized as the various means by which people interact and communicate with a system to accomplish task-related goals. The interface encompasses input/output hardware, software, and technical facilities such as training programs that support a person's interaction with a system⁵. Given the emphasis on cognitive processes within technology-based tasks each project will also examine the relationship between age-relat-

ed changes in cognition on specific aspects of task performance. It is anticipated that the outcomes of each project will include design guidelines and information on aging, cognition, and everyday task performance. Thus each project will generate both practical and theoretical outcomes.

Age-Related Training for Technology

Arthur D. Fisk and Wendy Rogers

Georgia Institute of Technology

Overview

Rapid and continuous developments in technology create a need for people to learn to interact with many new technologies. Life long learning is becoming essential for successful adaptation to a rapidly changing environment. The focus of this research project is to understand how age-related changes in cognition influence the ability of older people to learn to use technical systems. The overall goal is to develop and validate training and instructional principles that accommodate older people for the widest range of systems, devices, and products. The aims are to create a better understanding of

the factors that influence safe and efficient use of technology and to demonstrate how to design training programs to maximize the ability of older people to perform a specific task, or use a specific system or device. Another important aim of the project is to understand how well learning generalizes across similar but distinct technical systems and varies according to level of experience with a technical system. To accomplish these goals the project will consist of a number of studies related to learning, training, transfer of learning, and retention. The outcomes of this project will include guidelines for the design of training programs that are effective for older people. The research will also contribute to the existing literature on aging and learning and skill acquisition.

Preliminary Findings

Instructional aids and provision of environmental support such as redundant cueing may help enhance the ability of older people to use technical systems. A preliminary study within this project is examining the use of environmental support among a sample of

Table 2. Summary of the research projects at each site.

Institution	Investigators	Research Focus	Practical Outcomes	Theoretical Outcomes
Georgia Institute of Technology, School of Psychology	Arthur D. Fisk, Wendy Rogers	Training, Transfer, and Retention	Guidelines for Training Programs	Aging and Skill Acquisition, Memory
Florida State University, Department of Psychology	Neil Charness	Input Modalities and Devices	Guidelines for Input Device Design and Selection	Aging and Motor Control, aging and Speech Generation
Universit of Miami, School of Medicine & College of Engineering	Sara Czaja, Joseph Sharit	Computer-Based Information Search and Retrieval Tasks	Guidelines for Interface Design and Navigational Aids	Aging and Speech Comprehension, Pblom Solving, Mental models and Information Search Strategies

younger and older adults in a task requiring the search of a computer display. Findings suggest that older people do not make use of and are not sensitive to environmental support that is available. Furthermore, this does not appear to be related to age-related attentional declines but rather a strategic approach to the task. These findings have implications for the design of training programs and indicate that older adults may need training on the availability as well as the use of environmental support.

Enhancing Computer Interactions for Older Adults: Input Device Design

Neil Charness

Florida State University

Overview

Although there is a growing body of research examining the relative merits and disadvantages of various input devices, research examining which input modes are optimal for which tasks and which people is needed. To date, only a few studies have examined the relative advantages and disadvantages of various forms of input devices for older people. The focus of this project will be on understanding the efficacy of various types of input modes for various types of systems and tasks. The initial project will focus on determining the relative utility and cost effectiveness of standard (mouse) and non-standard (e.g., light pen, gaze) computer pointing devices for pure pointing and data entry tasks. The second project will focus on assessing the utility of speech recognition software for older people for a variety of activities and the third project will focus on the effectiveness of desktop videoconferencing for this population. The overall goal of the research is to develop guidelines for system design that maximize the ability of older adults to communicate with technical systems. This research will also contribute to the existing literature on aging and motor control and aging and speech generation.

Preliminary Findings

Findings from an initial study that examined

the impact of type of input device (mouse vs. a light pen) on the ability of younger, middle-aged, and older adults to select targets from a drop down menu suggest that lightpens may be beneficial for older adults. Specifically the results suggest that age differences in target acquisition time were less for the lightpen as compared to the mouse. Also, older people were more impaired than younger people when using the non-preferred hand; however, use of a lightpen also minimized hand differences. Finally, task practice was especially beneficial for older people. These findings point to the importance of examining alternative input devices and of providing adequate practice and training on the use of input devices. These findings suggest that older people would benefit from using a direct positioning device such as a light pen for some tasks such as target acquisition.

Age-Related Differences in Technologically-Based Information Search and Retrieval Tasks

Sara J. Czaja and Joseph Sharit

University of Miami School of Medicine

Overview

Recent developments in technology and the expanding power of computers have made it possible for large numbers of people to have direct access to an increasingly large array of information and services. Many people commonly use computers and other forms of technology for information search and retrieval. Although this topic has received attention within the human-computer interaction literature, the available data on older people is limited. The goals of this research project are to investigate the ability of older people to use technology for information search and retrieval so that interface design guidelines can be developed to accommodate this population. The project will investigate a range of information search and retrieval tasks that cut across living domains and involve a wide range of technologies. The initial study will focus on telephone-based voice systems and will also investigate

the potential benefits of "screen phone" technology for older people. The second set of studies will focus on the World Wide Web and the third set of studies will focus on database inquiry tasks, which are commonly performed within work settings. The studies will also examine the relationship between cognitive abilities and task performance. The emphasis will be on understanding age-related differences in the performance of these types of task so that guidelines for interface design and navigational aids can be developed. The research will also contribute to our understanding of age differences in speech comprehension, problem solving strategies, and information search.

Preliminary Findings

Findings from a study examining age differences in the use of interactive telephone menu systems suggest that use of these types of system may be more difficult for older people. A sample of community dwelling participants, ranging in age from 20 to 82 yrs., used simulated banking and utility company telephone menus to perform a sample of routine tasks (e.g., obtain checking account balance). Preliminary results suggest that the older people had more difficulty using the menus than the younger people even when controlling for differences in prior experience with these types of system. The findings also suggest that older people perceive that these systems are frustrating and difficult to use and that they prefer slower speech rates. Overall, the findings from this study suggest that older people may need training to use these types of system and that instructional aids may be beneficial for this age group. The findings also point to the importance of interface design features such as speech rate.

SUMMARY

This paper describes a multidisciplinary research program focused on issues associated with aging and technology. The program is multidisciplinary and broad-based and is examining a wide variety of technologies

across a wide variety of tasks. The overarching goal of the program is to develop empirically driven, broad-based design guidelines for technical systems that encompass all aspects of the user-system interface including hardware, software, and training. An additional goal is to develop a large database that includes information on user capabilities and limitations, attitudes, and preferences and needs. In addition, information will be generated on the efficacy of alternative design solutions. A unique feature of the program is the use of "ecologically valid" research methodologies and protocols. The intent is to ensure that the findings from the research projects can be translated into general principles for design as well as contribute to the emerging literature on aging and everyday competence.

Findings to date suggest that older adults are willing and able to use technical systems. However, they may have more difficulty adapting to these systems than younger adults. Importantly many of these problems may be remediated by training or design interventions such as alternative input devices or use of environmental support aids. The goal of the CREATE program is to develop and test these types of design solutions so that technology is useful and usable by people of all ages.

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