Psychology and Aging: Enhancing the Lives of an Aging Population

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Abstract

A pressing need for upcoming decades is ensuring that older adults, who constitute an increasing percentage of the population, are able to function independently and maintain an acceptable quality of life. One important concern is the usability of new technologies. Unfortunately, the science that could direct proper design and implementation of current and future technological advancement is underdeveloped and less mature than the engineering that supports technological advancement. We review data documenting age-related usability issues and how psychological science can remedy such problems. We also outline how training principles can be applied to older adults. We conclude that psychological science has much to contribute to the goal of enhancing the lives of older adults.

Keywords

cognitive aging; system design; training

From news reports or simple observation, it should be clear that within developed countries, the number of older adults is increasing faster than the number of their younger counterparts. Indeed, the life expectancy of the population in the United States and other countries is, collectively, increasing. Rowe and Kahn (1998) highlighted the dramatic nature of the increase in life expectancy when they estimated that of all humans who have ever lived to be 65 years or older, half of them are currently alive. This demographic shift brings with it certain challenges if society is to meet the needs of these older individuals. Psychological science is well positioned to help meet these challenges.

We use the term engineering psychology to refer to the applied science with the goal of understanding how humans sense, process, and act on information. Engineering psychology also applies that knowledge to the design of and training for new and existing technologies to make them safe, efficient, and easy to use. To accommodate older populations, it is necessary to understand age-related differences in sensing, processing, and acting on information. It is also necessary to apply that knowledge base to ensure that products and systems are safe, efficient, and easy to use by older adults.

Psychologists have conducted considerable research on the fundamentals of cognitive aging (see Craik & Salthouse, 2000, for specific reviews). These data serve as the starting point for designing products and systems that older adults can use.

ARE EXISTING SYSTEMS AND PRODUCTS EASY TO USE?

Are existing systems and products easy to use? In a word, no. They are not easy to use by individuals of any age, and usability problems may be exacerbated for older adults. In his book *The Psychology of Everyday Things*, Norman (1988) illustrated how many products and systems are difficult to use. The typical response of users who encounter a problem is to assume that they made a mistake and the problem lies with them. Not so—typically the problem lies with either the design of the system or the instructions provided for using it.

In a study examining usability problems with everyday products such as cleaners, toiletries, over-the-counter medications, and health care products (Hancock, Fisk, & Rogers, 2001), we found that 72% of the respondents reported experiencing some usability problems. Reported problems included difficulty understanding written materials (29% of respondents), trouble interpreting symbolic information (21%), perceptual problems such as inability to see print clearly (47%), memory problems such as forgetting actions to perform or procedures to follow (45%), and motor control and manipulation difficulties (84%). The survey respondents' age range was 18 to 91, but people of all ages reported similar types and frequencies of usability problems; the only exception was that people over age 65 reported more perceptual and motor problems than people under 35.

Many of the difficulties reported in this survey might be classified as "annoyance problems" (e.g., difficulty reading text or opening a bottle). However, many usability problems are not just annoyances but have the potential to be dangerous or even life threatening. Studies of home health care technologies illustrate this point.

Blood glucose meters are devices used to self-monitor glucose levels in the blood. Often these devices are advertised as simple to use: "It's as easy to use as 1, 2, 3.

Just set up the meter, check the system, and test your blood." Yet these devices are not so easy to use. A detailed task analysis of one presumably easy system revealed more than 50 substeps for the performance of the three basic steps (Rogers, Mykityshyn, Campbell, & Fisk, 2001). Further, in an observational study of 90 users of blood glucose meters, 62% were found to make at least one clinically significant error (Colagiuri, Colagiuri, Jones, & Moses, 1990). Unfortunately, Colagiuri et al. engaged in the common practice of "blaming the user," as evidenced by their statement that "the most commonly encountered . . . errors resulted from a *general lack of care on the part of the patient* [italics added] in complying with the manufacturer's instructions" (p. 803). Such blame does not lead to understanding human error or minimizing future errors, and it ignores errors caused by system design or inappropriate instructional materials.

Design can induce errors, and design problems are often coupled with poorly written diagnostic aids. This point can be illustrated by an anecdote. A news crew was filming a story on our research concerning the usability of home medical devices. A reporter, skeptical of the usability issues we were reporting, attempted to set up a blood glucose meter, and it displayed the message "ERROR 2." To correct the problem, he went to the manual section labeled "What to do if errors" and found "ERROR 2—Device may not be working properly." After he admitted that there might be problems with the system design and the manual, we told him that he had the calibration strip in upside down. There were no markings on the strip to perceptually guide its insertion.

It is not only blood glucose meters that are difficult to use and to learn how to use. Home health care systems are often relatively complex, and existing instructions are not adequate (Gardner-Bonneau, 2001). Safe and effective uses of home health care technologies, especially those targeting older adult users, will require behavioral science–based design changes and development of adequate training materials.

CAN PSYCHOLOGICAL SCIENCE REMEDY THE USABILITY PROBLEMS?

In an effort to better understand how psychological science can improve the lives of older adults, we conducted a series of focus groups to document the usability problems older individuals encounter in their daily activities (Rogers, Meyer, Walker, & Fisk, 1998). Each reported problem was classified according to the activity the respondent was engaged in when he or she encountered the problem, the source of the problem (i.e., motor, visual, auditory, cognitive, external, or general health limitations), whether the problem was related to the inherent difficulty of the task or potential negative outcomes, and how the participant responded (e.g., stopped performing the task, compensated somehow).

Of the problems reported by the older adults in this study, 47% were due to financial limitations, health difficulties, or other general concerns not specific to the product's design. Each remaining problem was classified according to whether it could potentially be solved through redesign, training, or some combination of the two. Approximately 25% of the problems could potentially be remedied by improving the design of the systems involved to solve sensory or motor problems. For example, the possible remedies identified included lowering steps on buses, developing tools for grasping or scrubbing, improving chair design, and enlarging letter size on a label.

The remaining 28% of the reported problems had the potential to be solved through training, or through a combination of training and redesign. For example, an older person learning to drive for the first time would benefit from driver training tailored to his or her age-related needs. For other complex systems, such as personal computers or health care technologies, novices would need training; however, such systems clearly also have the potential for design changes that would improve their usability for users of all ages.

These data should not be interpreted as if the problems reported by older adults currently have solutions. Instead, the data imply that the potential exists to apply the science of psychology to enhance the lives of older adults. Design efforts must consider the capabilities and limitations of older adults, and the literature on cognitive aging provides a starting point for understanding more about this user population (e.g., Craik & Salthouse, 2000). In addition, the categories of usability problems we have reported in our studies (Hancock et al., 2001; Rogers et al., 1998) provide valuable information for design efforts. The application of task analysis and other tools used by engineering psychology to determine user requirements (see Salvendy, 1997, for a review of such tools) can be valuable for identifying both problems users have and how to minimize sources of design-induced errors (e.g., Rogers et al., 2001).

APPLICATION OF TRAINING PRINCIPLES

A goal of product design should be to minimize training requirements by designing systems that take into account the capabilities of users. However, even if products and systems are designed optimally, users often require training. Psychological science has much to contribute to efforts to optimize how younger and older adults are trained to use complex systems.

Training programs come in many forms and include materials ranging from written manuals to multimedia, experiential tutorials. What is the best way to develop such training programs? Theories of training abound in the research literature, but there has traditionally been a disconnect between developers of training theories and practitioners who could benefit most from the application of such theories (as discussed by Salas, Cannon-Bowers, & Blickensderfer, 1997). Applied psychology has the potential to serve as the bridge from the training principles in the literature to the development of training programs for practical applications. There must also be a link back to theory development to ensure that theories of training are refined on the basis of limitations that are discovered when the theories are applied to complex, real-world problems.

How, then, should trainers design programs for older adults to learn how to interact with technological systems? The background knowledge psychological science can bring to bear on such training is substantial. A review of the literature on skill acquisition and aging reveals basic principles: It is not the case that older adults cannot learn or that they always learn less or more slowly than younger adults; to understand age-related differences in learning, one must consider the task variables, the context, and the type and amount of training being provided (see Fisk & Rogers, 2000, for a review).

Older adults do exhibit declines in abilities important for learning and skill acquisition (Craik & Salthouse, 2000), such as working memory, perceptual speed, spatial ability, and fluid abilities in general (i.e., those abilities that are generally independent of processes that take advantage of the person's accumulated knowledge). Proper instructional design that capitalizes on intact abilities and compensates for declining abilities holds much promise for helping older adults obtain basic proficiency, as well as for improving their performance with additional training and helping them retain the levels of proficiency they achieve.

For example, we recently assessed the differential benefits of video-based versus user-manual-based training for younger and older adults learning to calibrate a blood glucose meter (Mykityshyn, Fisk, & Rogers, in press). The type of instruction was critical for determining older adults' performance. Older adults trained using the manual performed more poorly than all other groups. After only one calibration, older adults who received video training performed as accurately as the younger adults. Older adults' performance declined more than young adults' across a 2-week retention interval, but the benefit of the video training was maintained for the older adults. The video-based training provided environmental support for the learner by explicitly demonstrating the task sequence, and minimizing reliance on working memory (for visualizing) and reading comprehension (for drawing necessary inferences).

It is important to note that not just any video will result in superior performance. In one of our studies (Rogers at al., 2001), we demonstrated that the video provided by the manufacturer of a blood glucose meter was not sufficient for training users to operate the system. For a video to be effective, it must follow instructional principles.

Accurately assessing the expected benefits of a training approach is necessary for making informed selections among training options. Charness and Holley (2001) described one method for assessing the effectiveness of training using learning-curve data. A learning curve showing how many repetitions of an activity (i.e., trials) a particular group (e.g., older adults) needs to reach each of various levels of performance can provide the basis for making predictions. For example, by extrapolating from a learning curve, one can predict the number of trials that will be necessary to reach a higher level of performance than is shown in the curve itself. Rates of learning demonstrated after different kinds of training can be statistically compared to estimate their relative benefits. In addition, learning curves can be used to estimate how much training will be needed for a desired level of performance. Such predictions may be very useful in illustrating the effectiveness of training programs.

CONCLUSION

Through examples, we have highlighted opportunities for enhancing older adults' lives, particularly with respect to technology design and training. If research on training and system design is to be used to enhance performance of older adults, it can and should be driven by psychological theory. This view is shared by other scientists, as illustrated by a National Research Council (2000) report, *The Aging Mind*, which made recommendations for future cognitive research. One recommendation was to develop "knowledge needed to design effective technologies supporting adaptivity in older adults" (p. 35). The report also said that realizing such a goal "requires integrating behavioral science and engineering in a context of product design and development" (p. 36).

We agree and wish to extend this point. Certainly there still exists a gap between the knowledge base of the psychological scientist and the information needs of the nonscientist consumer of that knowledge. There is a crucial need for research programs aimed at clarifying how age-related changes in function affect older adults' ability to interact with technology successfully. To fulfill this need, researchers need to sample task environments, much as they sample participant populations (see Fisk & Kirlik, 1996, for examples). With such research, psychology will move toward fulfilling its promise of giving designers the science-based design principles they need for developing useful applications of current and future technologies.

Recommended Reading

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Note

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