HUMAN FACTORS AND THE OLDER ADULT: PROFESSIONAL DIVERSITY BRINGS SUCCESS

Arthur D. Fisk
Georgia Institute of Technology

As is well known, the number of older adults within developed countries is increasing faster than their younger counterparts. Such a change in demographics brings with it unique challenges and opportunities for both the public and private sectors. Human factors and ergonomics has played, and can continue to play, a major role in meeting these challenges and capitalizing on the opportunities. At the very least, economic factors should increase the need for human factors and ergonomic input oriented toward older adults for the design of work, home, and leisure environments. Thus, the topical focus of this paper is becoming a central concern of many professions. With this increased concern comes the crucial need for increased communication among the contributing professions and increased leadership from the human factors and ergonomics professional community.

It is clear that the life expectancy of the population in America and in other countries is, collectively, increasing (Rowe and Kahn, 1998). Rowe and Kahn highlighted the dramatic nature of the increase in life expectancy when they pointed out that of *all* humans who have ever lived to be 65 years or older, half of them are currently alive. Our populations in the world are growing older. Such good news brings with it certain challenges. These challenges are the result of shifts in demands for goods and services.

A DAY IN THE LIFE OF MY MOTHER

If such demographic change points to shifts in demands for goods and services, what might those be? To better understand the range of systems encountered by older adults; let's examine a day in the life of an individual approaching the fastest growing age group. Let's consider my mother. Fortunately, for her and for her family, she is in rather good health, both physically and mentally.

Mom's day begins early, about 6 a.m., and she must take a correct dosage of several medications. After taking her medication she begins her daily routine. In the bathroom she is careful not to slip and fall as she enters the shower. She wonders about those new products that not only clean but also add a non-slip surface to the tub. As she is getting dressed and putting on her stockings she feels lucky that she can easily bend down. She thinks about one of her friends who can't bend down to put on her own stockings; rather than worry about it, her friend uses a cane to pull up the stockings. "An older person's life is never dull, we're always solving problems that seem routine to a younger person," thinks Mom.

After getting dressed she fixes her breakfast using the stove and microwave with all of those knobs and dials. Because her memory is not as good as it use to be, she checks her daily reminder list to help plan her day. Mom does volunteer work as a county zoning board member and as a hospice volunteer. So, she makes a few calls to some businesses and works her way through all of those phone menus. With each call she tries to remember what the options are and whether or not an option matches what she wants to do. Even though she has a push-button telephone, sometimes she's just glad when the mechanical voice says, "If you have a rotary phone please hold" – finally she can talk to a real person.

She remembers that some of the retirees from where she last worked are having trouble getting medical things worked out between insurance and Medicare. Fortunately she knows all of the ropes, and the forms are not hard for her to fill out. Because she does this so much, she knows

many of the administrative personnel at the doctors' offices and the hospitals so she is able to get things worked out for the retirees.

Mom is not doing badly financially but she does not have enough money to afford the minimum balances to talk to a real teller at her bank. So, she does the best she can with the on-line banking software and shifts some money from savings to checking. The bank tells her how easy it is to use an ATM but she wonders why they do not provide training on those darn things so that she does not have to use the software.

Grocery shopping is on her task list for the day. The drive in town has many intersections and stop signs. Her car is relatively new so she is extra careful and slow so that she does not hit anything. A few people are upset because she takes her time at the intersections but she thinks it is better that they are upset about her being slow than with her hitting them. On her way to the grocery store she gets on the new four-lane road. This is a new route for her so she needs to follow all of the signs, not get lost, and prepare for the unexpected.

At the grocery store Mom thinks how nice it would be not to have to push such a heavy cart around. At the store she compares prices, nutrition value of the foods, and reads the labels for some over-the-counter medicine to make sure that it does not interact with her prescription medicine. From the store Mom goes on to visit one of her hospice patients, calling on her cell phone to tell the family she is on her way. Mom is a retired nurse, but at the house she finds an array of new medical devices. If used correctly these devices will ease the patient's suffering. If not used correctly . . . well, she is glad she got the proper instruction at the last hospice training meeting but wonders how folks with less medical background than her can get these things to work.

She leaves and takes her groceries home. She has built a makeshift carrier for her groceries, how else would she get them in the house. When younger she cut her own firewood but as she loses her strength even simple lifting is not so simple anymore.

She needs to prepare a report for the zoning board meeting this evening so she turns on her computer and thinks about how easy it was before Windows 95 made her learn all of those new commands. She accesses her word processor and prepares and prints her report. More telephone calls and she is off to the zoning board meeting for a series of appeals on local ordinances. After the zoning meeting she goes home and enters her notes into the computer and adjusts her daily planner for tomorrow. Thinking of the full day she has planned for tomorrow, Mom sets her home security monitoring system and goes to bed.

SUCCESS STORIES

With this background of a real day in the life of a real person, I would like to further explore why our work as human factors practitioners and scientists is crucial for improving the lives of older adults. What follows is a discussion of a few success stories, work in progress, and future needs. Although many more examples are available, the following examples should be sufficient to point to why human factors and ergonomics, because of its unique technology and its inherent diversity, is the field to help solve age-related issues of safety, mobility, and well-being. Indeed, the examples point to why the field of human factors and ergonomics should be the general contractor in the progress.

Just as a forest is rather boring if composed of only one single type of vegetation, so too would human factors be stagnant if only one type of professional effort were its makeup. Indeed, Human Factors is a forest of much varietal differentiation. Let us look at some of the variety adding to success in the area of human factors and the older adult.

A driving force in our design efforts should be to enhance the daily lives of older individuals. Indeed, a primary goal of many older individuals is to maintain an independent lifestyle. What are the types of frustrations and difficulties active older individuals encounter in their efforts to remain fully functional in a changing environment? How do we discover this information? The

field of human factors and ergonomics is quite versed and well prepared to address these two questions. One of our cornerstone tools is task analysis. With slight adaptation, we can understand aspects of functional limitations, why these limitations exist, and ways to address the limitations.

Consider a study conducted in Georgia to assess such issues (Rogers, Meyer, Walker, and Fisk, 1998). Constraints on daily living were assessed in focus-group interviews of healthy, active adults aged 65 to 88. Individual comments about specific problems were coded along the dimensions of (a) locus of the problem – motor, visual, auditory, cognitive, and so on; (b) the activity involved – for example, transportation, leisure, housekeeping; (c) whether the problem was due to task difficulty or the perception of risk; and (d) response to the limitations – persistence, cessation, compensation, or self-improvement. The data provided information about the types of difficulties encountered in everyday activities as well as the ways in which individuals responded to such difficulties.

Each comment was also coded in terms of whether it was remediable via training, design changes, or some combination of the two. More than half of the problems reported had the potential to be improved by human factors intervention. Think of it: over half of the problems reported by this sample of quite diverse older people – diverse in terms of culture, economic, life history, and so on – could be potentially overcome by what our field does in the normal course of our professional daily activities. Moreover, almost all of the cognitive challenges were amenable to human factors intervention. This, indeed, is quite exciting for us as a profession and for the enhanced quality of normal daily living of older adults.

Training alone seemed a reasonable approach for skills not involving complex devices. Redesign alone was best for primarily motor or sensory difficulties. Combined redesign and training seemed most appropriate for learning more complex devices such as computers. Although these devices could certainly be designed to be simpler, the tasks of using them are probably complex enough to warrant training even with improved designs. Many of the participants were reluctant to even try such devices without some initial training. But, importantly, many of these older adults expressed a desire to learn to use computers, fax machines, and many other technologies.

Transportation was a very limiting factor of activities of daily living, particularly for non-drivers. This is particularly notable given that the participants had access to Atlanta's public transportation system. While there were some issues with crime and inadequate bus schedules, participants were mainly hindered by bus steps and station escalators, and by not knowing how to find their way around – these are all problems we as a profession can address.

The data were striking in the variety of new technologies that participants reported encountering. Some technologies they had little choice about using, such as phone menus or new gas pumps. However, some participants had voluntarily learned to use new devices, and most were eager to learn. It was not only that they could not insulate themselves from changing technology – most did not wish to do so. However, because of inadequate design and lack of accessible training, many had not been able to use a host of new technologies.

SAFETY AND MOBILITY OF OLDER ADULTS

The safety and mobility of older drivers have probably received the most attention in human factors. Why is this the case? As pointed out by Barr and Eberhard (1991), a moment's reflection reveals that safety *and* mobility are twin goals but these goals are not always perfectly compatible. Most older drivers do not wish to stop driving, nor do they wish to have their driving curtailed. Most do not need to stop driving. Yet motor vehicle crash rates do begin to increase after age 60, implying that human factors countermeasures are necessary to maintain safe driving in this population.

Much work has been done in this area including work on visual attention, cognitive factors, diseases of the eye, environmental design, and driving. For example, Staplin's work has demonstrated that highway environments need not be taken as a given but instead can be modified through human factors efforts to suit diverse populations of drivers using the highway (e.g., Staplin and Fisk, 1991).

Ball and Owsley (1991) have modeled visual and cognitive correlates of accident frequency. Their work has demonstrated that a crucial single predictor of accident frequency is the concept of useful field of view. Useful field of view has been defined as the visual field area over which information can be acquired during a brief glance. Ball and Owsley have demonstrated that aging can bring with it a dramatic restriction in the useful field of view such that, conceptually speaking, the driver may be looking out of a peephole. This would be important on its own. Yet, Ball and her colleagues (Ball et al., 1988) have developed training programs showing that much of this loss can be reversed. They have reported improvements in useful field of view up to 133% and these improvements are maintained over a 6-month period without additional training. This is quite a success story. There are numerous other success stories as far as improving both safety and mobility of older drivers archived in papers in our journal *Human Factors*.

The concept of automated banking is deceptively simple: You walk up to the machine, enter your card, input your personal identification number, and then do your banking. However, as many of us know, things can (and do) go wrong. Automatic teller machines (ATMs) were designed to increase the flexibility of banking for customers, and to save banks money. When you open an account you get all you need, except instruction on how to use the system. More often than not, bankers assume that the ATM is intuitive to use and that you can learn how to use the ATM on your own. An informal survey of banks in two large metropolitan areas revealed that only 15% provided even a brief pamphlet describing the functions of the ATM. Officials at the remaining banks reported that they did not provide any materials for using ATMs. Those 85% expressed the feeling that such systems were trivially easy to use, so intuitive that training was not necessary. Research suggests that this is not the case, especially for older adults (see Rogers, Fisk, Mead, Walker, and Cabrera, 1996; Rogers and Fisk, 1997).

A survey of over 1,500 adults in Memphis and Atlanta showed that adults aged 18 to 34 use ATMs far more than those 65 and older — 86% versus 33%. Most instructive, nonusers aged 61 to 81 years old gave several reasons for avoiding ATMs including not feeling safe using them, not needing them, and not knowing how to use them. Yet, safety and need were not the most compelling reason for nonuse. Indeed, 21% said they would use ATMs if they were easy to use and someone showed them how to use them. Design and training, or lack thereof, were the bottlenecks to effective use or even use at all. The studies with older adults who had never used ATMs showed they made correct transactions only 20% of the time; as startling, using an ATM with no guided training, but given what you would get from the best of the banks, resulted in no improvement across practice – practice that was the equivalent of using the ATM daily for a month. Other work demonstrated that embedded, action-guided training greatly improved older adults' performance (to about 80% correct), greatly improved their ability to transfer to new systems and new transactions, and greatly improved their retention of the material so that performance was maintained at least over 30 days with no practice (Mead and Fisk, in press).

This type of research has also aided the development of principles for system design. Such system improvements benefit all users, not just older adults. These guidelines involve changing system design to embed training so that lack of knowledge about how to use an ATM can be overcome. Another important design consideration includes dealing with the breadth versus depth issue of menu design such that the problem of getting lost in the system is attenuated. Interestingly enough, being able to effectively correct errors on-line needed to be implemented within the ATM design philosophy. Environmental design issues can be important to adequately deal with the fear of lack of security. And of course, correcting the poor visual displays is a straightforward human factors contribution.

MOVEMENT CONTROL AND USING A COMPUTER MOUSE

There is large body of literature that shows that as people age, their movement control performance gets worse. Generally, older adults take longer than younger adults to make similar movements. Walker, Philbin, and Fisk (1997) found that older adults also have more difficulty in using a mouse to position a cursor on a computer. Given the prevalence of point-and-click–based interfaces, this age-related difference in performance can be a major impediment to computer usage by older adults.

Why are older adults slower and more error prone when it comes to movement control, especially computer mouse control? Walker's basic laboratory research established the source of the age-related performance decline as a combination of (1) poorer perceptual feedback, (2) increased "noise" in the motor pathway, and (3) strategy differences in approaching the task. This information is important but what does one do from a design perspective?

Given this difference in performance discovered in the lab, a straightforward approach to making the interface easier to use was to implement software changes in the gain and acceleration profiles that translate mouse movement into cursor movement. All current computer systems have software that allows a user to adjust the gain ratio to customize cursor-positioning performance. Walker's research showed which gain functions could compensate for poorer movement control of older adults, a cost-effective way to partially compensate for age-related differences in movement control in this domain.

What about redesign? Further research has also evaluated effective interface design solutions for movement control facilitation (Worden, Walker, Bharat, and Hudson, 1997). In those studies the data nicely show that with proper interface design, in this case area cursor with sticky icons with adaptive gain control, older adults' performance can be improved by at least 40%, without training. An important by-product of attending to age-related issues is that an interface was designed that also improved young adults performance by about 20%.

HEALTH CARE AND REHABILITATION

There are numerous opportunities for human factors input to improve the quality and safety of daily living of older adults. Space does not permit me to do much more than mention one more important area. Consider health care and rehabilitation. The important issues surrounding human factors, aging, and health care or rehabilitation recently received excellent coverage in a report by Gardner-Bonneau and Gosbee (1997). They point to the fact that this important area has received little attention until recently from the human factors community. However, there are numerous opportunities for substantive contributions from the broad field of human factors and ergonomics. Work is needed in both basic research and applications.

Consider remote video medicine. Telemedicine provides much promise in the health care of older adults. Interactive videoconferencing as well as video e-mail offer opportunities to provide much needed health care to individuals in remote areas while potentially reducing cost, transportation problems, and so on. The concept is simple. The health care provider is in one location, the patient is in another location, and they are linked via the technology. Although telemedicine can be successful, numerous human factors issues remain. Video-mediated communication issues must be investigated as they most surely compound age-related face-to-face communication issues. Decision making capability from both diagnostician and the patient must be addressed. All of the classic design-related problems of interface, navigation, cognitive, perceptual, and motor control issues must be addressed. Indeed, this one area cries out for vigorous human factors input.

The need for more human factors input into medical device design is quite apparent. Consider the relatively simple home-based glucose monitoring systems. On the surface these systems are

simple, you prick your finger, you drop blood on a test strip, and you measure. But, these systems introduce classic problems that human factors specialists are well situated to address and solve. The problems include motor control: you load the lance and prick your finger and get the blood onto the test strip. This sounds simple but try to do it while your hand shakes or with severe arthritis. There are classic perceptual issues relating to display design and reading test strips, and there are cognitive issues associated with calibration, instruction following, and so on. Although progress has been made, much more needs to be accomplished in this important area.

WHAT DO WE DO NEXT?

Our profession certainly has some successes; but, we also have much more to do. What should be our next steps? Certainly we need to continue to do what we are good at doing. We need to continue to work as a diverse team with overarchingly similar end goals. Czaja (1997) has nicely summed up some further specific steps for our continued success. These include (a) the fact that research is required to gather information concerning the needs of older adults and the types of problems encountered when interacting with products, devices, and so on; (b) data are required on specific aspects or demands of tasks that are problematic for older adults; (c) research must be conducted and translated such that specifics concerning capabilities and limitations of older adults can be specified in terms of implications for system design parameters; (d) a principled approach to technology evaluation, from the perspective of the older adult is required; and (e) specification of design of training programs is required to ensure that older adults can acquire the requisite skills to use systems.

SUMMING UP – WHAT IS THE MESSAGE?

What is a message that I hope you take from this paper? I hope that you see how, as a profession with much diversity, we are poised to add value to the lives of older adults. Indeed, it is this diversity that will bring much success. I have tried to show that we know much about aging that is being usefully applied, but there are still gaps in our basic, fundamental knowledge. With research efforts conducted in the context of design (see Fisk and Kirlik, 1996), success on the research side is quite within our grasp.

The history of human factors demonstrates that its unique technology can be used to solve complex, challenging problems. Our profession has worked to ensure the safety, the productivity, and the well-being of individuals working and living in rather complex environments. We can most certainly help solve the challenges facing older adults in daily living. Yet, much must be done in the design of tasks, devices, systems, and environments to better accommodate the aging user.

REFERENCES

Ball, K., & Owsley, C. (1991). Identifying correlates of accident involvement for the older driver. *Human Factors*, **33**, 583–595.

Ball, K., Beard, B., Roenker, D., Miller, R., & Griggs, D. (1988). Age and visual search: Expanding the useful field of view. *Journal of the Optical Society of America*, **5**, 2210–2219.

Barr, R. A., & Eberhard, J. W. (1991). Safety and mobility of elderly drivers, Part I: Special issue preface. *Human Factors*, **33**, 497–498.

Czaja, S. J. (1997). Using technologies to aid the performance of home tasks. In A. D. Fisk and W. A. Rogers (Eds.), *Handbook of human factors and the older adult*. (pp. 311–334). San Diego, CA: Academic Press.

Fisk, A. D., & Kirlik, A. (1996). Practical relevance and age-related research: Can theory advance without practice? In W. A. Rogers, A. D. Fisk, and N. Walker (Eds.), *Aging and skilled performance: Advances in theory and application*. (pp. 1–15). Mahwah, NJ: Lawrence Erlbaum Associates.

Gardner-Bonneau, D., & Gosbee, J. (1997). Health care and rehabilitation. In A. D. Fisk and W. A. Rogers (Eds.), *Handbook of human factors and the older adult*. (pp. 231–255). San Diego, CA: Academic Press.

Mead, S. E., & Fisk, A. D. (in press). Measuring skill acquisition and retention with an ATM simulator: The need for age-specific training. *Human Factors*.

Rogers, W. A., & Fisk, A. D. (1997). Automatic teller machines: Design and training issues. *Ergonomics in Design*, **5** (1), 4–9.

Rogers, W. A., Fisk, A. D., Mead, S. E., Walker, N., & Cabrera, E. F. (1996). Training older adults to use automatic teller machines. *Human Factors*, **38**, 425–433.

Rogers, W. A., Meyer, B., Walker, N., & Fisk, A. D. (1998). Functional limitations to daily living tasks in the aged: A focus group analysis. *Human Factors*, **40**, 111–125.

Rowe, J. W., & Kahn, R. L. (1998). *Successful aging*. New York: Pantheon Books.

Staplin, L. K., & Fisk, A. D. (1991). Left-turn intersection problems: A cognitive engineering approach to improve the safety of young and old drivers. *Human Factors*, **33**, 559–571.

Walker, N., Philbin, D. A., & Fisk, A. D. (1997). Age-related differences in movement control: Adjusting submovement structure to optimize performance. *Journal of Gerontology: Psychological Sciences*, **52B**, P40–P52.

Worden, A., Walker, N., Bharat, K., & Hudson, S. (1997). Making computers easier for older adults to use: Area cursors and sticky icons. *Human Factors in Computing Systems '97 Proceedings*, Atlanta, GA: ACM.