Communication Technology Changes How We Age

James L. Fozard, and William D. Kearns *Members, ISG*

***Abstract*—Of the six technical disciplines most directly involved in Gerontechnology—chemistry, architecture, communication, mechatronics (robotics), ergonomics, business management--communication is directly or indirectly involved in more areas of technologically supported environments—health, everyday living transportation, work and leisure—than any of the others. This paper selectively reviews recent research on communication technology improves: the acceptance and use of communication technology; communication between people, between people and machine generated information; and the use of direct communications between machines and people to influence or guide human behavior.**

I. INTRODUCTION

COMMUNICATION technology has facilitated person to person interactions and the documentation of human societies since the beginnings of recorded history. The evolution of communication between remote people has evolved from the fabled Greek messengers who memorized and repeated spoken messages betweens heads of state to the dedicated telephone lines available to heads of state and now the internet which facilitates written and to a lesser extent spoken interactions among people worldwide. The records of societies has evolved from drawings on the walls of caves to digital records obtained from live streaming video episodes transmitted worldwide over high speed internet networks. Power, wealth and education have always been important determinants of how technology communications are used, but the importance of age has be assumed greater importance in the 20th and 21st centuries partly because of the ever increasing complexity and speed of communication technology. An eighty year old adult in an industrialized society has experienced changes in user interfaces for the telephone from the first practical telephones to the hand-held cell phone with miniature keypads and/or keyboards that themselves have multiple uses. The changes in user interfaces over the lifetime of people creates technology generations [1] of users who must adapt to different to different ways to perform the same task. Miniaturization of the displays and controls of contemporary cell phones and household digital phones has created significant difficulties in using these devices by people who have experienced age related declines in brightness sensitivity and increased sensitivity to glare. There have been two industry responses to the problems of miniaturization and complexity of telephones. Phones for use in the home have been devised that have large keypad displays and memory banks that have icons or photos that identify the stored telephone numbers. A cell phone marketed under the catchy brand name, "Jitterbug," provides a basic cell phone that is less expensive and purportedly more user friendly to older persons who do not use text messaging or want cameras in their cell phones.

The creation of user interfaces that compensate for the age related perceptual-motor limitations is probably the best established development in communication as related to Gerontechnology. Interventions appropriate to a variety of situations, e.g., vision in twilight conditions as newer communication between people and complex machine generated information, e.g., automated telephone systems or information generated on the Internet. A second concerns novel uses of communications technology to mediate communications between people, e.g., telemedicine. A third is the increasing use of direct communications people and machines, e.g., service robots and the use of machines to coach and direct human activity without a human intermediary. These three developments are discussed in the remainder of this paper

.

II. COMPENSATION FOR PERCEPTUAL LIMITATIONS

Table 1 summarizes the interventions that best compensate for age associated losses in sensory perceptual processes. The interventions employ standard ergonomic principles and apply to both general and specific problems, e.g., acuity under twilight conditions. understanding speech in a noisy environment, reading an ATM display in direct sunlight, or the brightness contrast and letter size of LCD displays. Further details are provided in [2] and [3].

Table 1. Interventions for sensory systems

Increase signal strength directly or by increasing Signal/background contrast
Slow rate of presentation
Provide redundant information
Increase signal distinctiveness
Use smart technology to find right signal strength

The internet and television as sources of information has created some additional problems for older users as has the

Manuscript received April 29, 2008. (Write the date on which you submitted your paper for review.) This work was supported in part by the U.S. Department of Commerce under Grant BS123456 (sponsor and financial support acknowledgment goes here).

James L. Fozard is a Courtesy Full Professor in the School of Aging Studies, University of South Florida, Tampa, FL 33620 USA. Tel: +1 727-789-0581; e-mail: fozard@tampabay.rr.com

William D. Kearns is a Research Assistant Professor at the Louis de la Parte Florida Mental Health Institute, University of South Florida, Tampa FL 33612-3807 USA e-mail: kearns@fmhi.usf.edu

use of automated telephone systems. In the case of internet, research has focused on providing navigation aids to help overcome getting lost in a series of purportedly related web pages, e.g., [4] and [5]. Similar problems make the use of hierarchical telephone menus in which the caller has to make a series of choices to navigate through the menu in order to successfully use the system
[6], [7]. In television newscasts and advertisements, the speaker is usually reading from a prompter which allows the broadcaster to speak more rapidly than ordinary conversation. Although it is sometimes possible to obtain written copies of the spoken materials, it is not a favored solution for persons who simply want to obtain summaries of current news. Japanese engineers reported the development of a device that allows older listeners to slow the stream of speech in real time so that they can better understand the broadcast [8]. The device can manipulate the separation between successive elements of the digitized speech signal.

III. COMMUNICATION BETWEEN PEOPLE

Virtual communication channels using the Internet are now commonplace for dating services and chat rooms. In the USA and other countries, organizations such as Seniornet.org provide chat rooms and virtual games oriented towards the interests of older adults. Such services may help older persons develop new friendships and novel ways to communicate with family and friends.

Advanced video technologies are used in telemedicine applications and some mental health counseling services.

Many systems are in place to provide alarms to onsite or remote caregivers [9]. Korean scientists report the development of a 24 hour health monitoring system that contains 3 components: a system of sensors for electromyogram, electrocardiogram, body temperature and blood temperature that wirelessly transmits the information to servers that are in turn connected to a caregiver monitoring system and computers that store the archived data. [10].

Video supported telemedicine applications have been particularly useful in rural settings and harsh environmental conditions where travel to a clinic is especially difficult.[11].The level of sophistication of these services are greatly enhanced with high speed video streaming made possible by Internet2 [12].

IV. COMMUNICATION BETWEEN PEOPLE AND MACHINES

Robots developed in Japan have been used to guide elderly residents in nursing homes to medical appointments [13]. Adaptation to nursing homes has been evaluated by an adaptive intelligent machine, Paro a robotic harp seal with sensors embedded in its skin. Paro adapts its responses to those of its user. In one study it was shown that when Paro's stereotyped responses were adapted to the user, the user's stress hormone levels were lowered [14]. The use of machine to machine communication can increase the versatility of robots.

Recent developments in location aware technology using Radio frequency identification (RIFD) and its modern variant, ultrawide-band allows for tracking direction, duration, and acceleration of movements of multiple persons with decimeter accuracy range in a monitored space. The RIFD devices are small computers and can activate other sensors dependent of their location, thus allowing for exit controls or other automatic services to be initiated in smart house settings. Kearns et al [15] have demonstrated the usefulness of this technology for tracking the movements of one person following or shadowing another's movements. The authors are currently tracking daytime movement patterns of multiple persons in a congregate living setting for the elderly with the goal of using machine based pattern recognition systems identify movement patterns related to wandering and other changes in health status. The results would be reported to staff in a qualitative way and would be stored for analyses of the data.

A stand-alone system to alert persons to use proximity triggered handrail to stabilize their balance. Diode emitting sensors were attached to speakers which provide a spoken message to the walker as they approached the handrail. The usefulness of the system was evaluated by having persons walk on a moving platform in a simulated office space. When the platform suddenly changed speed, the warning reduced stumbles and near falls more than in a control condition [16]

The idea of using machine generated messages to guide or change behavior will receive increasing amounts of attention in the management of wandering and unwanted exiting of safe areas by persons with dementia. Messages generated by a cell-phone contingent on its GPS determined location represent a possible step beyond the current use of the cell phone to alert a caregiver of the location of the person with the cell phone. Sophisticated location aware technology can perform the same function in a building. Kearns and Fozard provide a detailed analysis of the psychological principles that govern machine generated interventions in management of wandering, agitation and anger in persons with dementia. [16].

Since the publication of "Persuasive Technology," [17] there has been increased interest in the use of machines to directly influence behavior. Many of the core ideas stem from Skinner's principles of operant conditioning for acquiring conditioned responses [18]. The persuasive properties of the machines depend in part on the novelty attractiveness and verisimilitude of the displays [19] and the ease with which people to attribute human characteristics to machines. Applications include machine coaching for strength training in which feedback on muscle response would be obtained from sensors on the trainee or in his or her clothing. Information from training sessions or exercise games can be shared with others to increase motivation through competition. The development of virtual games such as bowling with the Wii accelerometer enabled controls has already attracted interest among older persons.

REFERENCES

[1] M. Docampo Rama, H. de Ridder, H. Bouma, "Gerontechnology generation and age in using layered user interfaces." *Gerontechnology, 1, 25-40, 2001.*

[2] J. L. Fozard. "Gerontechnology and perceptual motor function: New opportunities of prevention, compensation, and enhancement." *Gerontechnology, 1, 5-24, 2001.*

[3] J. L. Fozard, W. D. Kearns. "Technology, aging and communication." In Gari Lesnoff-Caravaglia, ed, *Gerontechnology,* Springfield IL: Charles C. Thomas, 2007, pp. 271-291

[4] C. E. Hudson, C.T. Scialfa, R. Eliaz-Marino, J. Leberge, S.D. MacKilop. "Effects of navigation aids on web performance in younger and older adults." *Gerontechnology,8, 3-21, 2008.*

[5] S. J. Czaja, C.C. Lee "The internet and older adults: Design challenges and opportunities." In N. Charness, D.C. Park B.A. Sabel, (eds), *Communication, technology and aging: Opportunities and challenges for the future.* New York: Springer, 2001, pp.60-78.

[6] S. Czaja, J. Sharit. "The usability of telephone voice menu systems for older adults." *Gerontechnology, 2,88,2002.*

[7] L. Dulude. "Automated telephone answering systems and aging." *Behavior and Information Technology, 21,171-184, 2002*

[8] E. Myasaka."Some applicable trials for realization of human-friendly broadcasting." In K. Sagawa, H. Bouma (eds) *Proceedings of the International Workshop on Gerontechnology Tsukuba, Japan: National Institute of Bioscience and Human Technology, 2001, pp.23-26.*

[9] H. Bouma, J.L. Fozard, D.G. Bouwhuis, V. Taipale. "Gerontechnology in perspective." *Gerontechnology, 6,190-216, 2007.*

[10] W...D. Kearns, J. L. Fozard. "Technologies to manage wandering." in A.L. Nelson, D. L. Algase (eds), *Evidence-based protocols for managing wandering behaviors.* New York: Springer Publishing: 2007, pp.277-298.

[11] H. Lee, Y. T. Kim, J.W. Jung, K. H. Park, D.J. Kim, B. Bang, Z.Z. Bien. "A 24-hour health monitoring system in a smart house." *Gerontechnology, 7, 22-35, 2008.*

[12] S. M. Finkelstein, et al. "Home telehealth improves clinical outcomes at lower cost for home healthcare. *Telemedicine and e-health , 12, 128-136, 2006.*

[13] W. D. Kearns, J.L. Fozard. "High-speed networking and embedded gerontechnologies." *Gerontechnology, 6, 135-146, 2007.*

[14] M. Montemerlo, J. Pineau, N. Roy, S. Thrun, V. Varma, "Experiences a mobile robotic guide for the elderly. In *National Conference on Artificial Intelligence. AAAI, August 2002.*

[15] T. Saito, T. Shibata, K. Wada, K. Tanie. "Relationship between interaction with the mental commit robot and change of stress reaction of the elderly." *In Proceedings of the 2003 IEEE International Symposium on Computational Intelligence in Robotics and Automation, July 16-20, 2003; Kobe, Japan, volume 1.* Piscataway: IEEE; 2002, pp.119-124.

[16] W. D. Kearns, D. Algase, D. H. Moore, S. Ahmed. "Ultra-wideband radio: A novel method for measuring wandering in persons with dementia." *Gerontechnology, 7, 48-57, 2008*

[17] C. Y. Scovil, P. Corbeil, T. A. Lee, S. M. McKay, A. L. Peters, B. E. Maki "A novel handrail cueing system to prevent falls in older adults." *Gerontechnology, 6, 224-229, 2007.*

[18] B. J. Fogg. "Persuasive technology: Using computers to change what we think and do." *Amsterdam:* Morgan-Kaufmann, 2003.

[19] B. F. Skinner. "Psychology in year 2000." *J. exp. Analysis Beh, 81,207-213.*

[20] J. L. Fozard, W. D. Kearns. "Persuasive GERONtechnology: Reaping technology's coaching benefits at older age." In W. IJsselsteijn et al (eds) *Persuasive technology 2006, LNCS 3962.* Berlin Heidelllberg: Springer-Verlag, 2006, pp.199-202.

[21] M. Morris." Biofeedback revisited: Dynamic displays to improve health trajectories." In W. IJsselsteijn et al (eds) *Persuasive technology 2006, LNCS 3962.* Berlin Heidelllberg: Springer-Verlag2006, pp.207-214 .