Preface

Improvements in health care and life style choices, as well as changes in family reproductive patterns, have led to a dramatic increase in the world’s older population (Grimes, Hough, Mazur, & Singorella, 2010). According to the World Health Organization (2010), over one billion people worldwide will reach the age of 60 or older by 2025. An earlier study by Humes (2005) indicates that 71.5 million Americans, which is about 20% of the U.S. population, consider themselves to be senior citizens. This burgeoning senior population has numerous special social, educational, and health needs. According to Dorin (2007), although large numbers of older adults in the United States will be productive in later life, many will be searching for new ways to contribute to the social good as well. Furlong (1997) refers to this extended period of active adulthood as the “Third Age,” and Hough (2004) has characterized this stage of later adult development as an important period of learning and personal development.

The productivity and contributions of older adults can be significantly enhanced through the use of modern technology, but what is the current state of technology use among the elderly? Research suggests that seniors aged 65 and older are the fastest growing age group among online users, increasing by 25% yearly (Nielsen-NetRatings, 2003; cited from Bertera, et al., 2007). Evidence shows that engaging seniors in online activities enhances their life satisfaction (Dorin, 2007), self-efficacy (Bertera, et al., 2007), motivation (Hardt & Hollis-Sawyer, 2007), and knowledge and awareness of health-related prevention (Taha, Sharit, & Czaja, 2009). Clearly, technology use among older adults is a quickly growing phenomenon, with beneficial outcomes for those who choose to participate.

In the last ten years, the study of Internet use among older adults has emerged as a specific area of interest, and is gaining importance both in its contribution to theory and practice. Researchers have investigated: (1) the behaviors of seniors with regard to information search (Hardt & Hollis-Sawyer, 2007), (2) seniors’ attitudes toward the Internet (Trentin, 2004; Taha, et al., 2009), and (3) older individuals’ use of the Internet to obtain information on personal and health issues (Chen & Persson, 2002; Cresci, Yarandi, & Morrell, 2010). Beyond seniors’ behavior, instructional designers have engaged in research related to issues of technology use and aging. For instance, cognitive load theory has exerted a strong influence on the design of multimedia instructional materials to be used with older populations (e.g., Paas, Van Gerven, & Tabbers, 2005; Van Gerven, Paas, Van Merriënboer, & Schmidt, 2000, 2002, 2004; Van Gerven, Pass, Van Merriënboer, Hendriks, & Schmidt, 2003). However, despite the rich research on aging individuals and the use of digital technology, there has been a failure to adequately integrate these many approaches and present an organized and coherent picture of the field. In this book, we hope to achieve this goal. In addition, we present an overarching theoretical framework that we hope will serve as an organizing scheme for adult educators, social workers, medical professionals, researchers, and policy makers.
When considering older adults’ use of the Internet and other digital technologies, we must remember that they experience a predictable set of constraints that are the result of the aging process. Among these constraints are reduced sensory capabilities, a decrease in working memory, and a slowing of processing speed. One way to offset these constraints is to use the capabilities of modern technology to compensate for the deficits that occur as a natural result of aging. To the extent that this is possible, research suggests that improvements in cognitive performance are positively related to the affective aspect of learning (Avci, Yuksel, & Soyer, 2009; Hyland, 2010; Littledyke, 2008). Avci et al. (2009) demonstrated that cognitive and affective changes can be mediated by the learning environment. This was confirmed in an earlier study by Ke (2008), who identified the facilitation role of modern technology in cognitive and affective improvements. Although the aforementioned studies did not focus specifically on aging and technology, the theoretical and practical implications are clear: the human performance of older adults is a function of both cognitive and affective factors. These factors interact, but they can also be influenced by modern technology, which can serve to enhance cognitive capabilities and increase motivation. However, this enhancement requires a clear knowledge of the limitations of the cognitive system of older adults, the factors that serve to motivate older adults, and proven instructional design strategies that can scaffold these existing cognitive and affective systems. In Figure 1, we present our proposed model:

As can be seen from Figure 1, human performance (i.e., learning) is the result of cognitive and affective factors. Cognitive and affective factors themselves interact (e.g., if a person is seeking an important piece of health advice, they may persist even when cognitive limitations make the search difficult). However, these cognitive and affective factors may themselves be influenced by modern technologies. Technologies can help alleviate limitations that may exist in working memory capacity and the ability to receive sensory input. They may also enhance motivation and create positive emotional environments. However, the ability for modern technologies to enhance cognitive and affective factors is strongly influenced by instructional design. Good design results in enhanced cognitive and affective function. Bad design can simply make the limitations that older individuals face worse.
This text will present, for the first time, a structured approach to understanding the research on aging and digital technology. The use of the Internet and other forms of modern technology are studied through the lenses of cognitive function, motivation, and the affordances provided by new technologies. Good principles of instructional design, as well as new ideas on instructional design tailored to the needs older adults, will also be explored. There is a substantial need to integrate knowledge in this area within a single work. We hope that this book will serve that need, and that the preceding theoretical model will help provide an overarching organizing principle when reading the individual contributions presented in this volume.

THE CONTRIBUTION OF THIS BOOK

It has been demonstrated above that a unified theoretical framework in aging and Internet/digital technology use is lacking. This book will: (a) identify the role and function of the Internet and other forms of digital technology in older adult learning, (b) bring together studies in older adult Internet use with a focus on cognitive and affective domains in older adult learning and digital technologies, and (c) bridge the theories with practices in older adults’ Internet/digital technology use by focusing on effective design and development of Internet and other digital technologies for older adults’ learning. The book will target educators globally with an emphasis on diverse aspects in older adult and Internet learning that includes learner characteristics, cognition, design principles, and applications. Drawing on the authors’ own expertise and research, the authors bring together researchers, practitioners, and theorists from institutions of higher education in the United States, Asia, and Europe, and from a variety of disciplines, including teaching and learning, instructional design, computer-human interaction, cognitive psychology, communication, and learning sciences. This book, thus, moves beyond traditional disciplinary and geographical boundaries. It accommodates issues in older adults’ use of Internet/digital technologies across disciplines and at all levels.

THE ORGANIZATION OF THIS BOOK

The three sections of this book are organized to maximize the value for the readers as they move from the theoretical to the practical and from a focus on cognition to the design and application of the technology for older adults.

Section 1 presents a theoretical perspective on aging and technology. It contains four chapters that cover a wide range of topics on aging and technology, including cognitive architecture, working memory, gesture visualization, and social collaboration, in the use of technology for older adults.

In Chapter 1, Christopher A. Was of Kent State University and Dan J. Woltz of the University of Utah review the distinctions between explicit memory (i.e., effortful storage and retrieval of information) and implicit memory (i.e., learning and memory that does not require conscious effort) and present the evidence that implicit memory does not decline at the same rate as explicit memory. The authors discuss the possibility of using implicit memory processes (e.g. procedural memory) to aid explicit memory processes (e.g., declarative memory). Finally, the authors discuss the need and the opportunity to incorporate information and communications technologies into the lives of older adults in order to support memory and learning.
In Chapter 2, Jason M. Watson, Ann E. Lambert, Joel M. Cooper, Istenya V. Boyle, and David L. Strayer, all from the University of Utah, and Ann E. Lambert of the University of Virginia focus on attentional control and the behaviors of older adults. Using a high-fidelity simulator, the authors measure individual differences in participants’ abilities to maintain a prescribed following distance behind a lead vehicle, as well as their reaction time to press a brake pedal when this lead vehicle brakes. Consistent with the literature on age-related changes in driving, following distance elongates with increased age, and brake reaction time slows. Furthermore, regression analyses reveal the increase in following distance and the slowing in brake reaction time both co-varied with age deficits in attentional control. These results provide a novel demonstration of the inherent value of cognitive theory when applied to naturalistic settings, sharpening our understanding of the relevance of age-related deficits in attentional control for complex, real-world tasks, like driving.

Chapter 3, by Kim Ouwehand, Tamara van Gog, and Fred Paas of Erasmus University Rotterdam, The Netherlands describes the role of gestures in instructional design from a cognitive load theory perspective, addressing, in particular, how this might benefit aging adults. Healthy older adults have to cope with several cognitive changes related to their working memory, such as a decline in: 1) the ability to deal with interference, 2) cognitive speed in response to unimodal stimuli (e.g. visual information), and 3) the ability to associate and integrate information elements. Cognitive load theory, with its focus on adapting learning formats to the limitations of working memory, provides a promising framework to address learning in older adults. Research inspired by cognitive load theory has shown that attentional cueing can reduce interference during learning, presenting instructions in a multimodal format can make more efficient use of WM stores (both auditory and visual), and the manner of presentation of information can aid integrative learning. Interestingly, studies using gestures in instruction show that gestures accompanying verbal information improve learning in similar ways. In the present chapter, the authors discuss the possibility of gestures improving multimedia learning in older adults using some important guidelines proposed by cognitive load theory.

Chapter 4 explores the role of technology in supporting collaboration between health care providers and older adults. Daniel Morrow and Jessie Chin of the University of Illinois discuss two technologies that help link patients to their providers by giving them access to health information and services: 1) patient portals to Electronic Health Records, and 2) Personal Health Record systems. Theories of distributed cognition and common ground are used to frame a review of the small but growing body of research that investigates which older adults use or do not use these technologies, and why. The findings, while sparse, suggest that older adults with lower levels of health literacy stand to benefit the most from this technology, but they tend to have fewer cognitive, literacy, and other psychosocial resources needed to take advantage of the technology. This discrepancy is due in part to systems that are not designed with older adults’ needs and abilities in mind. The authors conclude with recommendations for improving the use of these tools to support patient/provider collaboration by making them easier to use and by integrating them with other communication media to support the broader context of the patient/provider relationship.

Section 2 deals with issues of instructional design in aging and technology. The section contains four chapters that introduce instructional design for older adults by considering the effects of cognitive architecture on learning. It explores everyday technologies and known factors influencing the successful use of technology and suggests ways to examine both the constraints and the opportunities of Internet use among older adults, which have significant implications in the design and development of technology
for older adults. The section ends with a chapter on designing effective online learning for older people using a heuristic design approach.

Chapter 5 is authored by Renae Low and Putai Jin of the University of New South Wales, Australia, and John Sweller of University of New South Wales, who created the Cognitive Load Theory. The authors examine the aged subpopulation’s needs and their ability to use digital technology from the perspectives of human cognitive architecture and the principles of instructional design guided by cognitive load theory. The chapter focuses on the following critical issues: a) the evolution and formation of human cognitive architecture, b) cognitive functioning as influenced by aging, c) compatibility between elderly people’s available mental resources and the cognitive requirements of digital equipment, and d) guidelines for human-computer multimedia interactions derived from the accumulated experimental evidence on effective instructional design and delivery.

In Chapter 6, Marita A. O’Brien of the University of Alabama and Wendy A. Rogers of the Georgia Institute of Technology describe best practices and challenges for enabling older adults to adopt everyday technologies transformed by technology innovations. The authors first define everyday technologies and known factors influencing their successful use including environmental support and context of use. Then, the authors discuss issues and challenges of design for everyday technologies and summarize the factors that influence everyday technology use in a conceptual diagram. The authors also present recommendations for specific constituents that may improve technology adoption by older adults. Lastly, the authors discuss future opportunities for enhancing everyday technology use with good design, useful support, and appropriate innovations.

In Chapter 7, Yiwei Chen, Bob D. Lee, and Robert M. Kirk of Bowling Green State University use a Lifespan Developmental Perspective to examine both the constraints and the opportunities of Internet use among older adults. Given age-related changes in physical, cognitive, and socio-emotional processes, older adults may encounter different constraints in Internet use than younger adults. The Selective Optimization with Compensation model is used to explore opportunities for older adults in using the Internet to improve quality of life. The authors suggest that future product designs and training programs should take into account older adults’ physical and cognitive limitations, as well as their socio-emotional needs. They also recommend that social policies should help older adults overcome these constraints in order to reduce age-related digital divide and promote quality of life for older adults.

Chapter 8 examines the cognitive constraints related to older people in learning, particularly in e-learning. Robert Zheng of the University of Utah proposes a new design approach, which (1) assists the instructional designer and Web development in identifying issues related to older people’s involvement in e-learning, (2) helps reduce the mental load in designing and developing e-learning for older people, and (3) uses heuristics to systematically support the designers in making decisions about meeting the needs of older people in their learning and searching for information online.

Section 3 presents research studies and conceptual papers focusing on the practical aspects of applying technology for older adults. It entails chapters that focus on new perspectives pertaining to the use of technologies in various educational settings including e-learning for older adults.

This section opens with a theoretical investigation by Karin Slegers, Centre for User Experience Research, Belgium, and Martin P. van Boxtel, Maastricht University, The Netherlands. Chapter 9 focuses on the impact of computer and Internet use on several aspects of quality of life and the autonomy of older adults. It is based on an intervention program that included concise computer training and the use of a computer and the Internet for twelve months. The results of this randomized, controlled study showed no effects, neither positive nor negative, of computer and Internet use on cognitive functioning,
autonomy, well-being and social network, the use of everyday technological devices, and subjective physical functioning. Overall, it was concluded that computer and Internet usage by healthy older adults is a safe activity, albeit with no robust advantage for cognitive capacity in healthy older adults.

In Chapter 10, Michael K. Gardner and Robert D. Hill of the University of Utah review the episodic memory difficulties typically encountered by older adults. Their study demonstrates that mnemonic interventions can improve episodic memory in the elderly, though such improvements often do not transfer broadly and do not result in improvements in the area of subjective memory assessment. The chapter then presents three approaches to improving episodic memory for numeric information, each based upon a different approach. These approaches demonstrate: (a) that a mnemonic targeted at numeric information can improve number recall; (b) that self-generated strategies can improve recall at nearly the same level as a targeted mnemonic; and (c) that episodic memory can be converted into procedural memory, though this approach did not demonstrate improved episodic memory performance. Future directions for memory remediation are discussed, based upon research findings to date.

In Chapter 11, Eulàlia Hernandez-Encuentra, Modesta P. Fernández, and Beni Gómez-Zúñiga of The Open University of Catalunya in Spain examine older adults’ adoption and experience of using Information and Communication Technologies (ICT), in particular the Internet. The authors make their arguments based on the experiences of a group of older people, all already users of ICT, in a collaborative, relaxed, and self-managing environment—the virtual campus of the Universitat Oberta de Catalunya (an online university). Older adults adopt ICT in relation to a personal project, sometimes as a tool to achieve it, so ICT use has to be done on their own initiative, with a positive attitude, and under their control. Based on the Selective Optimization and Compensation (SOC) theory of adaptation processes, the authors believe that introducing ICT through selection and optimization strategies can be a successful means of assuring effective adoption of these technologies.

In Chapter 12, Shane O’Hanlon, Alan Bourke, and Valerie Power of the University of Limerick in Ireland examine the benefits of e-Health for older people. They point out that barriers concerning e-Health still remain, including an immature evidence-base, questions about risk and safety, and variable rates of uptake in this population. Their chapter explores these issues and reviews the literature on e-Health for older adults. Successful clinical trials are identified, and the e-CAALYX project is described in detail as a case study. e-Health presents many exciting opportunities but needs further development and guidance.

Chapter 13 features a conceptual paper by Robert D. Hill of the University of Utah. This chapter presents a guided framework for describing Remote Care Delivery Technologies (RCDT) in the processes of healthcare management among older patients diagnosed with chronic disease. To date, a process framework for the application of RCDT for chronic health conditions has not been systematically described, although much of the literature on RCDT, including telemedicine and telehealth, has focused on issues that involving the monitoring of chronic disease symptoms and the coordination of ongoing care. To elucidate how this process framework operates in managing chronic health conditions, examples are provided from the published literature to clarify and differentiate each of the steps of this framework. A final section describes guidelines informed by this framework for providing RCDT in the management of chronic disease.

Finally, in Chapter 14, Candice M. Daniel, Bret Hicken, Marren Grant, and Randall Rupper of the VA Salt Lake City Health Care Center, and Marilyn Luptak of the University of Utah present a case study for using tele-health technology to support caregiver training. The authors describe the barriers and challenges related to caregiver training. To address this problem, the authors develop a psycho-educational caregiver intervention for use with in-home digital technology that is currently underway at
three Veteran’s Health Affairs (VA) health care centers. The chapter provides: 1) a brief summary of the background and rationale for the intervention development; 2) an overview of the project; and 3) the issues and lessons learned from developing interventions using digital technology for use with older adults.

Robert Z. Zheng  
*University of Utah, USA*

Robert D. Hill  
*University of Utah, USA*

Mike K. Gardner  
*University of Utah, USA*

**REFERENCES**


