Aging and Online Learning

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INTRODUCTION

In response to changes in demographics and technology, education in North America is undergoing a transformation. Dorin (2007) summarizes several critical factors in demographic trends that will significantly impact the development of the educational landscape in North America. First, as baby-boomers age there is a dramatic shift in the composition of our population, that is, a greater percentage of the entire population will be represented by those 65 and older. Second, older adults will remain productive in the workforce. Third, life expectancy will increase, adding again to a greater percentage of our population falling into the older adult category.

There are also many changes related to technology use occurring within the older adult population. For instance, older adults are increasingly more interested in opportunities for continuing education (Mannheimer, Snodgrass, & Moskow-McKenzie, 1995) which is more and more frequently accomplished via technology. Outside of educational contexts, we see an interleaving of technology into everyday activities for older adults such as searching for health information on the world Wide Web (Karavidas, Lim, & Katsikas, 2005) and using e-mail as a communication tool to maintain contact with family and friends (Hilt & Lipschultz, 2004). Jastrzembski, Charness, Holley & Feddon, (2005) assert that "older adults may comprise one of the fastest growing segments of the estimated 80 million Internet navigators in the US, having jumped 47% as of 2004. Thus 22% of older adults are now online…" (p. 39).

This chapter provides a review of research findings in the area of aging, describes how age-related declines may impact older adults' use of computers and presents approaches suggested in the literature to addressing these issues.

BACKGROUND

Cognitive Deficits

Speed of Processing

Currently, comprehensive explanations of cognitive aging are represented by two perspectives: processing-speed theory and process-specific theories. Processing-speed theory (Salthouse, 1996) rests on the premise that cognitive declines in many areas are due to a general slowing of cognitive processes. Neuroscience evidence (Hedden & Gabrieli, 2004) suggests this slowing is a result of reduced efficiency in neural transmission, that is, the speed at which electrochemical messages can be passed from one neuron to the next in the brain. This is due to reductions in both the density of synaptic connections and in concentrations of certain neurotransmitters.

In contrast, other theories of aging (e.g., Hasher & Zacks, 1999) refer to more process-specific mechanisms, mechanisms unique to individual processes such as attention, to explain degraded cognitive performance.

A large number of studies provide evidence that speed of processing is a substantive contributor to cognitive aging (e.g., Lemke & Zimprich, 2005; Rush, Barch, Braver & Todd, 2006: Wood et al., 2005) but a number of researchers maintain that speed of processing and process-specific factors work together to impact the course of normal cognitive aging (e.g., Birren & Fisher, 1995; Madden & Gottlob, 1997)

To date, evidence from the human computer interaction and educational technology literature converge with the behavioral and neuroscience evidence regarding the slowing of cognitive processes due to aging. Although speed of processing effects are difficult to isolate in complex on-line tasks, older adults were found to be slower than younger adults in completing an on-line information search task (Boechler, Foth & Watchorn, 2007), using a sequential on-line hierarchy Kurniawan, Zaphiris & Ellis, 2002), and completing tasks in a 3D computer environment (Sjolinder, Hook, Nilsson, & Andersson, 2005).

Memory

Any explanation of the memory deficits we observe during the process of normal aging should be prefaced by a general description of the underlying architecture of human memory. The human memory system is made up of two storage units: long-term memory and working memory. Long-term memory is a repository for information and knowledge that we have been exposed to repetitively or that has sufficient meaning to us. Long-term memory is a memory store that has an indefinable duration but is not conscious; that is, any information in long-term memory must first be retrieved into working memory for us to be aware of it. Hence, any conscious manipulation of information or intentional thinking can only occur when this information is available to working memory. However, working memory has a limited capacity for the amount of information that can be processed at one time. Baddeley, Thomson, and Buchanan (1975) reported that the size of working memory is equal to the amount of information that can be verbally rehearsed in approximately 2 seconds.

Short-term memory, an early term for working memory, refers to a constrained aspect of working memory, that is, the number of items that can simply be held in working memory without any type of manipulation. Manipulating items in working memory (e.g., revising the order, categorizing) uses more cognitive capacity than merely holding items in memory. Age effects have been reported in both short term and working memory measures (Zacks, Hasher & Li, 2000).

The current literature on cognitive aging provides evidence of differential deterioration across different memory systems (Prull, Gabrieli and Bunge, 2000), that is, processes that function in conjunction with the basic architecture of working and long-term memory. For instance, explicit memory refers to the conscious recollection of material, hence, explicit memory draws on the resources of working memory. Explicit memories could be memories that are personally experienced by the individual (episodic memory) or memories that represent facts or general knowledge (semantic memory).) Prull, Gabrieli and Bunge (2000) provide neurological evidence that the capacity for laying down new explicit memories declines during the normal aging process, the result being that older adults are less able to purposefully remember material that has been recently viewed whether that is episodic or semantic material. However, Hedden and Gabrieli (2004) note that previously encoded episodic and semantic memories remain quite stable over the lifespan.

Although explicit memory encoding declines with age, research indicates that implicit learning and memory remain relatively stable across the lifespan (Hedden & Gabrieli, 2004). Implicit memory refers to memory for material that has not been purposefully attended to or consciously processed in some way. Implicit memory would include memory for some previously learned skills that have become automatic and the unconscious priming of material rather than direct, intentional recall of material.

This disparity between age-related degradation of explicit but not implicit memory is easily understood because of working memory limitations. Implicit memory, because it is outside of conscious activity, does not draw on the resources of working memory and, therefore, is not susceptible to the age-related declines in working memory capacity (Zacks, Hasher & Li, 2000)

As an example of web-based learning in particular, Boechler, Foth and Watchorn (2006) found that two explicit memory skills, associative memory and short-term memory, were correlated with different aspects of older adults' performance during an information search task. In this study, associative memory was measured with a paired word test and short term memory was measured with a digit span test where participants viewed a sequence of numbers and immediately had to report that sequence back after it was removed from view. The results of the study showed that associative memory ability was related to recall for website material. Participants with better associative memory were more able to freely recall the page titles of the webpages on the website. This is in accordance with research that shows deficits in older adults' ability to learn new associations (Kausler, 1994). In addition, short–term memory capacity was correlated with performance on finding target information during the search task. Older adults that scored higher on the digit span test were able to find their way through the website to the