Technology Usability across the Adult Lifespan

Peter Graf[1], Hiroe Li[1] & Joanna McGrenere[2]

[1] Department of Psychology
University of British Columbia
Vancouver, BC, V6T 1Z4, Canada
pgraf@psych.ubc.ca & hywli@interchange.ubc.ca

[2] Department of Computer Science
University of British Columbia
Vancouver, BC, V6T 1Z4, Canada
joanna@cs.ubc.ca

Current interface design guidelines encompass only a subset of the relevant human-factors data, and seem to have evolved more from intuition than systematic empirical research. In order to close the young-old digital gap, we advocate the development of guidelines that are more firmly anchored in a comprehensive understanding of adult lifespan developments in cognition, learning style as well as personality and attitude, supported by research on their validity and reliability.

Human-computer interaction, computer accessibility, usability research, cognitive aging, declining perceptual-motor skills, assistive technologies, attitudes toward computers, fear of failure.

INTRODUCTION

The computer revolution is currently fuelled by rapid advances in versatile wireless communication devices (e.g., smartphones) and powerful handheld computers (e.g., Personal Digital Assistants or PDAs) that offer many of the standard functionalities of PCs. Because they are small, mobile and powerful, these new technologies are suited for many purposes. For elderly individuals who may be alone, and mobility or otherwise impaired or in poor health, a handheld wireless device may provide an escape from isolation, an alternative method for remaining involved and connected, for communicating with friends, relatives, health care providers and others who are crucial to healthy and enjoyable aging. Moreover, the new technologies are ideal as platforms for portable aids and assistive devices (e.g., reminder systems, locator systems) for the elderly and for persons with cognitive impairments.

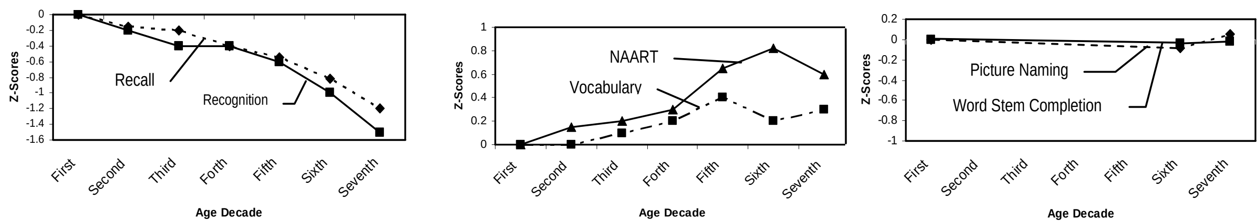
The elderly, the most rapidly growing segment of the industrialized world's population, have landed on the wrong side of the digital divide, the gap between information and communication haves and have-nots. In 1997, there was a 31.4% difference in the percentage of Internet users among people aged 35 or younger versus 65 or older, and by 1999 this difference had increased to 42.9 %. Tomorrow's normal-aging seniors are expected to be dramatically older, healthier, better educated and more computer savvy, but despite the latter, it is likely that developments in handheld wireless technologies will widen the young-old digital gap mainly by virtue of the small size of handheld devices, especially their limited screen display area, low resolution, and unfamiliar user interfaces and input devices (e.g., a slim stylus rather than the familiar keyboard). These design factors may constitute a unique class of access barriers for healthy elderly individuals and especially for cognitively impaired individuals.

The rapid aging of society and the growing young-old digital gap are widely recognized and are strong motivators for achieving Universal Accessibility (Shneiderman, 2000). A variety of user interface design guidelines have been developed over the years, some of which seem broadly consistent with evidence of age-related declines in cognition (Craik & Salthouse, 2000; Graf & Ohta, 2002). However, we believe that current guidelines encompass only a subset of the relevant human-factors data, and seem to have evolved more from intuition than systematic empirical research. Consequently, the guidelines have blind spots in essential areas; moreover, where guidelines do exist, they can be hard to translate into specific user interface characteristics. We advocate the development of guidelines that are more firmly anchored in a comprehensive understanding of adult lifespan developments, supported by research on their validity and reliability.

COGNITION ACROSS THE ADULT LIFESPAN

Current efforts to achieve universal accessibility are heavily biased by the finding that healthy, normal aging is accompanied by significant declines in sensory, perceptual, cognitive and motor functions (Craik & Salthouse, 2000; Graf & Ohta, 2002), and by the finding that such declines tend to be selectively magnified in cognitively impaired individuals (Squire & Schacter, 2002). However, as illustrated by Figure 1, only some aspects of cognition decline, whereas others remain the same or even improve across the adult lifespan. Moreover, it has been demonstrated, for example by Glisky and Schacter (1988), that despite a profound deficit in explicit episodic memory, an amnesic individual with spared implicit memory was able to perform a complex data-entry job at the same level as non-amnesic controls. In the face of the rich pattern of age-related changes depicted by Figure 1, and the complex mapping between test performance and behavior on real-life tasks, intuition is not an adequate basis for developing user interface guidelines. Instead, empirical research is required to ferret out how specific developments across the adult lifespan might translate into specific usability issues.

FIGURE 1: The figure illustrates age-related declines on explicit episodic memory tests (left panel, adapted from Uttl, Graf & Richter, 2002), age-related improvements on semantic memory tests (middle panel, adapted from Uttl, 2002) and age-invariance on implicit memory tests (right panel, adapted from Mitchel & Bruss, 2003).



Cognition Occurs in Context

On explicit episodic memory tests, 7- to 9-year old children show performance levels similar to those of the 60- and 70-year olds in the left panel of Figure 1. Yet, children typically are skilled and sophisticated users of handheld digital devices (e.g., Nintendo's Game Boy) with highly complex interfaces. The interface-guideline lesson illustrated by this comparison between children and older adults is that complex real-life task performance is rarely determined by a single variable, but instead depends on a multitude of cognitive and non-cognitive factors that seem to work in a compensatory manner.

Personality and Attitude

Aging is accompanied by both positive and negative changes in personality and attitudes, these occur independently of changes in cognitive abilities, and it is possible that older adults might experience problems with new digital devices because of such personality or attitude changes (DeYoung & Spence, 2004). For example, older adults are more conscientious (Cuttler & Graf, 2005), and are therefore more likely to be concerned with "doing things right"; they are also more likely to be afraid of failing, and thus reluctant to try new ways of doing things. Usability research is required to ferret out the distinct contributions due to age-related changes in personality and attitudes versus age-related changes in cognitive abilities.

Learning Style

Learning styles may be placed on a continuum that extends form discovery learning (e.g., learning by doing) to reception learning (e.g., learning by seeing). Learning styles are known to vary across contexts and tasks, as well as across individual-difference variables such as age (Ayersman & von Minden, 1995). In novel situations, older adults tend to adopt a reception style of learning whereas young adults tend to opt for a discovery style. Consistent with their preferred learning style, in a recent digital camera usability study, we found that young adults did not request any help even after making up to 30 errors on a task, whereas older adults did not even commence this task without guidance.

Conclusion

Aging is accompanied by changes in cognition, as well as in learning styles, personality and attitudes. In order to close the young-old digital gap, future research needs to examine how each of these factors on its own, as well as in interaction with the others, contributes to the different usability problems experienced by young versus older users of handheld digital devices.

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