Meeting the Challenge: Training an Aging Population to Use Computers

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Older adults present a special challenge to libraries offering computer training. Many of those seeking training have little, if any, prior experience with the concepts and skills necessary to use computers, yet their ability to learn those concepts and skills is hampered by the aging process. This article summarizes the factors in aging which most affect learning computer skills, and how those factors can be mitigated.

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Introduction

In September of 2001, the North County Regional Library of the Palm Beach County Library System opened a computer lab to offer hands-on computer training classes to patrons. The area demographics include a large proportion of older, retired adults, generally from the middle and upper-middle classes. Not surprisingly, approximately eighty percent of the training class participants have been over 55, with little or no computer experience. We found a unique challenge in tailoring our material to fit the special learning circumstances of this group, many of whom came to us after finding that other basic computer classes offered in the community were too difficult for them. A search of library literature provided little insight into the problems we were having, so the literature search was broadened. This article summarizes the results of that research, as well as the experience gained in implementing ideas gathered from the literature of research on aging and computer training.

The 1998 government study, "Falling Through the Net,"[1] and the 2001 Pew Internet Study, "Wired Seniors: A Fervent Few, Inspired by Family Ties,"[2] identified the older adult population as the fastest growing segment of Internet users. This segment is most likely to have missed the electronic revolution, yet it is becoming more and more a necessity for them to be able to use computers and computerized equipment, such as automatic teller machines and voting machines. For those who did not experience computers as part of their work environment, there is a steep learning curve, and until recently, more reason to ignore computers than to embrace them.[3] But even those who encountered computers before they retired will be at a disadvantage if retirement came prior to widespread use of graphical user interfaces and the mouse, since different skills are required for graphical user interfaces than were used in the earlier text-based systems.

As many librarians have learned, older adults now seem to be flocking to library classes on basic computer training and using the Internet,[4] and as many of us have also learned, they present a special challenge to trainers.[5] Besides the obvious physical obstacles encountered with using a mouse, there is the ubiquitous patron who asks a question about what was just covered as if it had never been mentioned, or the one who demands to know, "but what is this good for?" Some keep coming back for the same classes until we wonder if retention is an additional skill to be learned.

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1 Department of Commerce, *Falling Through the Net: Toward Digital Inclusion, A Report on Americans' Access to Technology Tools*, (Washington, D.C.: NTIA, October 2000), [http://www.ntia.doc.gov/ntiahome/fttn00/contents00.html] Accessed June 11, 2002.

2 Susannah Fox, et al. *Wired Seniors: A fervent few, inspired by family ties*, (Washington, D.C.: Pew Internet & American Life Project, September 9, 2001), Accessed March 20, 2002.

3 Fox, et al.; Philip J. Trocchia and Swinder Janda, "A Phenomenological Investigation of Internet Usage Among Older Individuals," *Journal of Consumer Marketing* 17, no. 7 (2000): 605-616.

4 Connie Van Fleet and Karen Antell, "Creating CyberSeniors: Older Adult Learning and its Implications for Computer Training," *Public Libraries* May/June (2002): 40; Kristina Daily-Brothers, "Computing for Seniors at the Brownsburg Public Library." *Indiana Libraries* 16, no. 1 (1997): 21-23; Trish Clarkson and Sally Bradford, "It's Never Too Late to Learn How to Surf the Net," The Library Association, Accessed June 5, 2002.

5 Van Fleet and Antell, 49; Mike Williams and Elaine Williams. "Teaching ICT Skills to Third Agers," *Learning in Later Life*, (October 29, 1999), Accessed December 16, 2002.

Malcolm Knowles identified basic strategies for educating adults, which he termed "Andragogy," as distinguished from "Pedagogy."[6] Most notably, those strategies address motivation and relevance. Adults are self motivated and self-directed. They seek to learn what is relevant to their lives. In computer terms, this means they will not be interested in learning to use a computer until they experience a relevant purpose for it, and they will learn only what is of immediate use to them, such as how to view an e-mail attachment. This is obviously where training older adults begins, but if that were the sum of what is necessary, there would not be twenty years of research identifying exactly why the older population is having difficulty learning computer skills.

There is a stubborn misconception, refuted by decades of research, that older adults cannot learn to use computers. Yet the declaration that even the very old can be taught computer skills may seem like news to those who have experienced the frustration of trying to teach those skills to a class of older adults. What exactly is the problem? There are several, directly related to the aging process: deterioration of physical aspects such as hearing, vision and motor control; declines in attentional processes; and cognitive slowing. Yet research shows that despite these age-related declines older adults can learn the concepts and skills necessary to use computers.[7]

Methods to improve the learning curve for older adults have also been the subject of research.[8] Summarizing the results of this body of research, two prominent researchers note, "There is a need for age-specific training; researchers have uncovered techniques for developing such training and have tested the benefits of that training."[9] Where training classes or programs are already in place, especially training for computer skills, attention to age-related issues may be all that is needed to improve effectiveness with older adults. Our experience confirms what one researcher concludes: "The learning performance of older people can be improved by manipulation of training technique."[10]

Physical Problems

Differences in the way younger and older adults learn involves the aging process. The most obvious difference is the physical aspect. As we age, there are physical declines in mobility, motor skills, vision, and hearing. The decline in motor skills affects the ability of older adults to use a keyboard and to control a mouse device. For example, the double-click function of a mouse will not work if the mouse is moved while clicking. Many older adults, however, have difficulty keeping the mouse stationary while trying to perform a double-click. Arthritis can affect their ability to hold the mouse and consistently click on the correct mouse button. Tremors and associated declines in motor ability caused by neural noise (signals generated within the nervous system unrelated to actual stimulus) affect their ability to accomplish fine-motor tasks such as positioning a cursor or holding the mouse still during a double-click task.[11]

Some of these difficulties can be alleviated or overcome with adaptive technology, which addresses the specific physical problems encountered using computers. For example, a mousing device which remains stationary, such as a trackball, may be easier for some older adults to maneuver than a regular mouse, which must be moved. Just because the input devices are difficult for a student to use, however, does not mean adaptive technology should be offered during training to make computer use easier. What will they encounter outside of class? If

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[6] Malcolm S. Knowles and Associates, *Andragogy in Action: Applying Modern Principles of Adult Learning* (San Francisco: Jossey-Bass Publishers, 1985), 14.

[7] Sara Czaja, "Computer Technology and the Older Adult," in *Handbook of Human-Computer Interaction,* 2nd, Completely Revised Edition (New York: Elsevier, 1997), 800.

[8] Ibid.; Katharina V. Echt, Roger W. Morrell, and Denise C. Park, "Effects of Age and Training Formats on Basic Computer Skill Acquisition in Older Adults," *Educational Gerontology* 24, no. 1 (1998): 3-25; Lisa A. Hollis-Sawyer and Harvey L. Sterns, "A Novel Goal-Oriented Approach for Training Older Adult Computer Novices: Beyond the Effects of Individual-Difference Factors," *Educational Gerontology* 25, no. 7 (1999): 661-684; Brett D. Jones and Ute J. Bayen, "Teaching Older Adults to Use Computers: Recommendations Based on Cognitive Aging Research," *Educational Gerontology* 24, no. 7 (1998): 675-689.

[9] Wendy Rogers and Arthur D. Fisk, "Human Factors, Applied Cognition, and Aging," in *The Handbook of Aging and Cognition,* 2nd ed. (New Jersey: Lawrence Erlbaum Associates, 2000), 585.

[10] Czaja, 803.

[11] Czaja, 806; Rogers and Fisk, "Human Factors, Applied Cognition, and Aging," 566-567.

they do not have a computer, but instead will be using computers in the library or somewhere else, they will be better prepared by training which uses the devices they will encounter. If the primary computer they will be using is their own, or one they plan to buy, students should be advised that alternative mouse devices are available, but are not standard equipment. Given the fact that adaptive devices will cost extra for their own computer, many seniors choose to learn to use the standard mouse, even if it is initially more difficult. Since part of learning to use a mouse device is understanding the concept of pointing and clicking in a graphical user interface, we believe initially learning the concept and skill on a mouse which they will typically encounter outside their own home is more valuable than offering an alternative which they may never encounter again.

The double-click operation is one of the most problematic for older adults. We have found that initially instructing older adults to click once to highlight an icon and then to press the Enter key to open the corresponding program gives them an easy alternative to remember. When we subsequently teach them about double-clicking, we remind them about pressing the Enter key if nothing happens when they double-click. Usually, just having that knowledge is enough, although most will still try to master double-clicking. Another strategy, useful for those who have difficulty holding the mouse still while clicking, is to show them how to use one hand to hold and move the mouse and to use the other hand to click the buttons. It may seem counter-intuitive, but for some older adults it is a welcome solution which enables them to continue.

Age-related changes in vision begin as early as middle age. As vision declines and older adults begin using bifocal or trifocal glasses, viewing the monitor becomes problematic because of the viewing distance, which may be between their close and distant vision points. Glare is also more of a problem for older adults due to changes in vision. Adjusting the monitor's tilt can reduce glare, but we have found that older students usually do not realize the monitor can be moved or adjusted. If they see the monitor moved and adjusted for them as they arrive for class, they realize a problematic monitor elsewhere can also be adjusted.

Age-related changes to the eye also affect the quality and amount of light that is seen, so that color perception is affected.[12] Distinguishing between blues and purples becomes more difficult, and cataracts will make white appear yellow. The more contrast there is on a screen, the easier it will be for seniors to read. Unfortunately, when using World Wide Web sites in training, there is not much that can be done with the color combinations a site uses, or the standard colors of links and visited links, so it is important to keep these visual factors in mind when selecting web sites to use in training, and when designing web-based training. Changing the screen resolution can help, but if that option will not normally be available to them, it again becomes an issue of what they will be using after the class.

For older adults, written instructional material is a major part of the learning process. Two prominent researchers in the field of computer instruction to the elderly, Morrell and Echt, have argued that the lack of adequate printed instructions is a major inhibitor to seniors learning to use computers.[13] Drawing on their own research and the body of research on teaching computer skills to seniors, they advocate using both verbal and printed materials in training older adults to use computers. Our own experience, as well as others',[14] verifies their conclusions. Written instructions, however, must be readable and understandable to older adults to be useful. In terms of vision related declines, text size and layout are critical. Research summarized by Morrell and Echt indicates font size 12 to 14 is preferable to smaller size fonts. A sans serif font like Helvetica seems to be the easiest to read. To accommodate vision related declines, as well as attentional and cognitive issues, discussed below, the format and structure of written materials should include relevant illustrations, presented in discrete segments with simple language.

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[12] Roger W. Morrell and Katharina V. Echt, "Designing Written Instructions for Older Adults: Learning to Use Computers," in *Handbook of Human Factors and the Older Adult* (New York: Academic Press 1997), 348

[13] ibid., 338.

[14] Sarah Muller, "Design of a novices' computer course for older adults," (honor's thesis, St. Mary's College of Maryland, 2001); Dennis Mark Roberson, "Selected Case Studies of Senior Citizen Computer Technology Implementation and Training Through Non-Formal Instructional Techniques," (master's thesis, New Mexico State University, 2000).

Age-related changes to the ear and central auditory nervous system affect not only what is heard, but also how well it is processed. Within the range of hearing, the higher pitches are the first to be negatively affected with age. The pitch of a typical male voice is ideal, but since it is the extremes which are most impacted, a woman's voice which is not in the higher pitches will be just as discernable to those with age-related hearing loss.[15] In addition to pitch, the combination of increased neural noise and decreased ability to suppress external noise (stimulus which is unrelated to the attentional focus) degrades speech perception as adults age.[16]

Declines in attentional processes, discussed below, also affect the ability to correctly interpret what is heard. Slow, distinct speech is imperative, as well as blocking out, or at least minimizing, external noises. Even quiet chatting between students in an otherwise quiet room will have a negative impact on how much can be processed and retained by the others. Finally, since older learners need slightly more time to process speech and the new information they are hearing, it is important to allow time for processing what is said.[17]

Attentional Processes

Attentional processes involve selective attention, inhibition, and control of the attentional focus. The practical effects of declines in attentional processes are twofold: interference with the ability to focus only on the task at hand, and making incorrect inferences. Since one's working memory involves using what is in the attentional focus, declines in inhibition (the ability to exclude not only distractors, but irrelevant or inappropriate content) will affect the ability to learn and retain new information. The older adult must, in effect, find the focal point and maintain it while excluding pre-existing knowledge which points to something else. In our experience, even following explicit, step-by-step, printed instructions can be an attentional challenge for some older adults.

Computer training requires learning new concepts and associations, such as "icons" and "shortcuts." But declines in attentional processes make it more difficult to exclude prior associations with these terms, and replace them with the new associations. The experience of older students learning new concepts and associated tasks would be similar to going to a reunion and finding everyone's name has changed. As two researchers in aging, Rogers and Fisk, have noted, "generally, older people have more difficulty...modifying existing concepts."[18] However, the more they hear the new associations, the better their retention will be. Priming, a procedural memory process which is not affected by age, occurs when a term or concept is introduced briefly for later recall. Research indicates priming will increase retention in older adults.[19] Repetition, especially when incorporated in practical experience, is the key to retention. Cues, such as "cheat sheets" or labeled graphics which draw attention to screen locations, have also been found to be effective,[20] just as name tags would help at the reunion where everyone's name has changed.

External distractions which interfere with the attentional focus can be environmental, such as noise or temperature, or attention related, such as a visually busy web page. In either case, processing new information, which is already negatively affected by age, is further taxed by the distractions. In their article, "Issues in Training Older Adults to Use Computers," Kelley and Charness, two prominent researchers on aging, note, "attentional resources [are] especially important for unfamiliar tasks or [when it is] uncertain where attention should be focused."[21] We have found that when using printed instructions and handouts, brief and concise directions, using relevant graphics with easy to read text, in a simple step-by-step format, help seniors maintain their attentional focus.

Temperature can be an attentional distraction to older adults due to thinning skin and decreased circulation which makes them more sensitive to cooler temperatures. A room temperature which may be comfortable for younger adults can be an uncomfortable

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15 James L. Fozard and Sandra Gordon-Salant, "Changes in Vision and Hearing," in *The Handbook of the Psychology of Aging*, 5th ed. (San Diego: Academic Press, 2001), 253.

16 Ibid.

17 Jones and Bayen, 677.

18 Czaja, 805.

19 James H. Howard and Darlene V. Howard, " Learning and Memory," in *Handbook of Human Factors and the Older Adult* (New York: Academic Press, 1997), 17-18.

20 Czaja, 802.

21 Catherine L. Kelley and Neil Charness. "Issues in Training Older Adults to Use Computers," *Behaviour & Information Technology* 14, no. 2 (1995): 107-120.

distraction to older adults. Conversely, a room which is uncomfortably warm for the trainer may be just right for seniors. To minimize this element of distraction it is important to be aware of what the comfortable temperature range is for older adults in the class and to adjust the room temperature accordingly.

Additional factors in attentional issues are the length of a class and the time of day it is given, as well as the amount and level of new material presented. New computer users need small doses initially, and extra time to internalize what they are learning. One hour seems to be the ideal class length, but we have found classes that teach the most basic skills can be extended up to two hours to allow for additional practice time. When concepts and terminology are new, repeated exposure increases recall, but the amount of new material which can be recalled later is still limited. Research has also found memory processes in older adults tend to be best in the morning hours.[22] Our own experience indicates a preference by senior adults for classes earlier in the day.

Cognitive Slowing

There has been significant research in the last twenty years on cognition in older adults and its effect on learning computer skills.[23] While everyone notes a difference in learning capabilities between younger and older adults, identifying the causal factors has been difficult. An often-cited study by Morrell and Echt identifies four cognitive processes which affect learning computer tasks: text comprehension, working memory, spatial visualization ability, and processing speed.[24]

Text comprehension, or text recall, is the ability to recall an idea or concept which has been recently read. As noted above, the level of comprehension will be affected by the extent to which prior experience is associated with an idea or concept. Two researchers found that the richer lifelong experiences older adults draw upon interfered with text comprehension by negatively impacting working memory and attentional processes.[25] Their study relied on complex expository passages but confirmed an earlier study which found a connection between attentional processes and text processing. In effect, the ability of older adults to comprehend the new concepts necessary to learn to use computers will be affected by their ability to inhibit prior associations and experience. For example, the term "drag" represents a very different concept to older adults than what it represents in a graphical user interface, which interferes with their ability to process the new concept. Because of this, using simple, clear language with illustrations or animation in instructional material works much better for older adults than lengthier, explanatory text.

Working memory is affected both by attentional processes and by processing speed. The age-related decline in processing speed is the common factor in all aspects of memory. While certain memory systems, such as semantic and procedural memory remain stable with age, they are still affected by processing speed. Put simply, with cognitive slowing there is "limited time in which relevant operations can be successfully executed, and products of early processing may no longer be available when later processing is complete."[26] The practical effect is that older people require more time to process new information, more practice time to learn new tasks, and consequently more training time. Because there are several ways people learn (listening, reading, seeing, doing, writing, or combinations of these), allowing time for older adults to incorporate their own method of learning can increase what is retained.

Another factor which has been identified recently as a significant predictor of performance in computer training is spatial memory, especially with the widespread use of the mouse and graphical user interface.[27] The mouse operates on a different plane from the computer screen, increasing the complexity of the task of selecting objects on the screen.[28] But spatial ability, like working memory, declines with age. As Morrell and Echt note, "older adults are

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[22] Cynthia P. May, Lynn Hasher, and Ellen R. Stoltzfus. "Optimal Time of Day and the Magnitude of Age Differences in Memory," *Psychological Science; a Journal of the American Psychological Society* 4, no. 5 (1993): 326-330.

[23] For a review, see Patricia A. Larkin-Leffers, "The Older Adult and Public Library Computer Technology: A Pilot Study in a Canadian Setting." *Libri* 50, no. 4 (2000): 225-235.

[24] See, for example, Czaja, 804, and Rogers and Fisk, "Human Factors, applied Cognition, and Aging," 569.

[25] Karen Zabrucky and DeWayne Moore. "Elaborations in Adults' Test Recall: Relations to Working Memory and Text Recall," *Experimental Aging Research* 21 (1995), 156.

[26] Jones and Bayen, 677.

[27] Czaja, 803.

[28] Morrell and Echt, 352.

inordinately affected by increases in task complexity...[especially] where verbal and spatial are combined." To minimize the effects of aging on the ability to learn to use graphical user interfaces, it is important to simplify instructions and concepts as much as possible at the beginner level, until mousing skills become automatic and using a mouse is no longer a task to be processed.

Moderating Factors

Since computer tasks and the effort to learn them primarily involve the same mental processes most affected by aging,[29] it may seem a wonder that older adults can be trained on computers at all. However, although age-related declines begin in middle age, the severity will vary by individual. All of these age-related factors are moderated by health, attitude, existing abilities, expertise and automaticity (previously established automatic processes).[30]

Health and attitude are major moderating factors. General health and level of activity are documented factors in the effects of aging.[31] It has been observed, for example, that even very old adults who exercise regularly do not experience the same degree of cognitive slowing as those who are less active.[32] Attitudes about computers can influence the motivation to learn to use them, and those attitudes can be affected by social factors, such as the experience of being left "out of the loop" without e-mail.[33] Prior experience on a computer, especially when positive, also favorably affects attitudes and the outcome of subsequent training.[34]

To the extent existing abilities, expertise and automaticity can be used in the new computer skills which must be learned, they will reduce the effects of aging. For example, learning to use the keyboard may be easier for a former typist. On the other hand, adjusting to the different keys and added keys may actually be more difficult for a former typist because of pre-existing automatic processes learned on a former keyboard layout, which must be unlearned.

In fact, there is a considerable amount of knowledge and skills which moderate the aging process. While working memory and processing speed decreases, older adults often make up for the difference by drawing more on their available conceptual and world knowledge, known as semantic memory, which is not affected by the aging process. Procedural memory, of which automatic processes are a part, also is not affected by age. As one researcher put it, "the ultimate effects of age on any given learning task will depend on the interplay of these systems"[35]

Factors which have been demonstrated to improve the learning performance of older adults include goal setting and partnering. Goal setting, a technique in which learners participate in setting goals for tasks, has been shown to improve computer training results for older adults in specific tasks and in the entire course outcome.[36] When they participate in defining the goal for a particular task or lesson, they see in advance the level and scope of what they will be learning. As they assess their progress toward each goal, they receive positive feedback on their abilities. Partnering learners with similar skills and experience during training has also been found to be effective, due to social interaction and reinforcement.[37]

Summary

There are specific, identified techniques which address the age-related issues of learning to use computers, both globally and at specific levels. On the global side, research indicates the most successful training techniques are those which reduce cognitive demands.[38] Specific techniques which address the issues involved in training older adults to use computers include:

- Make the class relevant. Adults, especially older adults, need a direct correlation to their lives to maintain

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[29] Czaja, 800.
[30] Howard and Howard, 20-23.
[31] Ibid., 22.
[32] Ibid.
[33] Van Fleet and Antell, 149.
[34] Jennifer L. Dyck and Janan Al-Awar Smither, "Age Differences in Computer Anxiety: the Role of Computer Experience, Gender and Education," *Journal of Educational Computing Research* 10, no. 3 (1994), 246; Czaja, 799.
[35] Howard and Howard, 23.
[36] Hollis-Sawyer and Sterns, 661-684; Czaja, 803.
[37] Elaine Zandri and Neil Charness, "Training Older and Younger Adults to Use Software," *Educational Gerontology* 15 (1989), 627.
[38] Rogers and Fisk, "Human Factors, Applied Cognition, and Aging," 569.

interest. When they do perceive a direct connection to their lives, interest and learning will be instantly enhanced.

- Allow extra time to accomplish even simple tasks. Many older adults take computer training classes before getting a computer. Without the opportunity to practice new skills as they learn them, their new abilities will not be retained.
- Adjust monitors before each class. Take the time to set the monitor for each individual within a comfortable viewing range, and adjust the tilt to minimize glare.
- Speak slowly. Since higher pitches are the first to be lost in aging, the lower the pitch of the trainer's voice, the better.
- Speak clearly, with frequent pauses. Older learners need more time to process speech and the new information they are hearing.
- Use precise, unambiguous terms. Although relating new processes or techniques to prior experience is helpful for conceptual learning, always be aware of prior associations which may interfere with the cognitive processes of learning new terms.
- Locate the training in a room or area conducive to learning for older adults. The optimum location is a relatively warm room well away from noise distractions. If this is not possible, at least be aware of the attentional hurdles you will be up against.
- Keep the length of the class manageable for Seniors, based on the amount of new information they will be getting and allowing extra time to practice new skills.
- Set the time for the class as early in the day as possible. For older adults, the morning hours are generally their optimal time of day for memory processes.
- Provide printed material in an easy to read font, with appropriate graphics. Instructions should be comprehensive and explicit: do not assume they will retain knowledge of prior steps.
- Involve Seniors in their training. To whatever extent possible, have older students participate in goal setting and feedback for specific tasks, and in the entire course outcome.
- Partner learners with similar abilities, to increase motivation and reinforcement.

Conclusion

Understanding the factors in aging that affect the ability of adults to learn computer skills is the first step to designing and teaching computer classes for older adults. There is a considerable body of research on the problems associated with older adults learning to use computers, as well as techniques which can be implemented to moderate the effects of aging. While many of the mental processes needed for learning deteriorate with age, some, such as automatic processes and semantic memory, do not. "The challenge," as two researchers put it, "is as much to design for what is retained in aging as for what is lost."[39]

Due to the variety of differences in abilities and needs among the aging population, there is no simple formula for training older adults to use computers. Because of individual moderating factors such as health and attitude towards technology, there is no typical older adult. Among those who have attended our classes, we have found a wide variety of cognitive, attentional, and physical abilities. Our most successful classes have been those where we implemented the strategies and techniques summarized above. As we met the challenge of training older adults, the training outcome for all of our students improved. Our experience has verified what two researchers concluded: a byproduct of attending to age-related issues is improved learning for younger adults as well.[40]

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[39] Howard and Howard, 23.

[40] Rogers and Fisk, "Human Factors, Applied Cognition, and Aging," 568.

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