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Memory Development and Aging

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"The stream of thought flows on; but most of its segments fall into the bottomless abyss of oblivion. Of some, no memory survives the instant of their passage. Of others, it is confined to a few moments, hours, or days. Others, again, leave vestiges which are indestructible, and by means of which they may be recalled as long as life endures. Can we explain these differences?"

And so, over a century ago, William James (1890) anticipated much of what has captured the attention of memory researchers in the ensuing years, particularly those working from the information processing perspective. I use this quote to open my Introduction to Psychological Science lecture on memory development across the lifespan because it alludes to different memory systems and stores, as well as individual and developmental differences in memory processing. In that lecture, questions of which memory processes and stores are most age sensitive are addressed, with the assumption that developmental changes in memory are not necessarily due to chronological age per se, but rather are mediated by a variety of intervening factors that are also age sensitive. This paper describes some of those variables at the general level, and then presents research on memory and aging from the perspective of self-efficacy theory. Emergent research indicates that memory self-efficacy is a powerful predictor of older adults' memory functioning.

Memory Across the Lifespan

Generally speaking, the relationship of memory and age can be depicted in a curvilinear fashion, increasing throughout childhood, peaking in adulthood, and declining in old age. On the whole, performance on memory tasks that demand effortful processing declines in adulthood. What variables might mediate this relationship?

From the child developmental literature, Flavell, Miller, and Miller (1993) offer four such variables: Strategies, Capacity, Knowledge, and Metamemory. Roughly speaking, memory performance in younger children is limited by smaller "amounts" of these variables, but as cognitive development unfolds, strategy usage, processing capacity, knowledge bases, and metamemorial techniques improve, thereby facilitating memory performance. An interesting parallel applies to the types of variables that contribute to memory failures experienced by older adults. That is, decreases (versus the increases observed in childhood) in strategy effectiveness and use, processing capacity, and some components of knowledge and metamemory occur in older adulthood, and may partially explain the declines in memory performance observed in older adults.

Jenkins (1979) called our attention to four sets of variables that act and interact to produce memory performance outcomes: subjects, criterial tasks, materials and orienting tasks. Subjects and test variables influence memory performance. Research indicates that memory performance is highly variable depending upon how a task is presented (visually versus auditorially, timed versus subject-paced), what is the task (words versus prose, recall versus recognition, gist versus verbatim recall), and what are the memorizer's characteristics (age, education level, expertise, health, and other individual differences variables). This latter variable, characteristics of the subject, has captured the interest of adult developmental researchers who work in the field of memory self-efficacy.

One of the most well-established conclusions from empirical research on memory and aging is that memory performance, relative to younger adults' criterion, is compromised in older adulthood.

Beliefs are powerful predictors of behavior; when likened to the lay concept of a "self-fulfilling prophecy," it may be that negative beliefs and self-evaluations about memory abilities held by some older adults may actually produce behaviors consistent with those beliefs and negative outcomes in memory-demanding situations.

This conclusion holds across several domains of memory including words, texts, pictures, drawings, object locations, numbers, names-faces, and activities, as well as across different encoding and retrieval conditions (for reviews, see Botwinick & Storandt, 1974; Smith & Earles, 1996; Verhaeghen, Marcoen, & Goossens, 1993). Older adults appear to be aware of their memory deficits: They have more complaints and concerns about their memories, experience more frequent memory failures, and evaluate their memory abilities more negatively than younger adults. While this effect is important from a clinical standpoint (memory complaints are significantly correlated with depression in older adults), there are important implications of negative memory self-evaluations for memory functioning. Beliefs are powerful predictors of behavior (Cavanaugh & Green, 1990; Levy & Langer, 1994); when likened to the lay concept of a "self-fulfilling prophecy," it may be that negative beliefs and self-evaluations about memory abilities held by some older adults may actually produce behaviors consistent with those beliefs and negative outcomes in memory-demanding situations.

Metamemory and Memory Self-Efficacy

Metamemory research evolved from a specific, unidimensional concept ("knowledge about memory") originally applied to memory development in children to a comprehensive, multidimensional system of interrelated knowledge, beliefs, and self-regulatory processing applied to memory and aging. The so-called "metamemory hypothesis" stated that knowledge about tasks, persons and strategies increased from early to later childhood with concomitant increases in memory abilities, and that the former (metamemory development) facilitated the latter (memory performance). By extrapolation, cognitive aging researchers argued that negative developmental differences in metamemory might explain the declines in memory abilities among older adults.

One aspect of metamemory is memory self-efficacy (MSE) and it has important ties to memory performance in adulthood (Dixon & Hultsch, 1983a, 1983b; Hultsch et al., 1988). MSE refers to self-evaluations of competence and confidence regarding one's own memory abilities. Self-efficacy is simply our combined sense of competence and confidence for a given task in a given domain. Note that it is not a global self-evaluation but rather, is sensitive to changes in task demands, situational determinants, social context, and individual development. Self-efficacy judgments are made under conditions of uncertainty, ambiguity, unfamiliarity, and/or stress, but not for those domains for which our behavior has become habitual and routinized. When the contingencies or "rules" of normally routine behavior change, the situation is reappraised and self-efficacy may change accordingly. For example, the contingencies for memory may change in old age due to negative self and social perceptions of memory failures.

According to Bandura, self-efficacy judgments are influenced by four sources of information: mastery experiences, vicarious observations, social persuasion and states of arousal. These sources represent information that is stored in memory and information that is available currently in the ongoing social context. Once a judgment of efficacy has been made, it has predictable effects on task-engagement behaviors and ultimately, mastery of the task itself. Higher self-efficacy is related to greater effort and persistence which in turn increase the likelihood of performing successfully. The model is recursive in that performances influence future efficacy judgments which influence subsequent performance and so on.

The theory is accompanied by a very specific research methodology that measures self-efficacy judgments. A concrete example helps illustrate these components. Take the domain of public speaking and ask students to think about their self-efficacy and anxiety for giving in-class presentations. Using Bandura's (1982) microanalytic methodology, a set of target behaviors can be identified and ordered hierarchically in terms of levels of difficulty (Self-Efficacy Level) and confidence ratings (Self-Efficacy Strength) are made for each level:

TASK GOAL:

Deliver calm and coherent classroom presentation

1) I could silently rehearse presentation to self
   NO YES
   10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
2) I could rehearse presentation out loud to self
   NO YES
   10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
3) I could rehearse presentation with best friend as audience
   NO YES
   10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
4) I could rehearse presentation to small group of friends
   NO YES
   10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
5) I could give presentation in class to classmates and teacher
   NO YES
   10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Students can think of their own personally relevant self-efficacy domains. The point is, self-efficacy analyses are domain-specific. Thus, one might have medium public speaking self-efficacy, low self-efficacy for social gatherings, high athletic self-efficacy, low smoking cessation self-efficacy and so on. Once a goal or target behavior has been identified, a task hierarchy can be constructed and used for measuring the congruence between self-efficacy judgments and actual performance. Self-efficacy principles have been applied across diverse domains including phobic disorders, education and achievement, health, parenting, sports, addictions, career choice, interpersonal and social skills, and more recently, memory and intellectual functioning in older adults.

Memory Self-Efficacy in Older Adults

Changes in memory self-efficacy may explain some of the age-related changes in memory performance. This argument is grounded in the developmental and aging literature on metamemory, or, self-knowledge of how memory works. Studies on the development of metamemory and its effect on memory performance in children led to the idea that certain types of memory deficits observed among older adults were due to faulty metamemorial processes. This was suggested by studies wherein older adults, relative to younger adults, were less likely to spontaneously use effective memorization strategies (the so-called production deficiency hypothesis).

Although these initial studies were informative, researchers became increasingly dissatisfied with the notion that older adults would "unlearn" knowledge that had served them well over a life time. But, these same researchers were not ready to abandon completely the metamemory ship. Instead, attention was turned toward the role of self-beliefs as contrasted with self-knowledge about the nature of memory in old age. In other words, what is the role of the subjective evaluation in predicting memory performance?

Recall that memory self-efficacy works through specific task-related behaviors: task approach/avoidance, task choice (easy, difficult), effort, persistence, motivation, personal meaningfulness, and the thoughts and behaviors that help or hinder task mastery (e.g., "I'll never get this" (and give up) versus "Well, this strategy isn't working — why don't I try something else" (and succeed). This suggests that self-efficacy should provide a particularly useful way of studying the subjective experience of memory failures that are age related. Older adults express concern and frustration over

increased incidents of memory lapses and forgetting. If one is faced with adapting to an increasingly unreliable memory system, it follows that memory demanding situations may become stressful and anxiety-ridden. This affective state, in turn, may lead to intrusive and negative cognitions about one's ability to remember accurately or satisfactorily. If this scenario is correct, then memory activity for some older adults can be construed as a memory self-efficacy problem. For this subgroup of individuals, self-perceptions of a faulty memory system may contribute to feelings of self-doubt and fear of failure, resulting in isolation from potentially stimulating and intellectually challenging situations. A negative feedback loop is set up, resulting in a self-fulfilling prophecy.

Some researchers (Berry & West, 1993; West & Berry, 1994) view MSE as a task-specific memory evaluation judgment tied to a specific memory task (e.g., "I could remember 16 items from a 16-item grocery list, and I'm 90% sure of this") whereas other researchers (Hertzog and colleagues) view MSE as a more general self-evaluation ("My memory is still pretty good"). Both groups of researchers have demonstrated adulthood age differences in MSE as well as the predictive utility of MSE to memory performance outcomes. That is, high MSE is correlated with high memory performance, and MSE declines in old age.

Robin West, Deidre Dennehey, and I (1989) constructed a memory self-efficacy questionnaire that could be used to examine age differences in memory self-efficacy and memory performance, as well as the predictive utility of memory self-efficacy for memory performance. We identified 10 representative memory domains from the cognitive aging literature. Memory tasks were developed for each domain.

The results indicated a positive relationship between MSE and memory performance, that was stronger at posttest than at pretest. These data are consistent with the upgrading of prediction-performance relationships across multiple trials obtained by Hertzog et al. (1990; 1994) and West et al. (1996), and with longitudinal data indicating that performance influences subsequent efficacy ratings (Lachman & Leff, 1989). We also found significant age differences on MSE scores. Older adults had lower MSE scores than younger adults. These data are consistent with other research evidence on negative age differences in memory self-evaluation (Hertzog et al., 1994; West et al., 1996).

According to self-efficacy theory, one mechanism by which self-efficacy influences behavior is effort expenditure. High self-efficacy should be related to greater task-related effort which in turn leads to greater levels of performance accomplishments. Berry (1987) tested this hypothesis on a sample of 120 older adult women with memory complaints. Subjects completed the MSE questionnaire and then were presented with a word recall memory task. Instructions to subjects were to "study these words for as long as you wish in order to recall as many as possible." Subjects were handed a stack of concrete nouns printed on cards and the experimenter recorded the amount of time subjects spent studying the words. Subjects then recalled the words out loud to the experimenter to record. The correlations between MSE, study time, and words recalled were all positive and significant. Statistical analyses indicated that older women with high MSE studied the words longer and in turn, recalled more words. Interestingly, memory complaint scores were negatively correlated with MSE scores, but depression was not related to MSE.

Conclusion

Research on aging and MSE indicates that MSE declines in older adulthood and may explain some of the memory failures experienced by older adults. This effect appears to be mediated by task-related effort and strategy usage, although further research is needed to substantiate this claim. Taking it out of the research laboratory for a moment, you can imagine an older adult who is being introduced to a couple of new people, and instead of focusing on their names, reconstructs a recent embarrassing moment when she forgot someone's name, wonders whether she will be able to remember the new names, engages in negative thinking about her ability to remember, and thus initiates the negative MSE loop. These negative ruminations may interfere with effective encoding of the new names and bring about the very result (forgetting) that she hoped to avoid.

I sometimes close the Introduction to Psychological Science memory lecture with reference to a classic tale from children's literature, The Little Engine That Could by Watty Piper. This is a tale about a little blue train engine faced with the daunting task of pulling a huge load of toys over a mountain for the girls and boys in the valley. Several engines, big, shiny, and powerful, had already declined the task as beneath them. And one rusty engine claimed: "I am so tired. I must rest my weary wheels. I cannot pull even so little a train as yours over the mountain. I can not. I can not. I can not." The load was much bigger than the Little Blue Engine was used to pulling; she said, "I'm not very big. They use me only for switching trains in the yard. I have never been over the mountain." But when she realized how important the task was, she decided to give it a try. With the encouragement of her cargo of clowns, dolls, and animals, the little blue engine started up the hill. She tugged and pulled and chugged and puffed along, saying: "I think I can, I think I can, I think I can." Slowly at first and then faster and faster the little train went, until they reached the top of the mountain and went down into the valley. And the Little Blue Engine puffed steadily down the mountain, saying, "I thought I could. I thought I could. I thought I could."

This metaphor is a fanciful illustration of the research results obtained in investigations of memory self-efficacy and aging. MSE research aids our understanding of memory problems associated with aging at the theoretical level. But there are also potentially significant implications for the psychological health and well-being of older adults who worry about and are distressed by their failing memory abilities. Applied research on memory and aging incorporates concepts of the relation of beliefs to behavior and attempts to improve negative conceptions of memory in older adults (Lachman, Weaver, Bandura, Elliott & Lewkowicz, 1992). This type of research may provide results that direct and facilitate the design of memory intervention programs for older adults with memory problems.

For a complete list of references, please write to Memory and Aging References, syc ology eac er etwor , d cation irectorate, A A, First treet, , as ington,