Metamemory:

Cognitive ability, Personality, Flexibility, Health, and demographic predictors

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Abstract

Cognitive ability, personality, flexibility, health, and demographic predictors of the Memory Functioning Questionnaire (MFQ) were examined in a sample of 496 elders (mean age=73.2 yrs; M=207, F=289) in the Seattle Longitudinal Study. Five hierarchical regression analyses were conducted including six primary mental abilities, flexibility, personality, health, and demographic variables as predictors of four domains of metamemory. Attitudinal flexibility, psychometric speed flexibility, self rated vision and income accounted for 26% of the variance in the General Frequency of Forgetting. Attitudinal flexibility and perceived change in vision were significant predictors for Seriousness of Forgetting (R^2=.12). For the Mnemonics Usage, reasoning ability, personality trait of honesty, and interest in science showed significance (R^2=.26).

Many researchers interested in age-related changes in memory have focused their attention on the role that metamemory plays in memory task performance and everyday memory behaviors (Hertzog, Dixon, & Hultsch, 1990; Zelinski, Gilewski, & Thompson, 1980). Metamemory, defined broadly as cognitions about memory (Hertzog & Dixon, 1990), is a multifaceted domain that includes such constructs as strategy selection and utilization, knowledge about how memory functions, and memory self-efficacy (Hertzog, Dixon, & Hultsch, 1989, Dixon, 1989). There are divergent views on the importance of metacognition in a general theory of cognitive development during adulthood. For some theorists, metacognition is a useful construct to the extent that it can explain age-related changes in such cognitive constructs as memory and problem solving (Hertzog et al., 1990). Recent reviews by Light (1991) and Salthouse (1991) argue that age changes in metacognition cannot account for all age changes in cognition.

A common method for operationally defining metamemory in the early developmental researches was prediction of memory task performance (Schneider, 1985). The original theorists treated metamemory as knowledge and awareness of memory processes (Wellman, 1983), and memory predictions were often conceptualized as an index of knowledge about one's own memory (Cavanaugh & Perlmultter, 1982). Cavanaugh (1989) defined predictions as an aspect of awareness of memory functioning, a construct closely tied to the concept of memory monitoring.

Much of the early studies on adult age differences in metamemory involved some type of memory prediction paradigm (Murphy, Sanders, Gabriesheski, & Schmitt, 1981). A common procedure is to give participants a description of a task with examples followed by a request to predict performance. Their main question is usually whether there are age differences in the accuracy of performance predictions. Some studies have suggested that older participants overestimate their performance on cognitive tasks (M. E. Lachman & Jelalian, 1984; Murphy et

al., 1981). M. E. Lachman et al. (1987) reported results suggesting that older adults can promote the accuracy of their predictions after task experience.

Along with the memory prediction paradigm, self-efficacy, or self-appraisal is often discussed when studying metamemory. Many researchers (Berry, West, & Dennehey, 1989; Rebok & Balcerak, 1989; Hultsch, Hertzog, Dixon, & Davidson, 1988) have argued that memory self efficacy represents an important unifying construct for understanding metamemory. Memory self-efficacy is probably a highly schematized system of beliefs regarding one's ability to use multiple types of memory in various contexts (Hertzog et al., 1990). Although self appraisal of memory ability is of interest in its own right (S. A. Williams, Denney, & Schadler, 1983), the evidence that negative appraisals –that is, complaints of memory problems—are related to memory performance is mixed. Some investigators have reported reliable relationships between memory self-appraisals and performance in the elderly (Carroll, 1986; Dixon & Hultsch, 1983; Zelinski et al., 1989), whereas others have failed to find one (O'Hara, Hinrichs, Kohout, Wallace, & Lemke, 1986; Yesavage & Rose, 1983). Self-perception of memory has a modest correlation with performance on memory tasks in some studies (Zelinski, Gilewski, & Anthony-Bergstone, 1990).

Several instruments for the self-appraisal of memory ability have been developed; the most widely used ones in the literature on aging are the Metamemory in Adulthood (MIA) questionnaire (Dixon & Hultsch, 1984) and the Metamemory Functioning Questionnaires (MFQ; Gilewski & Zelinski, 1986). Hertzog et al. (1989) showed that a subset of scales from both the MIA and the MFQ converge on a strong memory self-efficacy factor. MIA and MFQ measure memory self-efficacy by aggregating ratings of memory capacity and forgetting across several

specific memory functions. The items are generalized in that they are divorced from a specific temporal and physical context.

More extensive psychometric data have thus far been reported for the MIA than for the MFQ. The MIA questionnaire investigates several constructs, including use of memory strategies, knowledge of memory tasks and processes, memory and state anxiety, achievement motivation memory, awareness of change in memory, knowledge of one's own memory capacity, and locus of control in memory abilities (Dixon & Hultsch, 1983). The MIA has been factor analyzed, with mixed results as to whether scales load on separate factors representing memory self-efficacy and knowledge about the phenomena underlying memory performance in general or whether separated factors for strategy, affect, and change emerge (Hertzog, Dixon, Schulenger, & Hultsch, 1987; Hertzog et al., 1989).

On the other hand, MFQ is narrower in scope. It was designed to examine individual differences in constructs similar to those assessed by MIA. The MFQ has been used to investigate several major questions on the usefulness of assessing self-appraisal s of memory functioning.

A considerable body of research has addressed the issue of age related changes in memory, and has demonstrated that older adults often show pooper performance in a variety of memory tasks. However, age differences are generally modest (Bunnell, 1999). In addition, many researchers reported that metamemory differences between older and younger participants are either very modest or low (Murphy, Sanders, Gabriesheski, and Schmitt, 1981; Dixon, 1994).

Along with the studies of age differences in metamemory, there is also ample research on actual cognitive performance and memory complaints (Bruce, Coyne, and Botwinick, 1982; Flicker, Ferris, and Reisberg, 1993). However, there is no straightforward relation between

memory complaints and memory performance (Ponds and Jolles, 1996). In addition, many other researches had reported correlations between complaints and memory performance are either absent or low (Craik & Jennings, 1992; McDonald-Miszczak, 1999; Blazer, 1997). This finding has led to the notion that memory complaints and memory performance in elderly people are not solely determined by actual memory abilities or skills but are also related to contextual factors such as demographic variables (e.g. education, income), health and social variables such as personality traits, and life style.

Socioeconomic status such as education or income has been found to be positively related to better cognitive performance by older adults (Schimitz-Scherzer & Thomae, 1983). Individuals of lower socioeconomic status and poorer health have shown greater age-related decreases in performance (Owens, 1966). Similarly, Berg (1983) reported that lower socioeconomic status was associated with greater age-related declines in performance for men up to age 75, but he found no association between theses variables after that age, suggesting that after age 75, other factors are of greater importance than socioeconomic ones in determining cognitive functioning. One such factor could be health, which has consistently been found to be positively associated with better performance (Hertzog, Schaie, & Gribbon, 1978). Gender has also been shown to be related to cognitive performance, with older men having higher test scores than older women on Intelligence test (Shanan & Sagiv, 1982).

Several personality variables have been reported to be related to cognitive functioning in elderly people. Introversion has been found to be positively related to scores of elderly men (Owens, 1966; Schoenfeldt, 1973).Schoenfeldt (1973) reported longitudinal data indicating that egocentric independence was related to lower scores by older men on the Army Alpha Test.

As described above, many previous studies had been done to investigate the pattern of actual memory performance (Hertzog et al., 1990; Cavanaugh & Poon, 1989; Lachman & Jelalian, 1984) or finding the relationship between age differences in metamemory (Hertzog et al., 1990; Zelinski et al., 1980). Although many studies had investigated that health or other contextual factors such as personality would play an important role in predicting actual memory performance, not much of the developmental researches were focused on the question 'what could be the potential predictors for the metamemory?' In addition, although existing research have conducted many studies related to cognitive changes including metamemory in aging, most of the studies have not accounted all combination of cognitive ability factors, demographic variables such as age, education, and sex, health variables, personality factors, and flexibility factors together.

Therefore, the purpose of this article is to find out the significant predictors for the metamemory by taking into account of cognitive ability factors, demographic variables such as age, education, and sex, health variables, personality factors, and flexibility factors. Considering the findings of previous studies that age and actual cognitive abilities do not significantly accounted for the perceived memory functioning, and yet other variables such as personality, flexibility, and health variables were found to be related with cognitive functioning, the sub hypotheses of the study would be following;

1. Cognitive ability factors will account for less variance than personality factors, flexibility factors, health variables, and demographic variables.
2. Personality factors will show significance in predicting metamemory.
3. Flexibility factors will show significance in predicting metamemory.
4. Health variables will show significance in predicting metamemory.

5. Age will account for little residual variance after all the other variables (cognitive ability factors, personality factor, flexibility factors, health variables).

Method

Participants

Mean age of the 496 participants was 73.20 (Range 57-95 years; M=207, F=289; *SD* = 8.30) at the time of their MFQ and neuropsychological assessment. The educational level of this sample ranged from 7 to 20 years (*M* = 15.05, *SD* = 2.77). Participants were included only if they had been tested on the primary mental abilities battery in 1991 (seven years earlier) in addition to the 1998 occasion. The total sample those who tested on the neuropsychological battery consists of 499 adults (210 men and 289 women) who were part of the SLS seventh wave data collection in 1997-98. However, three participants out of the total were excluded in this analysis since they failed to complete MFQ.

Measures

Independent variables

Cognitive factor scores. The SLS psychometric ability battery involved represent multiple measures marking each of six ability factors (Schaie, 1996). The six cognitive factors represent 20 measures (Thurstone & Thurstone, 1949). The battery has been used since the beginning of the SLS in 1956. Cognitive factor scores from 1991 and 1998 SLS psychometric ability battery was used for this study. A brief description of the primary ability factors and the measures marking them is given below.

The *Inductive Reasoning factor* measures the ability to identify novel aspects of relationships and to infer principles or rules from observing the ordinary occurrence of instances.

This ability includes four tests: PMA Reasoning (Thurstone & Thurstone, 1949), ADEPT Letter Series (Blieszner, Willis, & Baltes, 1981), Word Series (Schaie, 1985), and ETS Number Series (Ekstrom, French, Harman, & Derman, 1976).

The *Spatial Orientation factor* measures the ability to visualize and mentally manipulate spatial configurations, to maintain orientation with respect to spatial objects, and to perceive relationships among objects in space. Four tests are included in this factor: PMA Space (Thurstone & Thurstone, 1949), Object Rotation (Schaie, 1985), Alphanumeric Rotation (Willis & Schaie, 1983), and Cube Comparisons (Ekstrom, et al., 1976).

The *Numerical Facility factor* measures the ability to understand numerical relationships and compute simple arithmetic problems with a high speed and accuracy. There are three tests in this factor: PMA Number (Thurstone & Thurstone, 1949), Addition (Ekstrom, et al., 1976), and Subtraction and Multiplication (Ekstrom, et al., 1976).

The *Verbal Comprehension factor* measures the ability to understand language expressions and comprehension. It assesses a person's recognition of vocabulary. Three tests make up this factor: PMA Verbal Meaning (Thurstone & Thurstone, 1949), ETS Vocabulary II (Ekstrom, et al., 1976), ETS Vocabulary IV (Ekstrom, et al., 1976).

The *Verbal Memory factor* measures the ability to store and recall meaningful language units. There are three measures included in this factor: Immediate Recall (Zelinski, Gilewski, & Schaie,1993), Delayed Recall (Zelinski et al., 1993), and PMA Word Fluency (Thurstone & Thurstone, 1949).

The *Perceptual speed factor* measures the ability to observe figures and perform the tasks involving visual perception with speed and accuracy. The factor includes three measures;

Identical pictures (Ekstrom et al., 1976), Finding A's (Ekstrom et al., 1976), and Number Comparison (Ekstrom et al., 1976).

Flexibility variable. Flexibility variables were measured using variables from the Test of Behavioral Rigidity (TBR). The TBR examines subjects' cognitive style to adapt circumstances. It contains three subtests: Capitals test, Opposites test, and TBR questionnaire. Three factors—Psychometric Speed, Motor-Cognitive Flexibility and Attitudinal Flexibility—were calculated from the scores obtained from these subtests. The psychometric speed includes capital test and opposites test. The attitudinal flexibility measures rigidity and perseverance.

Personality Factors. An item factor analysis of the 75 attitudinal flexibility resulted in solution (Schaie, 1996), a 13 factors solution (Schaie, 1996). From the 13 factor analysis, eight factors map on the Cattell taxonomy of personality dimensions: Affectothymia, Superego Strength, Threctia, Premsia, Untroubled Adequacy, Conservatism of Temperament, Group Dependency, Low Self-Sentiment. The remaining five factors are best described as attitudinal traits and were labeled Honesty, Interest in Science, Inflexibility, Political concern, and Community Involvement. The 13 factors are described in Table 1.

Health Indicators. The health indicators were come from health Behavior Questionnaire (HBQ). HBQ covered a wide range of health behaviors and included a variety of item formats (self-report measure, 7-point Likert scale, open-ended, multiple choice, etc.). All items were coded so that higher values indicated more healthy behaviors. The HBQ was first collected in 1993, and a second wave of HBQ data was collected in 1998 for SLS participants.

Demographic variables. Age, education and sex were taken from the 1998 Life Complexity Inventory (LCI).

Dependent Variable

Memory Functioning Questionnaire (MFQ; Gilewski & Zelinski, 1988. The MFQ was developed to assess the self-appraisal of everyday memory functioning in adults. It was derived from the Metamemory Questionnaire (Zelinski, Gilewski, & Thompson, 1980). The MFQ consists of 64 items rated on 7-point Likert scales from which four unit-weight factor scores are calculated: General Frequency of Forgetting, which includes ratings of how often forgetting occurs in 28 specific situations, including when one is reading, as well as 5 additional ratings of one's memory performance in general: Seriousness of Forgetting, ratings of memory failures from 18 differenct situations: Retrospective Functioning, ratings of changes in current memory ability relative to 5 points earlier in life; and Mnemonics Usage, the frequency with which 8 specific mnemonics are used. Higher scores reflect higher levels of perceived memory functioning, with fewer forgetting incidents, less serious incidents, improvement in current memory ability relative to earlier in life, and less use of mnemonics.

Results

The main purpose of this study was to find out the significant predictors for the metamemory by taking into account of cognitive ability factors, demographic variables such as age, education, and sex, health variables, personality factors, and flexibility factors. The sub hypotheses of the study would be following;

1. Cognitive ability factors will account for less variance than personality factors, flexibility factors, health variables, and demographic variables.
2. Personality factors will show significance in predicting metamemory.
3. Flexibility factors will show significance in predicting metamemory.
4. Health variables will show significance in predicting metamemory.

5. Age will account for little residual variance after all the other variables (cognitive ability factors, personality factor, flexibility factors, health variables).

The means and standard deviations for the six cognitive ability factors, flexibility factors, personality factors, health variables, and demographic variables are shown in Table 1. The correlation of dependent and independent variables for the total sample is presented in Table 2.

General Frequency of Forgetting

Approximately one quarter (26%) of the variance was accounted for in the general frequency of forgetting factor at the last step of the hierarchical regression analysis (step 5). In the final step the significant predictors were: Attitudinal flexibility ($p<.01$), Psychomotor flexibility ($p<.05$), self rating of vision ($p<.05$) and income ($p<.05$). Among the three flexibility factors, psychometric speed was found to be significant in first two steps and in the last step. Furthermore, attitudinal flexibility showed consistent significance across the steps. However, no significance was found among the personality predictors. When the health variables were added after personality variables, only self-rated vision showed significance. Even after the demographic variables were added into the analysis, 13% of the variance was explained by the self-rated vision variable. Among the demographic variables, income variable showed significance.

Seriousness of Forgetting

A total of 12% of the variance was accounted for in seriousness of forgetting factor. The significant predictors were: attitudinal flexibility ($p<.01$), and perceived change in vision ($p<.05$). However, none of the cognitive ability factors showed significance across the analysis steps. When the flexibility factors were added to the analysis, 13% of the motor flexibility factor variance was accounted for in seriousness factor. Psychometric speed factor explained 23% of

the variance when flexibility and personality factors were added to the analysis. Across the steps, attitudinal flexibility showed consistent significance.

Retrospective Functioning/Mnemonics

In the retrospective functioning/mnemonics factor, 18% of the variance was accounted. The significant predictors were: attitudinal flexibility ($p<.05$), the personality trait of honesty ($p<.05$), sex in favor of women and education. Among the six cognitive abilities, only verbal ability showed significance in the first step and after flexibility factors were added. In all the analysis steps, attitudinal flexibility showed significance consistently. When health variables were added in step 4, 13% of the variance was explained by self-rated hearing variable. After adding demographic variables, sex and education variables appeared to be significant.

Mnemonics

For the mnemonics sub factor, 16% of the variance was accounted for in the final step. The significant predictors were: reasoning ability ($p<.05$), the personality traits of honesty ($p<.05$), and interest in science (negative, $p<.05$), sex in favor of women ($p<.01$), and education. 13% of the variance was explained by verbal ability at the first step. When flexibility factors were added to the analysis, verbal ability and perceptual speed abilities showed significance. However, when personality and health variables were added, none of the cognitive abilities showed significance. Finally, when demographic variables were added, 17% of the variance was explained by inductive reasoning ability. Among the personality variables, interesting in science variable showed significance consistently across the steps. Similar to the result of the retrospective functioning/mnemonics factors, when demographic variables were added, sex and education showed significance at the final step.

Discussion

The purpose of this study was to find out significant predictor for metamemory. Overall, attitudinal flexibility was important predictor of metamemory relative to cognitive ability factors, health variables, personality factors, and demographic variables. In addition, among the demographic variables, age did not have significant influence on predicting metamemory. However, unlike previous studies, our research indicated that among all the personality and flexibility factors, only the attitudinal flexibility was found to be significant. In addition, interestingly, when predicting retrospective functioning and mnemonics factors, interest in science in personality factors was found to be significant.

The benefit of our study is that unlike previous studies, our study combined all five sets of predictors (cognitive ability factors, flexibility factors, personality factors, health variables, and demographic variables) together and investigated relationships when accounting for all five sets of predictors. The study was able to assess the relative contribution of each domain of predictors. The findings of the study has led to conclude that metamemory in elderly people is not solely determined by actual memory abilities or skills but also related to factors such as flexibility, personality, health and demographic variables.

Table 1.

Descriptions of Personality Factors

Factor	Description of the factor
Affectothymia	Outgoing, warmhearted, easygoing, participating tendencies
Superego strength	Conscientious, persistent, moralistic, staid
Threctia	Shy, timid, restrained, threat-sensitive
Premsia	Tender-minded, sensitive, clinging, overprotected
Untroubled adequacy	Self-assured, placid, secure, complacent, serene
Conservatism of temperament	Respecting traditional ideas, tolerant of traditional difficulties
Group dependency	A “joiner” and sound follower, group adherence
Low self-sentiment	Uncontrolled, lax, follows own urge, careless of social rules
Honesty	Endorsement of items that reflect personal beliefs of honesty
Interest in science	Endorsement of an item couplet that reflects interest in science
Inflexibility	Endorsement of items that reflect lack of tolerance for disruption of routines
Community involvement	Endorsement of positive attitudes about citizenship and civic responsibilities
Political concerns	Reflects attitudes toward other countries