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Age Differences in Word Recall Predictions

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AGE DIFFERENCES IN WORD RECALL PREDICTIONS

by

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Under the Direction of Dr. Ann Pearman

ABSTRACT

This study examined factors related to word list performance predictions made by younger and older adults. A performance prediction is an estimate made prior to being exposed to the material that is studied for a specific task. The current study examined the age differences in a sample of 59 older adults (*M* = 76.83 years old, *SD* = 8.28) and 51 younger adults (*M* = 21.19 years old, *SD* = 3.22) on performance predictions for both an immediate and delayed word recall task. Memory self-efficacy and other self-rating measures were not found to influence immediate or delayed predictions. A repeated measures ANOVA revealed that older adults improved in absolute accuracy from immediate to delayed prediction whereas younger adults became less accurate. The results suggest that all metamemory skills do not deteriorate with age, as the older adults were capable of monitoring their memory accurately based on previous performance.

INDEX WORDS: Thesis, Aging, Gerontology, Metamemory, Predictions, Psychology, Georgia State University

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DEDICATION

"The Castro regime took many things from us, forcing us to leave our country of birth, but he could not take everything away. He could not take [my education] away, and as long as I have this, we will have it all again, and more. Of that I am sure." - Abuelo Alfredo Trujillo

This thesis is dedicated to Abuelita, Abuelito, Abuela Flor and in memory of Abuelo. My grandparents had the strength to sacrifice everything when they left Cuba to give a better life for their family. They have taught me to dream big, work hard, value education and seize every opportunity that America offers.

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INTRODUCTION

A major concern for older adults is that they will experience memory loss as they age (Johnson & Halpern, 1999). The subject of memory loss has always been a common fear among adults, but is now receiving an abundant amount of attention as of the baby boomer population approaches old adulthood. The population of older adults, 65 years and older, is projected to double within the next twenty-five years, and the number of Americans aged 85 and older are expected to triple by 2050 (U.S. Census Bureau, 2004). Many older adults today are exposed to ageist stereotypes of memory loss in aging and are not aware of objective information about adult cognition, as the study of adult development and aging is relatively new (Hawley et al., 2006).

Increases in age correlate with increases in certain types of memory loss; therefore, the growth of the population of older adults has prompted researchers to understand age-related memory changes. Memory capabilities, both perceived and measured, are important to perform tasks of everyday living. One area of interest has been understanding older adult's memory self-knowledge, a component of metamemory.

There is limited research on the topic of age differences in the process of making changes in performance predictions to produce more accurate predictions. A performance prediction is made prior to being exposed to the material that is studied for a specific task and giving an estimate of how much will be remembered (Bieman-Copland & Charness, 1994; Connor et al., 1997; Hertzog et al., 1990; Woo et al., 2008). One study conducted by Hertzog and colleagues (1994) looked at adult age differences in prediction accuracy and the relationship among memory self-efficacy (MSE), memory performance, and prediction. They found that besides active performance monitoring and MSE, other factors, such as task experience, influenced the accuracy of predictions. To date, there have been no studies conducted that give a post-test questionnaire following a memory task to see if a more global self-evaluation of task performance influences a change in a later prediction. Furthermore, the existing literature on age differences in predictions often only explores prediction accuracy without examining what other variables may impact the change in delayed prediction that can cause prediction accuracy.

The purpose of this study is to determine what factors contribute to both initial predictions and the changes in the prediction of delayed word list recall between an older and younger adult sample. This study examines differences and similarities between older and younger adults in the process of making accurate predictions and who is more responsive to perceived and actual performance when making a later prediction of the same task.

CHAPTER 1.

LITERATURE REVIEW

The purpose of this literature review is to describe what variables may influence word list recall predictions and whether these predictions accurately reflect memory performance. This literature review begins with an overview on metamemory and age differences in metacognitive abilities. While there is some debate as to how to measure performance prediction, the proposed study will operationalize performance predictions as global estimates of task performance given before studying. Following that is the challenge presented in literature about determining what predictions actually measure. Some researchers suggest that predictions measure MSE on a specific task, whereas others suggest it is a measurement of memory knowledge. There is also a debate in the literature as to whether there are age differences in prediction accuracy and if predictions accurately reflect performance.

There is limited research that examines what variables contribute to performance predictions. Some literature t looks at MSE as a factor that influences predictions and contributes to prediction accuracy. Other research has looked at previous performance influencing later predictions, but without a sample of older adults. The aim of this research is to explore factors, such as MSE and previous performance, to better understand both initial predictions and why performance predictions may change.

Metamemory

Metamemory is the area of metacognition that focuses on a person's beliefs and knowledge about their own memory and memory processes (Dahl, Allwood & Hagberg, 2009; Johnson & Halper, 1999; Rabbitt & Abson, 1991). Hultsch, Hertzog, and Dixon (1987) define metamemory as an "individuals' understanding of their own memory functioning" (p. 193). A person often acquires metamemory skills by learning how their memory functions via experience and applying this knowledge to improve monitoring their memory abilities (Rabbitt & Abson, 1991). Since older adults have more life experiences using their memory than younger adults, previous research has hypothesized that they should become better at predicting how well they will remember things (Johnson & Halper, 1999). However, Hawley and colleagues (2006) found that in their sample of older adults, the oldest-old groups were less accurate at memory knowledge than other groups. Older adults seem to make assumptions about age-related declines in their own functioning, which in turn affect their confidence when making predictions (Serra, Dunlosky, & Hertzog, 2008). What may contribute to the assumed age-related decline for memory performance in later life may be from an individual's knowledge and beliefs about their own memory from situations that presented memory-demanding tasks (Hultsch et al., 1987).

Previous research on age differences in metacognitive abilities find that prediction accuracy varies on different tasks (Woo et al., 2008). Older adults tend to be more able to recognize their strengths and weaknesses on very specific memory tests, such as remembering lists of words. In fact, older adults have been found to be more accurate than younger adults when predicting their performance on certain types of memory tasks, such as appointment-keeping tasks (Johnson & Halper, 1999; Woo et al., 2008). However, Bieman-Copland and Charness (1994) suggest that older adults are only capable of distinguishing global differences between expected and actual performance, so they can only give global statements about memory performance – such as "I did not do well on this task."

Clearly, there are conflicting findings about the relationship between age, metamemory, and prediction accuracy. Woo and colleagues (2008) suggest that identifying age-differences in metamemory is dependent on two sources: the reference group and tasks being used in studies.

When changing the reference group different estimates of memory can occur (Woo et al., 2008). For instance, if an older adult is asked to compare their memory performance to a younger adult, their answer is often different than when evaluating themselves against their same age peers.

Although older adults have been shown to be capable of giving accurate predictions (i.e. Woo et al., 2008), their confidence varies depending on the demand of a specific situation (Rabbitt & Abson, 1991). After performing a memory test, older adults' answers on a self-rating questionnaire may capture their levels of confidence instead of their actual objective memory performance (Rabbitt & Abson, 1991). Thus, if there is a change in prediction for the same memory test at delay, it is necessary to look at both the actual performance of the first test and their perception of performance after completion.

Prediction

A performance prediction is made before studying items for a specific task and estimating how many will be correctly recalled (Bieman-Copland & Charness, 1994; Connor et al., 1997; Hertzog et al., 1990; Woo et al., 2008). There is some debate about what performance predictions actually measure.

Hertzog and colleagues (1990) reported that a performance prediction is based on a combination of global and local MSE beliefs and an appraisal of the memory task. The cross-sectional study examined the relationships between metamemory, memory predictions and memory performance in categorized free word recall lists and narrative texts. Results showed that regardless of age group participants increased the number of words predicted in the word recall task, but did not change the prediction for the text recall task. The age differences in the amount of increase for the word recall predictions were not significant, but the older adults continuously predicted lower recall than the younger participants.

The overall findings provide support for speculating that performance predictions should be regarded as task-specific MSE judgments (Hertzog et al., 1990). The metamemory scales related to MSE, and MSE itself correlated more with predictions than the other metamemory scales that were independent of MSE. It has also been hypothesized that with initial predictions self-efficacy judgments influence the absolute level of prediction, but previous knowledge of memory performance influences relative predictions (Bieman-Copland & Charness, 1994; Woo et al., 2008).

However, initial predictions have also been described as accurate indicators of memory knowledge (Bieman-Copland & Charness, 1994). Bieman-Copland and Charness (1994) studied memory knowledge and memory monitoring in a sample of younger and older adults making predictions on cued word recall tasks. Memory knowledge is when a person gathers information from their memory that allows them to give an expectation of performance, based from experience, for an unfamiliar memory task, (Bieman-Copland & Charness, 1994). Researchers found that there were no age differences at initial prediction, but changes in second prediction by younger adults more accurately reflected previous recall than older adults' second prediction.

Accuracy of Prediction

There is some uncertainty of whether predictions accurately reflect performance or whether they only show memory task knowledge or self-efficacy (Bieman-Copland & Charness, 1994). One assumption is that accurate predictions present a better understanding of the difficulty in a memory task and one's memory abilities (Woo et al., 2008). A main question that has often been studied in this line of developmental research is whether there are any age differences in performance prediction accuracy (Hertzog et al., 1990). A consistent finding from studies on age differences following the recall prediction paradigm has found that older adult participants showed more overconfidence in their predictions than younger participants (Connor et al., 1997; Crawford & Stankov, 1996). That is, older adults were likely to overestimate how much they would recall.

Connor and colleagues (1997) conducted three experiments looking at age differences in global memory predictions and item-by-item memory predictions on paired associated word recall tasks. In two of the experiments, the initial global prediction did not correlate significantly with recall in both younger and older adults. Older adults' second prediction only significantly correlated with recall in the third experiment, but the overall results showed that older adults do increase prediction accuracy from the first to second global prediction. What is missing from this study is an examination of other variables that could influence global prediction accuracy, such as MSE or self-evaluation.

A three experiment cross-sectional and longitudinal analysis was conducted by Woo, and colleagues (2008), on the influence of age in prediction accuracy. The experiment measured verbal memory, visuospatial memory and names-faces recognition and predictions with 65 younger and 65 older adults. The older adults had the most accurate predictions with the visuospatial memory task even though they performed worse than younger adults on the memory task. This research proves that older adults' predictions can be as accurate as the younger adults and are capable of not overestimating their memory performance.

Some of the research on predictions has included postdictions (e.g. Devolder, Brigham & Pressley, 1990; Connor et al., 1997; Hertzog et al., 1994) to evaluate if an individual can accurately judge their recent performance on a memory task. Postdictions are often measured exactly like predictions, but are given immediately after completing the task (e.g. "I recalled 15 out of 30 words"). Even though this has been successfully used to show changes in monitoring memory, Beiman-Copland and Charness (1994) suggested that older adults are more capable of giving general statements about their memory performance than a number. West and Yassuda (2004) studied memory control beliefs on performance and setting goals, which included a general memory self-evaluation prior to and following the study. Using a 7-item Likert scale that asked participants to rate performance, overall satisfaction and compare memory among peers, researchers found that younger adults gave higher scores than the older adults. Since there were no predictions, it is unclear if memory self-evaluations have an impact on memory performance or predictions and deserves further exploration. Hence, a goal of my study is to examine the relationship between memory performance self-evaluation and delayed prediction among younger and older adults.

MSE and Predictions

Memory self-efficacy can influence memory performance predictions (Hertzog et al., 1994; Serra, Dunlosky & Hertzog, 2008). Hertzog and colleagues (1990) define MSE as an individual's set of beliefs about their ability to use memory effectively in different situations. These can be given as an overall statement about their memory's current condition (Hertzog et al., 2004; Klassen, 2002; Klassen, 2007).

Serra and colleagues (2008) examined age-related differences in MSE. They found that when older adults are learning information they often feel less confident in their capabilities and complain about forgetting. The lack of confidence may be partially attributed to older adults' awareness of the physical and cognitive changes that occur as they age. Older adults have slower processing speed than younger adults and often take more time to remember things, which may also affect their confidence in their memory capabilities.

The accumulation of older adults' negative beliefs about actual memory capabilities often increases, as adults get older (Hawley et al., 2006; Wells & Esopenko, 2008). Low efficacy ratings of memory functioning may, in turn, influence a weak performance or poor motivation during a memory task (Valentijin et al., 2006). The decline in confidence before completing a memory task may hinder actual performance. For instance, Hertzog and colleagues (1990) found that older participants who gave lower predictions performed worse on two verbal memory tests than the younger participants. Thus, having lower perceived memory ability before a specific test may influence the actual performance for older adults.

A significant relationship between MSE and predicted objective memory performance for older adults was found in a longitudinal study on Dutch older adults (Valentijn et al., 2006). This study examined word recall at 6-year intervals. A series of questions regarding perceived memory change over time was the strongest predictor of actual performance. This study also supports the theoretical description that memory performance predictions can be classified as task-specific MSE judgments (Hertzog et al., 1990) because MSE was found to be the only significant predictor of memory performance during the follow-ups.

Another study examined the relationship between MSE and memory performance using only an older adult sample (Wells & Esopenko, 2008). Significant negative relationships were found in a word free recall task between age and three metamemory-type factors, including MSE, persistence, and perceived memory performance. Consistent with previous research, the results showed that as age increased the MSE scores decreased. The results of this study indicated that when using a sample of adults 65 years of age and older, a negative relationship between MSE and age was still possible as the older-old adults were less confident.

Memory for Past Test Heuristic

One learning strategy used in making predictions about future memory performance based on past memory performance has been called the Memory for Past Test (MPT) heuristic. The MPT heuristic states that when better cues for prediction are not present, people base their judgments of learning (JOL) on how well they performed on the previous test, despite any new learning or forgetting that may have occurred (Finn & Metcalfe, 2007).

Finn and Metcalfe (2007) found that without a previous test, participants could not rely on the MPT heuristic as a predictive cue to make their JOLs. However, it is important to note that in the aforementioned studies on the MPT heuristic (Finn & Metcalfe, 2007 & 2008) only college undergraduates were test subjects. Therefore, I am particularly interested in whether any evidence of the MPT heuristic exists for predictions in younger and older adults.

Summary

The current study attempts to expand on previous research about word-list recall predictions by determining the accuracy of the process in word-list recall task predictions changes between age groups. Unlike many of the previous studies, I will include a post-test performance self-evaluation question and more general MSE belief measurement. Specifically, this study will examine the degree to which MSE beliefs and post-test questionnaires following an initial word-recall task will influence initial and later predictions in a sample of older and younger adults.

CHAPTER 2.

CURRENT STUDY AND RESEARCH DESIGN

Current Study

The purpose of this study is to explore age differences in immediate and delayed predictions for word list recall in younger and older adults. Findings will assist in understanding age-related differences in these processes.

Research Design

The cross-sectional study involved a secondary data analysis of Dr. Ann Pearman's larger study on the role of personality in memory performance (*Neuroticism and Memory in Older Adults*), which was funded by Georgia State University's internal grant mechanism. Using an extreme age group design (younger vs. older adults), a team of researchers conducted a series of memory questionnaires (including predictions and post-test evaluations about performance and a MSE measure), personality tests, and a range of cognitive measures (including the word list recall task), along with 13 measurements of blood pressure across the testing session.

For my study, I looked at immediate and delayed word list recall predictions, actual performance, and post-test questionnaires to determine if immediate predictions and later changes in delayed prediction are based on actual task performance, the post-test evaluation of performance, or more general MSE measures and if these changes differ by age group.

Hypotheses

Hypothesis 1: MSE will be the only variable that influences initial prediction because previous research suggests adults base their first word recall prediction on MSE beliefs (Hertzog, Dixon & Hultch, 1990; Hertzog et al., 1994).

Hypothesis 2: Because of previous research that suggests that other variables besides Memory self-efficacy can influence later predictions (Hertzog et al., 1994), MSE will not be the only influence on delayed predictions. I predict that for older adults perceived performance, based on the post-test questionnaire, will significantly predict delayed prediction. I also predict that with younger adults actual performance will significantly predict delayed prediction.

Hypothesis 3: Based on previous research that suggests that older adults are less confident about their memory capabilities (e.g. Hawley et al., 2006; Serra et al., 2008; Wells & Esopenko, 2008), I predict that older adults will be less accurate in predictions than younger adults.

Hypothesis 4: The delayed prediction will be more accurate due to research that states after recall experience, prediction about future performance are based on past memory performance (Finn & Metcalfe, 2007).

CHAPTER 3.

METHODS

Participants

Older and younger participants were recruited in the Atlanta Area. Researchers screened potential volunteers by telephone to determine their eligibility and willingness to participate and to obtain a measure of their general cognitive functioning. Individuals were excluded if they reported that English was not their primary language, showed cognitive deficits, self-reported poor health, reported less than 10 years of education or had severe neurological deficits in the last five years. Participants received $5 for filling out the questionnaires and an additional $15 for participating in the laboratory session. Fifty one younger adults and 59 older adult volunteers participated. The mean age of the young adult sample was 21.19 years (SD = 3.22). The mean age of the older adult sample was 76.83 years (SD = 8.28).

Measures

Word List Recall Task. A list of 30 categorizable nouns was used to assess memory performance (Hertzog, Dixon & Hultsch, 1990; Howard, 1980). The list contained six words from five taxonomic categories. The words were shown in two columns on a sheet of paper. The participants studied the list for 3 minutes during the first trial and had unlimited time to write down as many words they could remember on the answer sheet provided in any order. When participants indicated they could not recall any more words, researchers proceeded with the instructions for the second trial. During the second trial participants were given only 1 minute to study the same words and as much time as needed to write down as many of the words as they could remember. The third trial was a delayed recall of the words presented earlier over the 2 trials. Participants were not given any additional cues and were asked to spontaneously recall as many of the 30 words they could remember on the answer sheet. Scores are based on the accuracy of the participant's word recall ranged from 0 to 30.

Predictions. Before studying the list in the first trial of the word list task, the task was explained to the participants and were then asked how many words from 0 to 30, they thought they would remember. Prior to the third trial the participants were again asked again how many words from 0 to 30 they thought they would remember without being given any study time.

Post-Test Questionnaire. Following each memory test, participants answered an eight-item questionnaire evaluating their performance on the previous word list task. This post-test questionnaire included a rating on perceived performance and task difficulty. The perceived performance scale is rated on a 5-point Likert-type scale of very poor to very good. The 5-point task difficulty scale ranges from very difficult to not at all difficult.

Memory self-efficacy. The Memory Assessment Clinics – Self-Rating Scale (MAC-S, Revised; Winterling et al., 1986) was used to measure MSE. This 48-item questionnaire addresses memory ability and frequency of memory problems in two separate 5-point Likert scales, plus four questions about global memory ability. The global memory rating assesses overall comparison to others, comparison to the best one's memory has ever been, speed of recall, and worry over memory function.

Memory self-efficacy beliefs were also measured by the Present Ability subscale from the Memory Controllability Inventory (MCI; Lachman, Bandura, Weaver & Elliott, 1995). The three questions from the subscale consist of 7-point Likert scales that assess participant's present perceived memory controllability beliefs.

The final question used to measure MSE was a single item question asking for a peer comparison to others their age about memory. Participants answered on a 5-point Likert-type scale ranging from 1 = Excellent to 5 = Very poor. Answers were reversed coded so that higher scores meant better perceived memory.

For each of the aforementioned scales, standardized scores were calculated by age group. A mean score for each participant was calculated where higher scores indicated better MSE.

Procedures

After an explanation of the study, interested potential participants were given verbal informed consent over the phone and mailed a pre-packet of information with a written consent form, demographic sheet, personality test, and a questionnaire about memory complaints and fears of memory loss related to aging.

At the scheduled appointment participants were given a written informed consent and filled out the MSE questionnaires. Participants then took the memory tests, including the word list recall task, which were given in random counterbalanced order. Before each memory task participants were asked to give a prediction of their performance by giving a number of items they thought they would remember, while a percentage was given in the story recall task. Between the second word list recall trial and third word list recall prediction several other memory tasks were given. There were approximately 20 minutes between the immediate recall and delayed recall. After each test, participants responded to the post-test questionnaires about their performance.

Analyses

The data were analyzed separately by age group (younger adults and older adults). Independent samples *t*-tests were used to compare the two age groups' ratings and scores for each study variable (see Table 1). Repeated measures analysis of variance (ANOVA) were used for comparing age group differences and changes in the accuracy and absolute accuracy of predictions at immediate and delayed testing times. Accuracy was calculated by subtracting word list performance from word list predictions so that higher values indicate overestimates. Absolute values of the accuracy scores were also calculated.

Simple linear regressions were used to obtain predicted values. In the simple linear regression analyses, all of the hypothesized predicted variables were entered together for each dependent variable. The first linear regression examined predictors of the participants' initial predictions using only MSE as the independent variable. The second linear regression used the participant's second prediction as the dependent variable. This regression examined the predictive relations of the independent variables MSE, first word recall performance, delayed word recall performance, and initial performance self-ratings (general performance and perceived difficulty). For the second analysis, I controlled participants' initial predictions. A third linear regression was carried out to predict initial absolute accuracy using MSE as the independent variable. The fourth, and final, linear regression examined the predictive relations of the independent variables initial absolute accuracy, initial performance self-ratings and MSE with delayed absolute accuracy as the dependent variable. An alpha level of .05 was used to determine the statistical significance for all statistical analyses.

CHAPTER 4.

RESULTS

Descriptive Analyses

Descriptive analyses were conducted to identify differences between the two age groups (young and old). Table 1 shows the means and standard deviations for study variables by age group. The immediate prediction for younger adults was significantly higher than the older adults' prediction, whereas there were no significant age differences on the delayed prediction. Both groups' predictions were close to the midpoint of possible responses with older adults being slightly lower than younger adults. Younger adults performed significantly better than older adults on all 3 word list performance tests. In addition, younger adults had significantly higher perceived general performance ratings after all three word-list recall tasks. Older adults also rated the word list recall task as significantly more difficult than the younger adults on all three

Table 1.
Mean, Standard Deviations, and Independent t-test for Study Variables by Age Group

	Younger Adults		*Older Adults*			
Variable	*M*	*SD*	*M*	*SD*	df	*t*
Age	21.2	3.22	76.8	8.28	109	-45.51***
Immediate prediction	14.60	4.59	11.34	5.16	109	3.49***
Delayed prediction	14.73	5.50	12.83	5.34	109	1.85
Word List Total T1	18.06	4.39	15.49	5.42	109	2.72**
Word List Total T2	22.04	4.44	18.63	5.36	109	3.62***
Word List Total T3	20.50	4.87	17.19	5.79	109	3.24**
Perceived PerformanceT1	3.38	.80	2.85	.97	105	3.08**
Perceived PerformanceT2	3.73	.819	3.17	.96	108	3.27***
Perceived PerformanceT3	3.83	.76	3.31	.92	109	3.24**
Perceived Difficulty T1	2.48	.64	2.90	1.02	108	-2.52*
Perceived Difficulty T2	2.40	.77	2.88	.94	109	-2.88**
Perceived Difficulty T3	2.33	.85	2.76	.97	109	-2.49*
Accuracy T1	-3.46	5.46	-4.15	7.71	109	.54
Accuracy T2	-7.44	5.76	-7.29	7.86	109	-.12
Accuracy T3	-5.77	3.50	-4.36	4.39	109	-1.85
Absolute AccuracyT1	5.38	3.53	6.53	5.80	109	-1.23
Absolute AccuracyT2	8.10	4.78	8.71	6.22	109	-.58
Absolute AccuracyT3	5.88	3.30	4.86	3.81	109	1.50

Note: Perceived General Performance = Rate your general performance on the word list (1 = very poor to 5 very good). Perceived Difficulty = Rate the difficulty of the word list task (1=very difficult to 5 = not at all difficult). Accuracy was calculated by subtracting performance from prediction; $^*p \leq .05$, $^{**}p \leq .01$, $^{***}p \leq .001$

trials. Finally, related to Hypothesis 3, there were no significant age-group differences on accuracy or absolute accuracy of predictions.

Table 2 shows the zero-order correlations by age group for the study variables. There were a number of significant correlations with the outcome variables of accuracy though not with actual predictions. In addition, for older adults, MSE was related to actual and perceived performance on the memory tasks. MSE was not correlated with any other variables in the younger adult sample. These correlations will be explored further in the regression analyses.

Repeated measures ANOVA

The first repeated measures ANOVA examined the within-subjects factor of Accuracy (Prediction minus Performance) with two time levels: immediate and delayed. The between-subjects factor was Age Group with two levels: younger versus older adults. For the two time measurements (immediate and delay), there was not a main effect of Age Group. There was a significant main effect of Time, $F(1,109) = 5.44$, $p < .05$. The Time effect was further qualified by an Age Group X Time interaction, $F(1,109) = 3.96$, $p < .05$, such that younger adults' accuracy decreased from immediate to delay whereas older adults decreased only slightly in accuracy from immediate to delay (see Figure 1). To test Hypothesis 4, a second repeated measures ANOVA was conducted on Absolute Accuracy (absolute value of Accuracy) at immediate and delay. Contrary to prediction, there was no main effect of Age Group or Time. However, the Age Group X Time interaction was significant, $F(1, 109) = 7.41$, $p < .01$. As shown in Figure 2, younger adults' absolute accuracy scores increased immediate and delay whereas older adults' decreased from immediate to delay, indicating that older adults improved in accuracy compared to younger adults.

Table 2.

Zero-Order Correlations for Study Variables by Age Group

Variables	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*
1. MSE	--	.15	-.04	.09	-.02	-.02	-.03	.11	-.03	-.06	.04	-.05	.06	.14	-.04	.02	-.08	.04
2. Imm Pred	-.03	--	.18	.26	.19	.16	.08	.23	.23	-.17	-.31*	-.05	.63**	.65**	.05	-.36**	-.54**	-.09
3. Delay Pred	.20	.20	--	.73**	.71**	.78**	.60**	.36**	.52**	-.37**	-.12	-.12	-.44**	-.40**	.49**	.30*	.41**	-.52**
4. Word List total T1	.34**	-.06	.62**	--	.80**	.86**	.55**	.48**	.43**	-.28*	-.21	-.03	-.58**	-.41**	-.05	.45**	.49**	-.01
5. Word List total T2	.38**	-.12	.68**	.90**	--	.92**	.33*	.62**	.44**	-.13	-.33*	-.07	-.49**	-.62**	-.17	.44**	.56**	.08
6. Word List total T3	.35**	-.11	.69**	.88**	.91**	--	.45**	.55**	.50**	-.18	-.2-	-.11	-.56**	-.58**	-.17	.45**	.61**	.11
7. Per Perf T1	.40**	-.19	.34**	.76**	.68**	.66**	--	.25	.44**	-.41**	.06	-.15	-.37**	-.19	.31*	.20	.30	-.26
8. Per Perf T2	.40**	-.10	.32*	.60**	.70**	.64**	.68**	--	.50**	-.04	-.48**	.07	-.20	-.30*	-.20	.25	.32*	.09
9. Per Perf T3	.46**	.07	.38**	.67**	.64**	.67**	.71**	.63**	--	-.27	-.25	-.21	-.15	-.16	.13	.28*	.19	-.13
10. Per Diff T1	-.64**	.00	-.39**	-.65**	-.65**	-.65**	-.72**	-.70	-.73**	--	.27	.28*	.08	-.04	-.33*	-.08	-.07	.32*
11. Per Diff T2	-.40**	.02	-.29*	-.46**	-.53**	-.54**	-.44**	-.74**	-.61**	.74**	--	.15	-.09	.10	.09	-.01	-.05	.03
12. Per Diff T3	-.51**	.02	-.22	-.46**	-.40**	-.49**	-.53**	-.52**	-.66**	.74**	.70**	--	-.02	.02	-.04	.11	.01	.03
13. Acc T1	-.26*	.71**	-.30*	-.75**	-.71**	-.69**	-.65**	-.49**	-.43**	.46**	.34**	.34**	--	.88**	.09	-.67**	-.85**	-.07
14. Acc T2	-.27*	.74**	-.33**	-.65**	-.76**	-.70**	-.58**	-.54**	-.39**	.44**	.38**	.28*	.95**	--	.17	-.63**	-.87**	-.14
15. Acc T3	-.22	.38**	.30*	-.41**	-.38**	-.48**	-.44**	-.47**	-.42**	.37**	.36**	.37**	.54**	.51**	--	-.16	-.20	-.97**
16. Abs Acc T1	.17	-.39**	-.00	.50**	.44**	.37**	.49**	.39**	.41**	-.32*	-.34**	-.28*	-.62**	-.56**	-.48**	--	.73**	.11
17. Abs Acc T2	.23	-.57**	.15	.53**	.63**	.52**	.49**	.52**	.39**	-.38**	-.40**	-.25	-.75**	-.80**	-.51**	.87**	--	.15
18. Abs Acc T3	.16	-.44**	-.209	.46**	.41**	.51**	.49**	.46**	.42**	-.34**	-.29*	-.37**	-.62**	-.57**	-.92**	.53**	.54**	--

Notes: Older = bold & below diagonal. Younger = above diagonal. Imm Pred is Immediate Prediction. Delay Pred is Delayed Prediction. Per Perf is Perceived Performance. Per Diff is Perceived Difficulty. Acc is Accuracy. Abs Acc is Absolute Accuracy.
*p < .05; ** p < .01

Table 3.
Repeated Measure of Analysis of Variance for Accuracy of Immediate and Delayed Predictions by Age Group

Source	*df*	*SS*	*MS*	*F*
			Between Subjects	
Age Group	1	13.07	13.07	.31
Error 1	109	4614.86	42.34	
			Within Subjects	
Time	1	105.36	105.36	5.44*
Time x Age Group	1	76.60	76.60	3.96*
Error 2	109	2110.19	19.36	

Note: *p $\leq$ .05

Figure 1.
Accuracy of Immediate and Delayed Predictions by Age Group

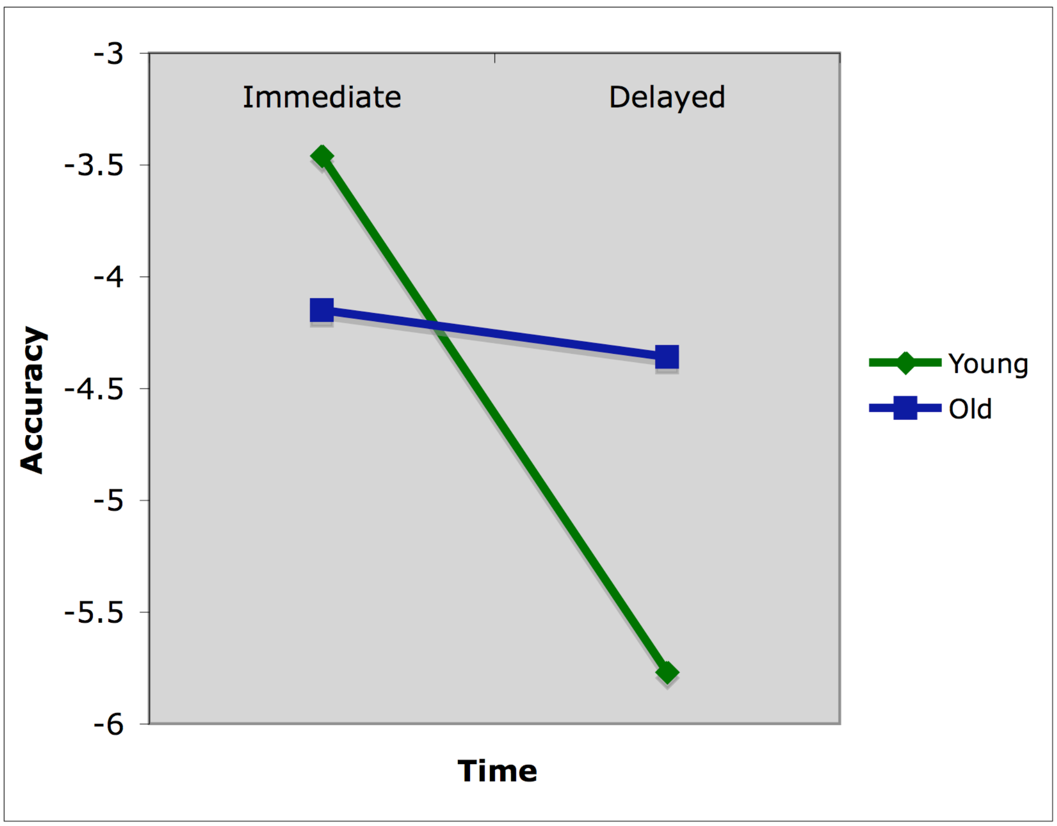
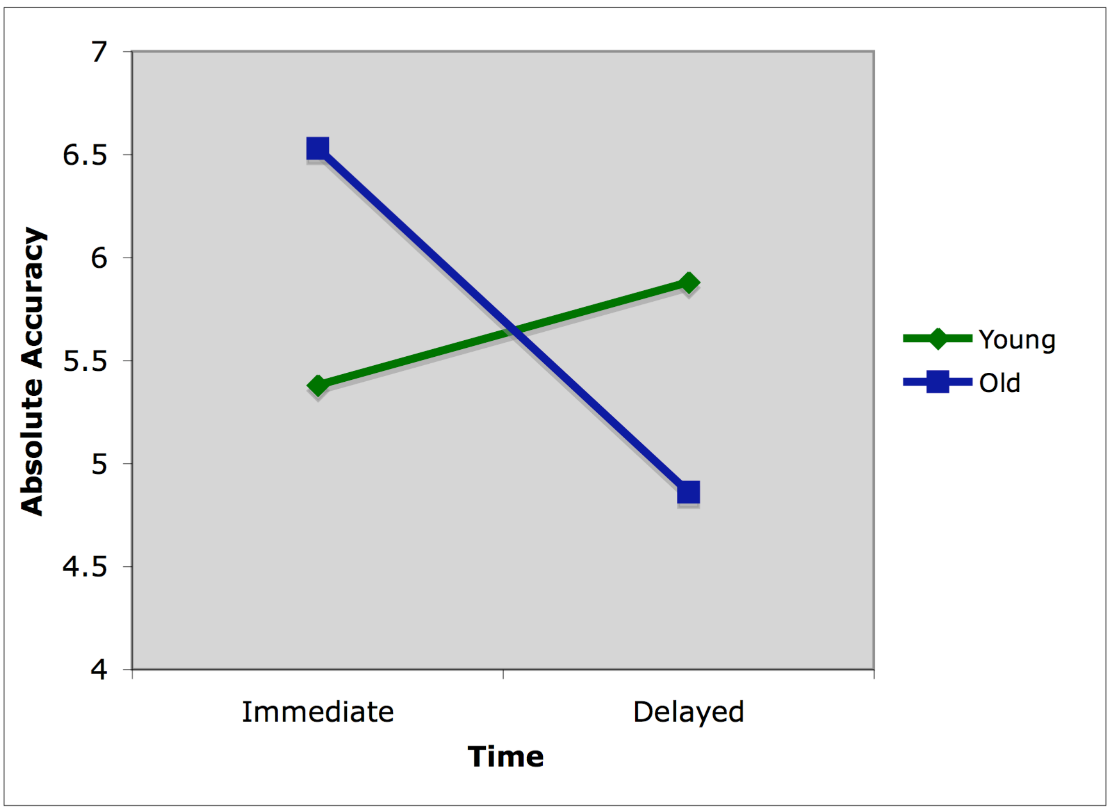


Table 4.
Repeated Measure Analysis of Variance for Absolute Accuracy of Immediate and Delayed Predictions by Age Group

Source	*df*	*SS*	*MS*	*F*
		Between Subjects		
Age Group	1	.23	.23	.01
Error 1	109	2814.51	25.82	
		Within Subjects		
Time	1	11.47	11.47	1.06
Time x Age Group	1	80.34	80.34	7.41**
Error 2	109	1181.49	10.84	

Note: **p $\leq$.01

Figure 2.
Absolute Accuracy of Immediate and Delayed Predictions by Age Group



Linear Regression Analyses

As described in the Methods section, four simple linear multiple regression analyses were conducted to examine the predictive relations of the hypothesized independent variables on the four dependent variables - initial prediction, delayed prediction, immediate absolute accuracy and delayed absolute accuracy. Results from these analyses are presented in Tables 5 and 6. To test Hypothesis 1 and 3, MSE was used as the independent variable to predict immediate prediction and absolute accuracy. For both immediate prediction (Hypothesis 1) and for absolute accuracy at Time 1 (Hypothesis 3), linear regression analyses revealed that MSE was not a significant predictor for either younger or older adults which suggests that factors other than MSE influence immediate predictions and accuracy

To test Hypothesis 2, using delayed prediction as the dependent measures, the following variables were entered into a regression analysis: MSE, initial prediction, immediate word list performance, perceived performance, and perceived difficulty. The total R^2 for the analysis for younger adults was .60 ($p < .001$). Contrary to the hypothesis, MSE was not related to delayed prediction for younger or older adults. In line with Hypothesis 2, for younger adults, immediate word list recall performance significantly predicted delayed prediction values ($\beta = .58$, $p < .001$). This suggests that younger adults based much of their second prediction on their initial performance. Initial prediction, MSE, and perceived difficulty were not significant predictors of delayed prediction. Perceived performance at Time 1 also approached significance ($\beta = .23$, $p = .06$) for delayed prediction in younger adults, such that the better younger adults thought they performed, the higher their next prediction. The total R^2 for the analysis for older adults was .43 ($p < .001$). However, contrary to hypothesis 2, the only significant predictor of delayed prediction for older adults was immediate word recall performance. Similar to younger adults, albeit to a lesser degree, delayed predictions were related to how many words older adults recalled after the first trial. In addition, the immediate prediction approached significance for older adults ($\beta = .21$, p

= .07), which suggests that older adults may have tended to have similar initial and delayed predictions

To further examine Hypothesis 2, regression analyses were conducted using absolute accuracy (rather than actual prediction) as the dependent variable (see Tables 5 & 6). Independent variables included MSE, immediate absolute accuracy (to test for change), perceived performance, and perceived task difficulty. For younger adults, the model was not significant and none of the individual variables significantly predicted absolute accuracy at delayed word recall. However, perceived difficulty did approach significance (β = .26, $p = .08$), such that the higher the perceived difficulty, the more accurate they were at delay. The total R^2 for the analysis for older adults was .35 ($p < .001$). The analyses revealed immediate absolute accuracy for older adults significantly predicted delayed absolute accuracy which suggests that older adults who were accurate at first were likely to be accurate at delay. Contrary to hypothesis, neither MSE nor the self-ratings were significant predictors of delayed absolute accuracy.

Table 5.
Summary of Final Regression Analysis Coefficients for Younger Adults

Cognitive factor	**Predictor**	***B***	**SE *B***	**β**	***p***
Initial prediction	MSE	.95	.86	.15	.28
Delayed prediction	MSE	-.70	.70	-.10	.32
	Initial prediction	.00	.12	.00	.99
	Word List Total T1	.72	.15	.58***	.00
	Perceived Performance T1	1.60	.82	.23	.06
	Perceived Difficulty T1	-1.01	.88	-.12	.26
Absolute Accuracy 1	MSE	-.08	.67	-.02	.90
Absolute Accuracy 2	MSE	.22	.60	.05	.72
	Absolute Accuracy T1	.16	.13	.17	.23
	Perceived Performance T1	-.76	.62	-.18	.23
	Perceived Difficulty T1	1.36	.76	.26	.08

Note: ***p $\leq$.001

Table 6.
Summary of Final Regression Analysis Coefficients for Older Adults

Cognitive factor	**Predictor**	***B***	**SE *B***	**β**	***p***
Initial prediction	MSE	-.18	.86	-.03	.83
Delayed prediction	MSE	-.05	.93	-.007	.96
	Initial prediction	.21	.11	.21	.07
	Word List Total T1	.75	.17	.75***	.000
	Perceived Performance T1	-1.30	1.09	-.24	.24
	Perceived Difficulty T1	-.31	1.03	-.06	.76
Absolute Accuracy 1	MSE	1.22	.95	.17	.21
Absolute Accuracy 2	MSE	-.30	.70	-.06	.68
	Absolute Accuracy T1	.24	.09	.37**	.01
	Perceived Performance T1	-.20	.76	-.05	.11
	Perceived Difficulty T1	1.18	.73	.29	.79

Note: **$p \leq .01$, ***$p \leq .001$

Chapter 5

DISCUSSION

Overview

This study was designed to investigate age differences in the factors that contribute to word list recall predictions. In addition, I investigated accuracy between prediction and performance with initial to delayed word list recall predictions between a sample of older and younger adults. The hypotheses were partially supported by the results. The hypothesis predicting that the delayed prediction in both groups would be more accurate was supported, but only for older adults. However, the hypothesis predicting MSE to influence initial prediction was not supported. In addition, the hypothesis predicting that other variables besides MSE influence delayed predictions was not fully supported. Lastly, the hypothesis predicting that older adults would be less accurate in predictions than younger adults was not supported. In fact, the repeated measures ANOVA revealed that the older adults' predictions were as accurate as or better than the younger adults. Overall, the results suggest that older adults are capable of monitoring their memory accurately based on previous performance. Even though the study only supported some of the hypotheses, there were several interesting results that require further discussion.

One interesting finding was that MSE was significantly correlated with actual performance in older adults but not younger adults. According to Bandura's (1986) social cognitive theory, people's memory beliefs may influence how they perform. That is, if people believe they will not perform well on memory tests, this will directly affect their performance through both motivation and effort. In the current study, the older adults with high MSE may have approached the word-recall task as a challenge to conquer and had a stronger commitment to remembering as many words as possible. While the older adults with lower MSE may have performed worse on the word recall task because they gave up easily when feeling frustrated with their memory rather than concentrating on performing successfully. Interestingly, older adults' MSE beliefs were also related to posttest ratings suggesting that MSE was a filter through which they judged their ability and performance. Thus, the beliefs about their memory are sometimes better predictors about how they will behave in future performances than remembering their previous performances. Unlike the older adults, the younger adults in this study are still developing and altering their self-efficacy beliefs through feedback from others while in college, which may be a reason as to why their MSE was not related to performance. Another reason may be that younger adults have a higher skill level and higher MSE in general which could lead to a restriction of range and, therefore, a lack of significant correlations.

Immediate Predictions

Contrary to expectations, MSE did not influence initial prediction in both younger and older adults. This hypothesis was derived from the work of Hertzog and colleagues (1990 & 1994) that suggested adults base their first word recall prediction on MSE beliefs. MSE measures were found to correlate more with predictions than other metamemory scales that were independent of MSE (Hertzog et al., 1990). Hertzog and colleagues (1994) further supported this when they found MSE correlated with initial prediction, but neither MSE nor initial prediction correlated with actual memory performance. In addition, there was no direct influence of age, sex, or memory performance on the initial word recall prediction when they controlled for MSE.

There are a couple possible reasons that my hypothesis of MSE influencing initial word recall prediction was not supported. The first possibility is that a different measure of MSE was used in this study compared to Hertzog et al. (1990 & 1994). In both of the studies by Hertzog and colleagues (1990 & 1994) MSE was measured by the Capacity Scale from the Metamemory in Adulthood Instrument (Dixon, Hultsch & Hertzog, 1988) and the Frequency of Forgetting scale from the Memory Functioning Questionnaire (Gilewski, Zelinski & Schaie, 1990). These were not the scales used to measure MSE in the larger study from which my data was derived. I measured MSE through a combined mean score from the MAC Self-Rating Scale which measures perceived decline, MCI Present Ability subscale which measures beliefs about one's current level of memory performance, and a peer comparison self-rating because I believed that these questions would best address individuals' perceptions of the their memory given the range of questions that were available to me. However, the combination of the aforesaid scales have not been tested for their validity and reliability in measuring MSE or used in previous studies. It should be noted, however, that MSE was related to actual performance and subjective task ratings, which suggests that the measure was capturing at least some aspect of memory self-knowledge, if not MSE.

The second possibility to explain MSE not being related to predictions is that the participants in this study may have based their initial prediction on the perceived midpoint, known as “anchoring”. Tversky and Kahneman (1974) identify this approach as the anchoring and adjustment heuristic. This heuristic refers to the tendency to make judgments by beginning with an initial number as the starting point, the anchor, and then adjusting this number to reach a final decision. Participants may have used this heuristic to simplify making a quick estimate about an uncertain task.

Woo and colleagues (2008) found that when given an anchor, younger and older adults modified their predictions accordingly in several memory tasks. Unlike the current study, participants in their study were given an accurate average anchor for their age, midpoint anchor, or no anchor. The results showed that predictions became more accurate as the participants received more task information from the anchor. Although there was no anchor given in this study, younger and older adults could have developed a midpoint anchor because they were told how many words needed to be studied. Younger adults in the current study appeared to use the halfway point (15 of 30) for their predictions. For older adults, their initial prediction was made under this midpoint. Older adults' under-midpoint predictions may reflect older adults' internalizing negative stereotypes about memory decline with aging

Delayed Predictions

The second hypothesis, which predicted that MSE and other variables would influence the delayed predictions, was not supported. Consistent with hypothesis 2, immediate performance was found to predict younger adults' delayed prediction. Thus, they did base their delayed prediction from how well they performed at the immediate word recall task. Although the other variables were not significant, perceived performance did trend in the predicted direction for younger adults (p=.06). This implies that younger adults increased their delayed prediction if they believed to have performed well on the initial task. Future studies should include a larger sample to see if this trend becomes significant.

Another interesting finding was that older adults' delayed prediction was significantly predicted by their immediate performance, suggesting that older adults monitored their performance on an unfamiliar task to make future judgments. This was the prediction for younger adults, but not older adults because it was presumed that older adults have not recently been exposed to repeated testing, unlike the younger adults who are undergraduate students.

Task familiarity has been hypothesized to explain age differences in memory monitoring. Rebok and Balcerak (1989) suggest that older adults are more likely to increase their metamemory and improve the accuracy of their predictions through training and feedback after experiencing an unfamiliar task. Instead of receiving feedback, older adults were given additional practice that may have contributed to becoming more familiar with the memory task and more accurate in their delayed prediction. What was unexpected was that the age differences did not favor of younger adults who encounter more tests than older adults that requires strategic memorization, similar to the word recall task. Of course, their initial predictions may have been influenced by this strategic memorization experience. Also, immediate prediction was found to have approached significance for delayed prediction in older adults (p = .07). This suggests that older adults did not stray much from their anchor or initial prediction.

Accuracy

Also contrary to hypothesis 3, I found that older adults were not less accurate than younger adults. These results contrast with previous studies that have shown that old adults are more inaccurate in their predictions before task performance than young adults (Bieman-Copland & Charness, 1994; Hawley et al, 2006). However, these results are similar to Woo et al. (2008) who reported that older adults' global memory predictions were nearly as accurate as the younger adults. In addition, they found no evidence to suggest that older adults overestimate their performance because the older adults repeatedly predicted lower memory performance on all the memory tasks that they actually performed poorly on than the younger adults. In fact, the only age difference found in prediction accuracy was that older adults were more accurate than younger adults in predicting visuospatial memory performance.

Even though younger adults have more opportunities to judge their performance in college, Johnson and Halpern (1999) suggest that they also rely on others' feedback of their performance through grades. On the other hand, older adults must develop their own way of monitoring their performance on a daily basis because they do not expect feedback from others.

This could explain why the older adults were found to be just as accurate or better in their predictions than the younger adults.

Change in Prediction Accuracy

The fourth hypothesis was also partially supported, as the older adults became more accurate from the immediate to delayed task predictions compared to younger adults. Hertzog and colleagues (1990) found this same pattern in their study on global predictions. This result is also consistent with previous research that has found memory for past performance can be a good accurate predictor of future performance, also known as the Memory for Past Test heuristic (Finn & Metcalfe, 2007 & 2008). This finding suggests that older adults learned from their performance and adjusted their predictions accordingly. Thus, older adults seem to be able to monitor their performance and are capable of accurately judging their future performance on a task.

Even though immediate performance was also found to influence their delayed prediction in younger adults, it is interesting that this did not significantly improve accuracy in predictions. In Finn and Metcalfe's (2007 & 2008) studies the sample consisted only of younger adults who used the MPT heuristic to base their prediction on their remembered past performance without taking into account any new learning or forgetting. One possible explanation for the younger adults in this study being less accurate is that they were not allowed to study the words more than once. Older adults have already developed a strategy to remember items from lifelong experience of using their memory on a daily basis. Therefore younger adults could need additional study time to determine what words they find too difficult to remember and may not have utilized the MPT heuristic in this study when making their delayed prediction. In addition, participants in the Finn & Metcalfe (2007 & 2008) studies gave judgments of learning rather than predictions.

Limitations

Limitations of the current study include the following: small sample size, non-standard MSE measurement, the use of a second immediate performance test without a prediction question, and the fact that this is a secondary data analyses. The total sample consisted of 110 participants with 59 older adults and 51 younger adults. With this size sample, it is harder to detect smaller relationships, as statistical tests normally require a larger sample size to justify that the effect did not just happened by chance alone. Future studies should include a larger sample.

Another limitation is the measurement of MSE used in the study. MSE was measured on Likert type scales that addressed memory ability, frequency of memory problems, overall comparison of memory to others and present perceived memory controllability beliefs. The subscales selected had been used to measure MSE, but we were not able to directly compare this to the other studies based on my hypotheses that used other measures of MSE. Further studies using other measures of MSE may reveal different findings.

Another issue with the current study is that there was a second immediate word list task given but participants did not give a second prediction. As a result there is no way of knowing whether a second prediction would have been more or less accurate than the delayed prediction. However, we do know from the correlation matrix that actual test performance at Time 2 was indeed related to the delayed prediction. But, it was also very high correlated (*rs* ranged from = .80 to .92) with Time 1 scores. To prevent excess multicollinearity, we decided to use the Time 1 scores only.

Finally, because this was a secondary data analysis, I was unable to include several variables of interest in this study. First, as mentioned previously, I could not compare my measures of MSE to the other studies I based my hypotheses on. Second, I did not have a measure of confidence in prediction, which is more commonly used in studies of prediction and calibration. Third, postdictions were not asked from the participants, which are often included in studies on memory monitoring and would have assisted in understanding participant's awareness of their recent cognitive performance. Finally, I would have liked to include a prediction at Time 2 so I could examine change over multiple trials.

Future Directions

Despite these limitations, the current study suggests that older adults are equally as accurate as or better at monitoring their memory than younger adults. The current study is perhaps the first study to explore post-test self-ratings as a variable that contributes to prediction changes and accuracy among younger and older adults. Although the variable was not found to be significant, a larger sample size could determine if the trends found in this study would be.

Future research could include a sample of middle-aged adults as well. Most research on memory typically focuses on comparing younger adults in college with adults above the age of 60. The addition of middle-aged adults would help us understand if by middle-age adults monitor their performance similarly to young or older adults. This could help pinpoint what metamemory skills people are using to improve or worsen their perceived memory accuracy across the adult lifespan.

CONCLUSIONS

While all hypotheses were not supported in the current study, it did lead to some interesting findings in understanding the age-related differences in the process of creating immediate and delayed word recall predictions. For example, the study demonstrated that older adults are capable of monitoring their memory as they based their delayed prediction on their immediate performance. In addition, older adults were found to be more accurate in their delayed prediction then younger adults. These findings should help challenge the stereotype that all memory skills deteriorate with age as it was found that older adults are actually better at prediction accuracy than the younger adults. Furthermore, the results suggest the importance of identifying what people know and can learn about their own memory abilities, so that strategies can be developed to help them accurately realize how many items they are able to remember. Overall, the current study reveals a promising direction for future research to build off of the these results and explore what other variables are involved in perceived memory, which seems to be particularly important for understanding memory in older adults.

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