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Prediction accuracy of young and middle-aged adults in memory for familiar and unfamiliar texts

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This study investigated the influence of age, familiarity, and level of exposure on the metamemorial skill of prediction accuracy on a future test. Young (17 to 23 years old) and middle-aged adults (35 to 50 years old) were asked to predict their memory for text material. Participants made predictions on a familiar text and an unfamiliar text, at three different levels of exposure to each. The middle-aged adults were superior to the younger adults at predicting performance. This finding indicates that metamemory may increase from youth to middle age. Other findings include superior prediction accuracy for unfamiliar compared to familiar material, a result conflicting with previous findings, and an interaction between level of exposure and familiarity that appears to modify the main effects of those variables.

A common concern among adults is that they will lose their memories with age. To address this concern, researchers in the area of memory have typically focused on comparisons between college students and adults above age 65. Results in this area often favor young adults, a finding typically attributed to the physiological deterioration of the brain, which reduces cognitive abilities. However, a new perspective on memory and aging has been revealed in the examination of metamemory, or the knowledge and understanding of one's own memory processes. This knowledge includes assessment of one's memory abilities, use of strategies to aid memory, and acknowledgement of personal strengths and weaknesses in memory ability. Whereas memory studies focus on the diminishing cognitive resources in the brain, metamemory studies focus on the management of those resources.

Although age differences in memory abilities are attributed to the physical condition of the brain, theories of aging and metamemory invoke experience as a primary factor. The more experience a person has with his or her memory, the better we would expect him or her to perform on a metamemory task. Because older people have more experience with their memories, we might expect an improvement in metamemorial abilities with age, as people become better at managing

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their cognitive resources. Research in this area has not found substantial evidence of age-related declines in ability, as have been found in memory research.

Many studies of metamemory have failed to find any age effects whatsoever (Lachman, Lachman, & Thronesbery, 1979; Perlmutter, 1978; Rabbitt & Abson, 1991). Of the studies that have found age effects indicating decline of metamemory ability with age, most indicate that the direction of aging effects seems to depend on the nature of the task. For example, Devolder, Brigham, and Pressley (1990) found no age differences in ability to predict performance on a text recall task, nor did they find any for word recall or digit span tasks. They did find superior prediction accuracy in young adults compared to elderly adults on a word recognition task, a face-name learning task, and a vocabulary task. However, they found superior prediction accuracy in elderly adults compared to young adults on an appointment-keeping task. Finally, some evidence does show enhancement of metamemory skills with increasing age (Hertzog, Dixon, & Hultsch, 1990; McDonald-Miszczak, Hunter, & Hultsch, 1994). Overall the picture of aging and metamemory does not appear to be one of age-related declines.

A particularly detailed picture of the development of metamemory skills across the adult life span is shown by Fingerman and Perlmutter (1994) in their study of metamemory in four age cohorts: 20-year-olds, 40-year-olds, 60-year-olds, and 80-year-olds. Participants from all four groups completed eight tests designed to measure a wide variety of cognitive skills. Following these tests, participants were asked to assess how well they thought they had just done, how well they thought they would have done on the same tasks 5 years ago, and how well they thought they would do on the same tasks 5 years in the future. Participants' prediction accuracy was measured by calculating difference scores between their actual scores and their estimated scores for past, present, and future. Significant age effects were found for six of the eight tests. The pattern was similar across tests, with the 40-year-old and 60-year-old cohorts making more accurate estimations of their performance than the 20-year-old cohort. All three of these cohorts were more accurate than the 80-year-old cohort.

The overall picture presented by Fingerman and Perlmutter is one of an inverted *u*-shaped developmental trajectory. In accord with this picture, studies examining elderly adults in relation to college students, a common strategy in the aging literature, might expect to find age-related declines in metamemorial ability. However, if the focus were shifted from the elderly to middle-aged adults, the resulting picture should be quite different. The explanation behind the inverted-*u* tra-

jectory of metamemory development lies in the balance between physiology and experience, between the presence of cognitive resources and the management of those resources. The decline of metamemory ability found in the 80-year-olds may be attributable to physiological deterioration in the brain. On the other hand, it is unlikely that the 20-year-olds are outperformed by the 40- and 60-year-olds simply because their brains have not yet fully matured physiologically. An examination of the role of experience is the next important step in more accurately depicting the development of metamemory abilities. The superior performance of middle-aged adults may stem from the fact that they have not yet reached the point of physiological deterioration, but have accumulated many more experiences than younger adults.

The experiences that middle-aged adults have had include ones not only with different kinds of information and different tasks but also with their own memories. Most middle-aged adults, particularly those involved in professional careers, are expected to make judgments of their memories regularly. An example is preparing for a meeting. This activity requires judging what material one has memorized and what material one needs to study in the same way that a test requires similar judgments from a student. The ability of many middle-aged adults to perform such tasks regularly supports the idea that they have not reached a point at which physiological deterioration substantially affects their metamemorial performance. Furthermore, many middle-aged adults have already finished the education process and have begun careers in which metamemory judgments are no longer explicitly evaluated by others, as they are evaluated by teachers, parents, and professors in a young adult's life. They are required to make judgments, such as how much and what sort of preparation they need to remember the information for a presentation. Then they must assess those judgments based on their performance in order to improve their performance next time. For example, if notecards were not a successful way to organize the information, perhaps an outline would be better next time. Young adults make the same kinds of judgments, but their assessment of these judgments is aided by the record of performance that is kept by their evaluators.

The ability to evaluate one's performance can be examined in two ways. In the Fingerman and Perlmutter (1994) study, participants were asked to estimate their performance after having just completed the task. This is called a postdictive judgment. Much of the metamemory literature focuses on the other kind of evaluation, a predictive judgment, in which a person is asked to predict his or her performance on a subsequent test. Fingerman and Perlmutter had participants predict their

performance for 5 years in the future. They were asked to judge abilities that were not tapped in the study. What Fingerman and Perlmutter actually assessed were participants' beliefs about how their memories change with time and whether those beliefs match their ability to remember information at the time of the experiment. They did not study prediction accuracy as it is defined in the literature. In the current experiment, we hypothesized that the *u*-shaped developmental trajectory that Fingerman and Perlmutter found for postdictive ability would also occur with predictive ability. Therefore, we expected middle-aged adults to be more accurate than younger adults at predicting their performance on a subsequent test.

There are several ways in which this superior prediction accuracy in middle-aged adulthood could be achieved. It could stem from differences in absolute levels of prediction. For example, if both age groups are performing poorly, we may find that middle-aged adults suspect this and consequently lower their predictions, whereas younger adults are not aware of their poor performance and make higher predictions, resulting in superior prediction accuracy in the middle-aged adults. Alternatively, the superior prediction accuracy of the middle-aged group could result from differences in actual performance. For instance, if both groups make similarly high predictions, these predictions might reflect superior prediction accuracy in the middle-aged adults if they perform better on the task than younger adults. Finally, superior prediction accuracy in middle-aged adults may derive from a combination of both absolute levels of prediction and actual performance scores.

Differences in absolute levels of prediction should result from differences in participants' beliefs about their memory. Hertzog, Hulstsch, and Dixon (1989) found strong correlations between predictions of word and text recall and participants' beliefs about their memories, as indicated by the Metamemory in Adulthood (MIA) instrument and Memory Functioning Questionnaire (MFQ). Furthermore, Hertzog et al. (1990) found that age differences for females in prediction of word recall lost significance when these beliefs were statistically controlled, suggesting that memory self-efficacy may play a large part in mediating the age differences in prediction accuracy. In this study, we expected similar predictions from younger and middle-aged adults. Because they perform similar memory and metamemory tasks in everyday life, we did not expect their beliefs about their memories to be as different as was found in previous studies examining young and elderly adults, who do not perform similar everyday tasks.

In this study, we administered a shortened version of the MIA instrument, designed to probe the beliefs of adults regarding how memory

works in general and how they use their own memories. We included questions from only five of the seven factors, chosen for their ability to tap beliefs that were particularly relevant to the examination of age differences and to this task. These were the Strategy, Task, Capacity, Change, and Locus factors. The Strategy factor examines participants' use of various techniques in aiding their memories. The Task factor examines participants' beliefs about how different aspects of a given task could affect the memorability of the information involved. The Capacity factor asks participants to judge their current personal memory abilities in different activities. The Locus factor explores participants' beliefs about control over memory ability, particularly over time. There is no reason to expect middle-aged adults' beliefs to differ from those of young adults on these four factors because the two groups have similar everyday memory requirements and have experience with similar tasks. The Change factor probes participants' opinions about whether their memory has changed over time. It is possible that age differences would be found here, considering the increasing concern that people have with their memory abilities as they age.

Although differences in beliefs were not predicted, we did expect differences in actual performance to lead to superior prediction accuracy in middle-aged adults compared to young adults. In pilot studies, participants did not perform exceptionally well on the memory task, earning an average of only 11–12 points out of 30. With the overall level of performance fairly low, we expected to find both groups overestimating their performance on the tests, with the younger group overestimating significantly more than the older group. That is, we predicted that middle-aged and young adults' predictions would be similar and would be overestimates of the actual scores, but that young adults would do poorly on the memory test compared to middle-aged adults, so their estimates would be less accurate. The hypothesis that middle-aged adults would outperform younger adults on the memory task is founded in their accumulated experience with similar tasks and with using their memories.

This study examined prediction accuracy by assessing participants' ability to predict their performance on recall of text material. Previous research has found that domain familiarity of text material affects people's predictions regarding that material (Maki & Serra, 1992). Schema theory suggests that familiar information should be processed better and therefore recalled better. Maki and Swett (1987) discussed this possibility in their study of prediction accuracy for consistent versus inconsistent ideas. Their participants read texts in which one target sentence was either consistent or inconsistent with the information in

the rest of the story. The only significant correlation they found between recall and prediction rating was for the consistent condition, in which the target sentence agreed with the information throughout the rest of the story. Participants who received consistent information were more accurate, although only in the immediate condition, than those who received inconsistent information, thus lending support to the schema theory. Accordingly, we expected that familiar information would be recalled better than unfamiliar information. Furthermore, because domain familiarity affects predictions, we expected that participants' ability to predict their performance would be better for the familiar than the unfamiliar text. In this study, familiarity was operationalized through the content of the texts being recalled.

An interaction was expected between familiarity and age, such that middle-aged adults would show an advantage over young adults in their ability to predict for familiar material. This advantage was not expected to occur for unfamiliar material. Support for this expectation is found in the literature. Devolder and Pressley (1991) found that younger adults showed superior prediction accuracy compared to older adults on word recall and recognition tasks and a face-name learning task—all laboratory tasks. Older adults, on the other hand, showed superior prediction accuracy compared to younger adults on an appointment-keeping task performed outside the laboratory. Thus, the older adults showed an enhanced prediction accuracy for a more familiar task.

Along with familiarity, a variable often found in research of prediction accuracy and text recall is level of exposure to the text. Maki and Serra (1992) found that prediction accuracy increases with increased exposure to a text. In order to give some attention to this variable, which like familiarity and age is also related to the role of experience, prediction accuracy was assessed at three points during this experiment. Participants were asked to make predictions of their performance on a test after reading the title of the texts, after scanning the texts briefly, and after carefully reading and summarizing the texts. This procedure of taking three "snapshots" was designed to give a more in-depth view of prediction accuracy for text material. We expected that both groups would show low prediction accuracy after viewing only the title, but that their prediction accuracy would increase with more exposure to the texts. Level of exposure was also examined for an interaction with age. We hypothesized that the increased amount of experience associated with the middle-aged group might improve their prediction accuracy across levels of exposure. Specifically, we predicted that the middle-aged group would require less exposure to the text than the younger group for maximum prediction accuracy because of the experience in managing cognitive resources that is acquired with age.

EXPERIMENT

METHOD

Participants

For the younger adult group, 20 participants were recruited from the subject pool for an introductory psychology course at Bucknell University and received course credit for their participation. A minimum of 5 points out of 30 on each of the two memory tests was required for a participant to be included in the study. Of the 20 young adults, 3 were dropped from the study having not met the 5-point criterion on at least one of the memory tests, resulting in a total of 17 young adults (14 women and 3 men). The mean age of this group was 18.7 years, ranging from 18 to 22, and the mean education level was 13.1 years. For the older adult group, 16 participants were recruited from the local community through advertisements in a newsletter, at a forum for administrative staff, and through e-mail to administrative staff. Of the 16 older adults, 1 was dropped for not meeting the 5-point criterion, resulting in a total of 15 middle-aged adults (7 women and 8 men). The mean age of this group was 42.3 years, ranging from 35 to 48, and the mean education level was 17.9 years. To control at least somewhat for the greater number of years of education of middle-aged adults compared to college students, we set a maximum education level for the middle-aged adults. In advertising for this group, a requirement of 1 to 6 years of post-high school education was included, with full- and part-time education weighted appropriately whenever possible. The range reported by the older adult group was 4 to 10 years of post-high school education. The resulting mean education level for the middle-aged group is approximate because some participants indicated that their education was full-time, some indicated part-time, and others made no indication either way.

All of the older participants were employed in positions that involved daily use of decision-making skills and demands on memory similar to those of college students, such as remembering information in preparation for meetings. Examples of participants include a university vice-president, staff from a university computer center, chief taster for a food company, an occupational therapist, and several elementary school teachers. Both age groups held similar beliefs about the memory requirements of their daily activities. On a rating scale where 1 indicated "not expected to remember much" and 5 indicated "expected to remember a great deal of information," the young adults rated their daily memory requirements at 4.1 and the middle-aged adults rated their daily memory requirements at 4.5.

Materials

To begin the session, participants filled out a general metamemory questionnaire, the MIA (Dixon & Hultsch, 1984). The original MIA was composed of 108 questions representing seven different factors: Strategy, Task, Capacity, Change, Anxiety, Achievement, and Locus. Five of these factors showed age-related differences when administered to young and elderly adults (Dixon &

Hultsch, 1983; Hertzog et al., 1990, Hultsch, Herzog, & Dixon, 1987). These were the Strategy, Task, Capacity, Change, and Locus factors, and questions falling under each of these factors were administered to check for similar differences between young and middle-aged adults. To reduce the length of the questionnaire, 4 questions were chosen at random from each of the five factors, resulting in a questionnaire consisting of 20 randomly ordered questions (ordered by factor in Appendix A).

The to-be-remembered texts were written by the experimenter, with the intent of manipulating the level of familiarity participants would have with the subject matter. For this reason, travelogues describing a familiar city (New York City) and an unfamiliar city (Prague, Czech Republic) were composed. The title and first paragraph of each text can be found in Appendix B. Across the two texts, the numbers of words, paragraphs, proper names, and numbers (e.g., dates) were kept comparable. The New York and Prague texts were 718 and 724 words and contained four and five paragraphs, respectively. An effort was made to exclude any Czech names that would introduce unusual orthography, and, to keep the texts comparable, more common synonyms were substituted for any obscure words (e.g., *rooster* for *cockerel*) found in the historical references on which the texts were based. The two titles, each containing 12 words, were matched to prevent biases due to length at the first level of exposure (title only).

Five questions, one of which targeted prediction accuracy, were given at three points during the experiment. The critical question asked participants to estimate how many points out of 30 they believed they would get on a test of the material to be found in the text. The first set of questions, posed after exposing participants to only the title of the text, asked participants what score they thought they would earn after reading the material in the text. The other four questions were filler questions probing participants' preferences concerning travel and general attitudes about memory. The phrasing of the critical question was the same for each text, but differed across the three points of time. The phrasing and ordering of all questions were kept constant across participants.

Finally, the memory tests were designed by the experimenter in conjunction with the texts. Each test contained seven short-answer questions with a total of 30 possible points. The purpose of using a short-answer format was to allow for partial credit, thus providing a realistic testing environment that would simulate everyday memory requirements. The test questions were designed to target both specific names and dates and more general descriptive information.

Procedure

Participants began the session by completing the MIA questionnaire. They were then exposed to the texts. A prediction accuracy questionnaire was administered at three points during exposure to the texts: after reading the titles, after scanning the texts briefly, and after reading and summarizing the texts. The memory tests completed the session. After being exposed to the first text at a given level of exposure, participants answered the questions corresponding to that text before being exposed to the second text at the same level of exposure and answering the corresponding questions for that text. The

presentation order of the two texts, familiar and unfamiliar, was kept constant across the three exposure levels and the test section, but was alternated across participants. Thus, participant A would receive the New York City text first and the Prague text second in all phases, whereas participant B would receive the Prague text first and the New York City text second in all phases.

During the first phase, participants viewed only the title of the texts and were asked to make their prediction based on their judgment of how they would perform after having read a text corresponding to the title. During the second phase, participants were given 2 min to skim the text, at which point they were asked to advance to the questions. Participants were encouraged to progress to the questions at their own pace if they were finished before the 2 min had passed. During the third phase, participants were asked to read the text more carefully and write an 8- to 10-sentence summary of the material in it. They were given time announcements at 5 min and 15 min. The first announcement was an aid to help them pace themselves, and the second indicated that they needed to advance to the questions. Again, participants were encouraged to progress at their own pace if they were finished with the summary before the 15 min had passed.

In the final section, participants took a seven-question short-answer test of the material in each text. The instructions encouraged them to write down any relevant information that they could remember because partial credit would be given. Participants were given as much time as they required to complete the tests, after which they were debriefed fully as to the purpose of the experiment and any anxiety about test performance was addressed.

RESULTS

Each participant made three predictions for each text, resulting in a total of six predictions per person. The actual memory tests were scored by the experimenter, who was blind to all participant characteristics during scoring and who followed a scoring sheet indicating how many points were awarded to each part of the correct answer. For example, a question from the New York text was "Why is Rockefeller Center such a popular winter attraction?" In response to this question, mention of the skating rink was worth 1 point and mention of the Christmas tree was worth 1 point, for a total of 2 points. A sample question from the Prague text was "What was the Hussites' symbol depicted on the Tyn Church and what happened to it?" Participants were awarded 1 point for indicating that the symbol was a ceremonial cup, up to 2 points for mentioning that the symbol was melted down to make a halo for the Madonna, and up to 2 points for mentioning that this occurred following defeat by the Catholic Habsburgs. Scores on the actual memory tests ranged from 7 to 25, with a mean of 13.7, for the younger group and 9 to 26, with a mean of 16.5, for the older group. There did not appear to be a floor or ceiling effect for either group.

To check the reliability of the scoring system, three independent raters were asked to score both tests (familiar and unfamiliar) from a random selection of 10 participants. The raters were given the texts to read before scoring and a copy of the scoring sheet, but were not given any other information about the purpose of the experiment. A Pearson correlation was conducted to examine the relationship between the three independent raters' scores and the experimenter's scores. The average reliability among the four was 0.97.

Prediction accuracy was calculated based on previously used methods by subtracting the actual test score from the predicted test score (Devolder et al., 1990; McDonald-Miszczak et al., 1994; Perlmutter, 1978). By this method a person is considered more accurate the closer he or she scores to 0, which would indicate a perfect prediction. Each participant had six prediction accuracy scores, derived by subtracting the actual score earned on the test of each text (the familiar and the unfamiliar texts) from the prediction made for that text at each level of exposure (posttitle, postscan, and postsummary). Prediction accuracy was initially analyzed in two ways: including signs and using unsigned values. Because the latter method revealed similar but slightly more conservative results, it will not be discussed further. The former method allows for discussion of underestimation and overestimation differences. For example, a prediction accuracy of 5 would represent a slight overestimation of one's performance and a prediction accuracy of -5 would represent an underestimation of one's performance by the same amount.

Levels of prediction

A three-way analysis of variance (ANOVA) was conducted to determine whether the two age groups differed significantly in the actual numerical predictions they made. The young and middle-aged adults did not differ significantly, $F(1, 30) = 1.24$, $p = .27$, in the absolute levels of their predictions for any of the levels of exposure on either text, with overall mean predictions of 21.91 and 20.57, respectively. Therefore, any differences in prediction accuracy did not result from one group predicting more conservatively than the other. Participants predicted at higher levels for the familiar text ($M = 23.6$, $SD = 4.2$) than for the unfamiliar text ($M = 19.0$, $SD = 5.4$), $F(1, 30) = 75.94$, $p < .01$. Furthermore, participants predicted at higher levels at the title ($M = 22.0$, $SD = 4.1$) and summary phases ($M = 22.6$, $SD = 4.5$) than at the scan phase ($M = 19.3$, $SD = 6.0$), $F(2, 60) = 19.96$, $p < .01$. Both the decline in levels of prediction from the first to the second phases and the increase in levels of prediction from the second to the third phases were found to be significant at the .01 level by a Tukey HSD test. There was no significant difference in levels of prediction between the first and third phases.

Finally, an interaction between familiarity and level of exposure revealed that participants' predictions were equivalent for all exposure levels of the familiar text, but they dropped at the second, postscan, phase for the unfamiliar text, $F(2, 60) = 18.51$, $p < .01$. This interaction between familiarity and level of exposure can be seen in Figure 1. The drop in predictions indicates that participants from both age groups lost confidence in their ability to remember the unfamiliar material after a certain amount of exposure, but with increased exposure they regained their confidence. This did not occur for the familiar material.

Prediction accuracy main effects

A $2 \times 2 \times 3$ ANOVA representing Age (between) $\times$ Familiarity (within) $\times$ Level of Exposure (within), was conducted to test for the effects of these variables on prediction accuracy. In support of our prediction, younger adults overestimated their scores by 8.2 ($SD = 7.1$) points, exactly twice as much as middle-aged adults ($M = 4.1$, $SD = 6.0$). Two one-sample t tests indicated that both groups made significant overestimations compared to a perfect prediction accuracy of 0, with the young adults overestimating their performance by 8 points, $t(16) = 6.03$, $p <$

Figure 1. Interaction between familiarity and level of exposure in absolute prediction levels (error bars = SEM)

.01, and the middle-aged adults overestimating their performance by only 4 points, $t(14) = 3.15$, $p < .01$. The younger adults overestimated significantly more than middle-aged adults, $F(1, 30) = 4.68$, $p < .05$.

A significant main effect was found for familiarity, but not in the hypothesized pattern. All participants were expected to be more accurate at predicting their performance for the familiar text than for the unfamiliar text. The results indicated the reverse. Participants were more accurate in their predictions for the unfamiliar text ($M = 5.0$, $SD = 6.7$) than for the familiar text ($M = 7.3$, $SD = 6.7$), $F(1, 30) = 6.43$, $p < .05$. Our interpretation of this unexpected result will become clear in light of the main effect for level of exposure and the interaction between familiarity and level of exposure.

The main effect for level of exposure did partially support the prediction. Participants were expected to increase in prediction accuracy as the amount of exposure increased across trials. As predicted, participants did increase in prediction accuracy from the title phase ($M = 6.9$, $SD = 6.7$) to the scan phase ($M = 4.1$, $SD = 7.1$); however, they decreased in prediction accuracy from the scan phase to the summary phase ($M = 7.5$, $SD = 6.3$), $F(2, 60) = 21.24$, $p < .01$. Furthermore, the increase in prediction accuracy from the title to the scan phase and the decrease in prediction accuracy from the scan to the summary phase were both significant at the .01 level, as indicated by a Tukey HSD test. However, this main effect was qualified by an interaction with familiarity.

Prediction accuracy interactions

It was hypothesized that the superior prediction accuracy of middle-aged adults compared to young adults would be greater for the familiar text than for the unfamiliar text. However, no such interaction was found, $F(1, 30) = 2.35$, $p = .14$. The superior prediction accuracy of the middle-aged adults compared to the young adults was the same for the familiar text as for the unfamiliar text. This effect is shown in Figure 2. Similar to familiarity, an interaction between age and amount of exposure was hypothesized but not found, $F(2, 60) = 1.06$, $p = .35$. The superior prediction accuracy of the middle-aged adults compared to the young adults was the same across the three exposure phases. No three-way interaction among age, familiarity, and level of exposure was hypothesized, and none was found, $F(2, 60) = 1.05$, $p = .35$.

No interaction between familiarity and level of exposure was hypothesized, but the interaction was found to be significant, $F(2, 60) = 19.11$, $p < .01$. The increase in prediction accuracy after scanning the passage occurred only for the unfamiliar text. A substantial difference was found at the scan phase such that prediction accuracy was better for the unfa-

Figure 2. Interaction between age, familiarity, and level of exposure in prediction accuracy (error bars = *SEM*)

miliar text ($M = 1.6$, $SD = 6.4$) than for the familiar text ($M = 6.5$, $SD = 6.9$), $F(1, 30) = 23.31$, $p < .01$. The graph of the relationship between age, familiarity, and level of exposure (Figure 2) shows that the drop in prediction accuracy for the unfamiliar text at the second level of exposure probably was responsible for the main effects of familiarity and level of exposure.

Memory scores

As predicted, middle-aged adults ($M = 16.5$, $SD = 4.8$) performed significantly better on the memory test than did the younger adults ($M = 13.7$, $SD = 4.5$), $F(1, 30) = 4.40$, $p < .05$. Also as expected, memory scores were higher on the test of the familiar text ($M = 16.2$, $SD = 5.4$) than on the test of the unfamiliar text ($M = 14.1$, $SD = 4.1$), $F(1, 30) = 5.13$, $p < .05$. However, there was no significant interaction between age and familiarity, $F(1, 30) = 1.41$, $p = .24$. The superiority of the scores for the familiar text compared to the unfamiliar text was the same for both age groups.

MIA scores

Finally, although differences have been found between college students and elderly adults on several factors of the MIA, participants from the two age groups in this study produced very similar scores on the MIA factors tested. A two-way ANOVA investigating age and MIA metamemory scores found no significant main effect for age, indicating as predicted that the two groups held similar beliefs about their memories. There was a significant interaction between MIA factor and age, $F(4, 120) = 4.00, p < .01$. This difference was probably elicited by age differences on the Change factor. The younger adults saw their memories as more stable across time, as indicated by higher Change scores ($M = 13.9, SD = 2.5$) than did the middle-aged adults ($M = 10.7, SD = 3.0$), $F(1, 147) = 16.89, p < .05$. Thus, the finding that middle-aged adults have similar confidence in their memories as younger adults, as indicated by their similar Capacity scores (young adults, $M = 12.8, SD = 2.6$; middle-aged adults, $M = 13.3, SD = 2.3$), is complicated by the finding that they were more likely to see their memories as subject to change, and particularly to decline, with age. We suggest that the middle-aged adults may be concerned about rumors that memory declines with age, but as a result of their daily experiences with their memories they do not yet see themselves as significantly deficient, at least no more so than do younger adults.

Correlational analyses of MIA and behavior

Correlational analyses were conducted to look at the relationship between MIA scores and behavior, in terms of both actual memory scores and prediction accuracy scores. A composite prediction accuracy score was obtained for each participant by averaging across the six separate prediction accuracy scores. A Pearson correlation was conducted between this overall prediction accuracy score and each of the five MIA factors. The Capacity factor correlation did approach significance, $r(30) = -.32, r_{\text{critical}} = -.349, p = .05$, indicating a trend for lower prediction accuracy scores (i.e., better prediction accuracy) in participants rating their memory capacities higher. Although this trend makes sense in light of the relationship that has been drawn between the Capacity factor and memory self-efficacy (Hertzog et al., 1989, 1990), neither the Change ($r = -.06$) nor the Locus ($r = -.04$) factors, also implicated in memory self-efficacy, even approached significant correlations. The Task ($r = -.09$) and Strategy ($r = .04$) factors also did not produce significant correlations. Prediction accuracy for each of the two texts also did not correlate significantly with any of the MIA factors. A Pearson correlation between the MIA and the memory test scores found significant correlations between scores on both the familiar test, $r(30) = .50, p <$

.01, and the unfamiliar test, $r(30) = .37$, $p < .05$, and scores on the Capacity factor of the MIA, suggesting that this measure was a fairly accurate indicator of memory ability for these adults on this task.

DISCUSSION

The most important finding in this study is the superiority of middle-aged adults compared to younger adults at predicting their performance on tests. One of the primary explanations for age-related declines in metamemory performance is that elderly adults may not be actively using their metamemories in the same way that young adults do. Middle-aged adults, on the other hand, have everyday metamemory requirements similar to those of younger adults, in that they need to monitor their performance on a daily basis. In fact, middle-aged adults may be required to use their metamemories more than younger adults. Younger adults in college have many opportunities to make judgments on their performance, but they can also rely on others, such as teachers, to make the judgments for them. Middle-aged adults are expected to devise their own ways of monitoring their performance because they do not get back tests and grades. Another explanation for why middle-aged adults were better predictors than young adults is that, by virtue of age, middle-aged adults have more experience at using their memories than do younger adults. Further examination revealed that the differences in prediction accuracy between the two age groups did not result from differences in beliefs about how well they would perform because the two groups made similar predictions. Instead, the differences in prediction accuracy seemed to stem from differences in actual performance levels, which were higher for middle-aged adults than for younger adults.

The present findings reflect an important step in the area of metamemory and aging. These findings clearly indicate that a simple downward-sloping linear function cannot account for the change in metamemory skills from young adulthood through old age. A curvilinear function, as proposed by Fingerman and Perlmutter (1994), is more consistent with the finding that metamemory does not simply decline with age. This curvilinear function takes into account both the physiological deterioration that can lead to declines in cognitive ability and the experience in using memory management skills that can enhance cognitive ability.

Whereas the results clearly supported the prediction for age, the main effect for familiarity was found to be the inverse of what was hypothesized. In opposition to previous findings in the literature, we found that participants were more accurate at predicting for the unfamiliar text than for the familiar text. Furthermore, a significant interaction between

familiarity and level of exposure indicated an increase in prediction accuracy only at the second level of exposure, or scan phase, and only for the unfamiliar text. Apparently, participants had too little information after reading just the title of the texts to distinguish accurately between familiar and unfamiliar information, whereas after they scanned the texts the distinction became clear. At this point participants drastically lowered their expectations of their performance, as is evident from the low mean prediction for the unfamiliar text at the second level of exposure compared to the means for the other five predictions (Figure 1).

This finding can also be explained in terms of confidence. Whereas at the title phase participants from both age groups were confident about their memories, they lost confidence at the scan phase. The lack of confidence at this level occurs for the unfamiliar text more than for the familiar text, possibly because the participant realized that the information was unfamiliar and that he or she didn't have time to absorb it during the quick scan. At the third level of exposure, participants regained their confidence for the unfamiliar material and raised their predictions even beyond the levels found at the title phase. Possibly the act of writing a summary creates a rebound effect, convincing subjects that they have increased their memory of the material and luring them into an overly high sense of confidence.¹ These differences suggest an important relationship between familiarity, level of exposure, and confidence as they affect prediction accuracy.

As indicated by the overall levels of prediction and by similar scores on the Capacity factor of the MIA, the confidence of the two groups in their current memory abilities were, as predicted, very similar. The only factor on which age differences did appear was the Change factor. This finding is important in relation to previous findings of age-related differences between young and elderly adults on all five of the factors examined in this study. Apparently, middle-aged adults are similar to young adults in their belief about their memory with the exception that middle-aged adults, like elderly adults, believe their memories will eventually decline with age, which young adults do not believe. Although it is important to examine participants' beliefs about their memory, it must be noted that the MIA scores, with the possible exception of the Capacity factor, did not bear any significant relation to participants' ability to predict accurately. Thus, memory self-efficacy may be a good indicator of predictive ability, although the results of this study only weakly support this conclusion.

Another issue associated with confidence is that of overestimation versus underestimation. Both groups in this study overestimated their actual performance, and the similar absolute levels of prediction indi-

cate that the confidence level was the same across the two groups. As predicted, the difference in overestimation was caused largely by the higher memory scores earned by the older group. The question remains whether differences in prediction accuracy that are generated by differences in actual memory scores really indicate metamemorial differences, as compared to prediction accuracy differences caused by similar memory scores and differences in absolute prediction levels. We believe that both cases are examples of metamemorial differences. The findings presented here, representing metamemory of the former kind, suggest that the middle-aged adults were more realistic in their confidence, overestimating their performance only slightly, whereas the younger adults exaggerated this tendency.

The questions of whether younger adults actually made predictions based on their perceptions of their own abilities raises the issue of motivation as a possible confound in this study. Because the middle-aged adult population was recruited strictly on a volunteer basis, they may have been more highly motivated to perform well than young adult population, all of whom received credit through an introductory psychology course. Furthermore, middle-aged adults, both in general and particularly the ones who participated in this study, appear to be greatly interested in the topic of memory because this is the point in life when people begin having serious concerns about memory loss. The concern of this age group was illustrated by their high Change scores compared to the young adults, as well as in casual preexperiment and postexperiment conversation. It is possible that their better performance on the tests and their superior prediction accuracy could be attributed in part to their interest in testing their memories and in finding ways to improve their memory abilities if they start to decline. Unless middle-aged (and elderly) adults can be convinced that their memories are not destined to deteriorate, there may be no way to eliminate the confound of concern about and interest in one's memory.

In light of the findings of this study, some of the concerns of middle-aged adults should be alleviated. Middle-aged adults not only recalled better but were also better judges of their memories than were younger adults. These findings should help to dispel the rumor that memory skills necessarily deteriorate with age, and may help start a new rumor: that middle-aged adults have good metamemory skills and can expect to use them in ways that enhance their performance on memory-related tasks. The findings may also have implications for programs designed to help the elderly improve their memories. Specifically, such programs may include exercises in using metamemory skills as a way of offsetting declines in memory ability.

A key point that has not yet been addressed by the majority of metamemory and aging researchers is the role of formal education in the development of metamemory. We attempted to control for level of education by specifying a requirement of between 1 and 6 years of post-high school education (some college education, but not above the master's-degree level) for the middle-aged adults, but some factors remain less amenable to control. The middle-aged adults in this study had on average approximately 4.5 years more education than the younger adults. An examination of the effects of education was not possible because of the informality of the education measure. Specifically, it was not clear whether the middle-aged adults were referring to full-time or part-time schooling when they indicated their years of education. Although it is likely that education does play an important role in prediction accuracy, the two age groups in this study may be more similar than they appear on the surface if one considers their potential similarity in terms of the final education level they are likely to attain. That is, the young adults in this study may well continue their education to the same level that has already been reached by the middle-aged adults examined here. However, future research should attempt to examine the effects of age and education on prediction accuracy more systematically.

Unfortunately, it is difficult to control for education, especially considering its entangled relationship with experience. For example, should graduate school be considered the same kind of education that is being received by the college students, or should it be considered a more autonomous kind of life experience similar to what the majority of professional middle-aged adults are engaged in on a daily basis? One possible solution would be to examine nontraditional, full-time middle-aged college students in comparison to traditional young adult students. This would equalize current life experiences and educational level between the two groups while allowing an examination of the effects of age and previous life experiences on metamemory ability.

A second potential solution to the confound of education would be to examine the pattern of metamemorial development from young to middle-aged adulthood in participants without a college education. The pattern could then be compared to a similar pattern of development for participants with more education. If improvements in metamemorial ability with age are strongly influenced by education, then such improvements should diminish or even disappear in the pattern for uneducated participants. It is possible that metamemory may deteriorate with age in the absence of education, although this does not seem likely considering the arguments given in this study for superior metamemory in middle age. Even without education, middle-aged

adults have more world experience and more experience with their own memory. A worthy goal in future research in aging and metamemory is to further disentangle the effects of age and education on the management of all one's cognitive resources.

Appendix A. MIA instrument

The questions are listed by factor, with numbers indicating their order when administered.

Directions: There are no right or wrong answers to these questions because people are different. Please take your time and answer *each* of these questions to the best of your ability.

Each question is followed by five choices. Draw a circle around the letter corresponding to your choice. Mark *only* one letter for each statement.

Keep these points in mind:

- (a) Answer *every* question, even if it doesn't seem to apply to you very well.
- (b) Answer as honestly as you can what is true for *you*. Please do not mark something because it seems like the "right thing to say."
- (c) Answer each question as close as possible to what you usually do or think. Don't worry if the estimate is not exact, or if there are some exceptions.

Strategy Factor:

3. When you have not finished reading a book or magazine, do you somehow note the place where you have stopped?	a. never
b. rarely
c. sometimes
d. often
e. always
12. When you try to remember people you have met, do you associate names and faces?	a. never
b. rarely
c. sometimes
d. often
e. always
17. Do you try to relate something you want to remember to something else hoping that this will increase the likelihood of your remembering later?	a. never
b. rarely
c. sometimes
d. often
e. always
18. Do you try to concentrate hard on something you want to remember?	a. never
b. rarely
c. sometimes
d. often
e. always

Task Factor:

1. For most people, facts that are interesting are easier to remember than facts that are not.	a. agree strongly
b. agree
c. undecided
d. disagree
e. disagree strongly
6. For most people, it is easier to remember information they need to use immediately than information they will not use for a long time.	a. agree strongly
b. agree
c. undecided
d. disagree
e. disagree strongly
7. Most people find it easier to remember directions to places they want or need to go than to places they know they will never be going.	a. agree strongly
b. agree
c. undecided
d. disagree
e. disagree strongly
13. Familiar things are easier to remember than unfamiliar things.	a. agree strongly
b. agree
c. undecided
d. disagree
e. disagree strongly

Capacity Factor:

2. I am good at remembering names.	a. agree strongly
b. agree
c. undecided
d. disagree
e. disagree strongly
8. I am poor at remembering trivia.	a. agree strongly
b. agree
c. undecided
d. disagree
e. disagree strongly
15. I am good at remembering the places I have been.	a. agree strongly
b. agree
c. undecided
d. disagree
e. disagree strongly
19. After I have read a book I have no difficulty remembering factual information from it.	a. agree strongly
b. agree
c. undecided
d. disagree
e. disagree strongly

Change Factor:

4. I'm less efficient at remembering things now than I used to be.	a. agree strongly
b. agree
c. undecided
d. disagree
e. disagree strongly
5. I am just as good at remembering as I ever was.	a. agree strongly
b. agree
c. undecided
d. disagree
e. disagree strongly
9. Compared to 10 years ago, I am much worse at remembering titles of books, films, or plays.	a. agree strongly
b. agree
c. undecided
d. disagree
e. disagree strongly
11. My memory for important events has improved over the last 10 years.	a. agree strongly
b. agree
c. undecided
d. disagree
e. disagree strongly

Locus Factor:

10. I have little control over my memory ability.	a. agree strongly
b. agree
c. undecided
d. disagree
e. disagree strongly
14. As long as I exercise my memory it will not decline.	a. agree strongly
b. agree
c. undecided
d. disagree
e. disagree strongly
16. I know if I keep using my memory I will never lose it.	a. agree strongly
b. agree
c. undecided
d. disagree
e. disagree strongly
20. No matter how hard a person works on his/her memory, it cannot be improved very much.	a. agree strongly
b. agree
c. undecided
d. disagree
e. disagree strongly

Appendix B. Familiar and unfamiliar texts

New York City: A Brisk Walk Down Broadway Reveals Some Spectacular Sites

Lincoln Center, just off Broadway, is the cultural anchor of the chic upper west side of Manhattan Island. Surrounding its central fountain are three major concert halls at which one can see top-billing symphonies, ballets, and operas performed. The Center lies at the bottom left corner of Central Park, home of the prestigious American Museum of Natural History. The park is a beautiful spot for daytime wandering, containing an extensive playground for kids, an old fashioned carousel, and secluded, cobblestone walkways that duck under picturesque bridges. However, tourists are warned not to walk through the park at night. Continuing south along Broadway, one passes within a block of several well-known buildings. Rockefeller Center is a complex of 19 buildings, supplemented by the outdoor ice rink often shown in movies. The rink, located on the lower plaza, is a prime spot for people-watching both in summer, when it is surrounded by café tables, and in the winter, when the skating rink itself comes alive and the ceremonious Christmas tree is lit in December. Also in the vicinity of Rockefeller Center is St. Patrick's, the Roman Catholic cathedral of New York. The gothic-style structure was made of marble and stone and dedicated to the patron saint of the Irish, one of New York's principal ethnic groups.

From Old to New: Visiting the Town Squares in Prague, Czech Republic

The Old Town Square, which peaked in growth in the 12th Century, lies at the end of Royal Way, the traditional coronation route of the Czech kings. While its original atmosphere encompassed music, art, and other creative crafts, it was not always such a place of festivity. During the 15th Century, it was the focal point of conflict between the Czech Hussites and the German Catholics. The Tyn Church in the square is a testimony to this conflict, as it once bore the golden ceremonial cup symbolic of the Hussites. However, following their defeat by the Catholic Habsburgs, the cup was melted down and made into the halo for a Madonna figure. Opposite the church is the Old Town Hall, which has served as the center of administration since 1338, and adjacent to it, the 200-foot Town Hall tower, built in the 14th Century. Also in this square is the Jan Hus monument, dedicated 500 years after Hus, a religious and national symbol for the Czechs, was burned at the stake in Germany. For the less historically-inclined, the 15th Century Astronomical clock is a favorite site among tourists. If one can manage to find space in the square when the clock is activated, which is not very common, a treat is definitely in store. A skeleton begins by tolling a death knell and turning an hour-glass upside down, while to his right, a Turk nods his head. The 12 Apostles then parade across the face of the clock, while a rooster flaps its wings and crows just as the final hour strikes.

Notes

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