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Influences of Age and Perceived Activity Difficulty on Activity Recall

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After they performed each of a series of activities, older and younger adults were asked to rate the difficulty of the activity. Recall of the activities was later tested. Older adults tended to remember those activities they perceived to be less difficult, whereas younger adults tended to remember those activities they perceived to be more difficult. Thus, when more cognitive effort was required to perform an activity, older adults tended to have difficulty later remembering the activity. Difficult activities are hypothesized to tax limited processing resources and induce anxiety in older adults, preventing successful encoding.

ONE type of memory that is essential to both younger and older adults is memory for activities that they have performed (Cavanaugh, Grady, & Perlmutter, 1983; Earles, 1996; Smith & Earles, 1996). Memory for things that one has done, such as taking medicine, putting the car keys in a drawer, or sending a card to a friend, is essential for everyday functioning. Thus, a decline in activity memory with increased age is a major source of concern for older adults.

One method that has been used to examine age differences in memory for performed tasks is to ask research participants to describe activities (e.g., cognitive tasks such as the subscales of the WAIS) that they have performed in the lab (e.g., Earles & Coon, 1994; Kausler & Lichty, 1988). When asked to recall activities that they have performed in the lab, older adults do not remember the activities as well as younger adults do (e.g., Bromley, 1958; Earles, 1996; Kausler & Lichty, 1988).

There is, however, variability in age differences in memory for different activities (Kausler, 1994). Kausler noted that determining why age differences are smaller for memory for some activities than for other activities has proven to be difficult. Although there is great variability in recall of different activities and in age differences in recall of different activities, it is not clear which features of the activities are responsible for this variation. One important feature of an activity is its level of difficulty.

The present experiment was designed to investigate the effects of perceived task difficulty on age differences in activity memory. Self-ratings of task difficulty were used in an attempt to determine whether individual differences in perceptions of the activities lead to differential recall. The effects of self-perceived task difficulty, task desirability, and time pressure on age differences in activity memory were investigated. Task desirability and time pressure were included because they may be related to the perception of task difficulty.

There are two alternative hypotheses for the effects of perceived task difficulty on activity memory. First, difficult activities may lead to a stronger memory trace, as suggested by Kausler and Hakami (1983), who found a significantly smaller age difference in memory for problem-solving tasks than for less cognitively demanding tasks. They suggested that the memory traces of more cognitively demanding tasks are more distinctive than those of less demanding tasks. When performing a difficult task, a strong memory trace may be generated through performance. Younger adults may use self-generated memory strategies, and, thus, may not need the tasks to be difficult in order to form a strong memory trace. Older adults, however, may rely on the task-generated memory trace produced by the performance of difficult tasks because older adults are less likely to use self-generated memory strategies.

Support for the hypothesis that age differences in memory are smaller for effortful tasks, however, is limited. First, only three problem-solving tasks were used by Kausler and Hakami (1983). Second, Lichty, Kausler, and Martinez (1986) found that age differences in memory for cognitively demanding tasks were *not* smaller than age differences in memory for noncognitively demanding tasks. Thus, previous research has not found clear evidence for an effect of cognitive demand on activity memory.

An alternative hypothesis for the effects of task difficulty on activity memory is that difficult activities may tax the processing resources of older adults. When performing a difficult task, therefore, older adults may not have the necessary resources available to form a memory trace of the activity. For example, older adults may not have resources available to associate activities with the contexts in which they are performed, leading to worse memory for those difficult activities.

If older adults remembered their more difficult activities better than their less difficult activities, they would provide evidence for the hypothesis that the performance of a difficult task leads to a stronger memory trace than does the performance of a less difficult task. The difference in recall between more and less difficult activities would be expected to be small for younger adults, because they can use

self-generated strategies to remember both easy and difficult tasks, and because they have adequate resources to process even the most difficult tasks. We expected, however, that the older adults would remember the less difficult tasks better than the more difficult tasks; such a finding would lend support to the hypothesis that the performance of a difficult task requires all of an older adult's available resources, preventing him or her from successfully encoding the activities.

In an effort to identify those features of activities that affect age differences in activity memory, we attempted to examine the effects of activity type on age differences in activity memory. Four broad classes of activities were used. Recall of perceptual speed activities, knowledge activities (e.g., vocabulary tests), memory activities, and problem-solving activities was compared.

METHOD

Participants

Forty undergraduate students (ages 19–26 years) from the Georgia Institute of Technology were given course credit for their participation in this study. Forty community-dwelling older adults (ages 57–87 years) were recruited through newspaper advertisements, and they were paid $10 for their participation. Participant characteristics are shown in Table 1. There was no significant age group difference in education level or in self-rated health, Fs(1,78) < 1. Older adults, however, reported taking significantly more medications than did younger adults, $F(1,78) = 15.31$, $MSE = 2.12$, $p < .05$. Older adults also scored significantly higher than younger adults on the Shipley (1986) Vocabulary test, $F(1,78) = 25.47$, $MSE = 14.86$, $p < .05$.

Materials

The participants performed twenty activities. There were five activities involving memory: (a) Size Judgment Span, (b) Listening Span, (c) Computation Span, (d) Backward Digit Span, and (e) Paired Associate Memory. The Size Judgment Span task was an adapted version of the task developed by Cherry and Park (1993). Participants heard lists of two to five words that named objects that they were then instructed to list in order of size, from the smallest object to the largest. Participants received two trials for each number of words. The Listening Span and Computation Span tasks were similar to tasks used by Salthouse and Babcock (1991). In the Listening Span task, participants heard a series of sentences. After each sentence, participants answered a simple question about the sentence while simultaneously trying to remember the last word from each sentence. The series of sentences ranged in size from one to four sentences, with one trial for each length. The Computation Span task was similar to the Listening Span task, except that participants saw a series of arithmetic problems. After each problem was presented, they solved the problem, while simultaneously remembering the last digit from the problem. In the WAIS-R Backward Digit Span task (Wechsler, 1981), participants heard strings of digits that they repeated in reverse order; participants received one trial each for strings of three to eight digits. In the Paired Associate Memory task, participants studied a list of eight pairs of words. They were then given the first member of each pair and were asked to recall the word that went with it.

Table 1. Participant Characteristics

	Younger Adults		Older Adults	
Measure	Mean	*SD*	Mean	*SD*
Age (years)	20.64	1.48	67.10	6.34
Education (years)	14.50	1.43	14.64	3.04
Vocabulary[a]	30.25	3.59	34.60	4.11
Health[b]	3.30	.56	3.28	.60
Medications[c]	.55	.99	1.83	1.81

[a]The vocabulary score is the number correct out of 40 on the Shipley (1986) vocabulary test.

[b]The health score reflects participants' responses to the question "How do you rate your health at the present time?" (4 = excellent, 3 = good, 2 = fair, 1 = poor). This question was taken from the Duke University (1978) OARS Multidimensional Functional Assessment Questionnaire.

[c]Medications are the number of prescription medications currently being taken.

There were five activities involving speed: (a) Digit Copy, (b) Boxes, (c) Digit Symbol, (d) Letter Comparison, and (e) Multiplication. In the Digit Copy task (Salthouse, 1994), participants received a sheet of paper presenting 200 digits from 1 to 9, inclusive. Each digit was placed in the top of a box, while the bottom of each box was left blank. Participants copied as many digits as possible from the top of the box to the bottom of the box. In the Boxes task (Salthouse, 1994), participants received two pages, each of which contained 100 boxes that were missing one side. Participants completed as many boxes as possible by drawing a line to close the missing side of each box. In the WAIS-R Digit Symbol Substitution task (Wechsler, 1981), participants were given a key in which the digits 1 through 9 were each matched with a simple figure. They received a page containing digits and wrote the symbol that was associated with each digit. In the Letter Comparison task (Salthouse & Babcock, 1991), participants decided whether pairs of letter strings, each of which consisted of three or nine letters, were the same or different. They wrote an "S" on the line between the pairs if they were the same and a "D" if the pairs were different. The Multiplication task consisted of 18 multiplication problems that the participants were asked to solve.

There were five activities involving knowledge: (a) Picture Integration, (b) Shipley Vocabulary, (c) Definitions, (d) Geography, and (e) Current Events. In the Picture Integration task, participants received 10 pairs of concrete objects and were asked to generate a sentence that integrated the two pictures in each pair. In the Shipley (1986) Vocabulary task, participants received 20 words and were asked to select and circle which of four other words was most similar in meaning to each of the 20 given words. In the Definitions task, participants were asked to define 10 words. The Geography task consisted of 10 questions about geography; participants were asked to choose the best of four multiple-choice responses for each question. The Current Events task asked participants to write answers for 10 questions about events in the news.

There were five problem-solving activities: (a) Remote

Associations, (b) WAIS-R Similarities, (c) Series Completion, (d) Relational Reasoning, and (e) Progressive Matrices. In the Remote Associations task (Mednick & Mednick, 1967), participants received five sets of three words each and had to generate a fourth word that linked the other three (e.g., base, snow, dance = ball). In the WAIS-R Similarities task (Wechsler, 1981), participants were given eight pairs of words. For each pair, they described how the two words were related. The items for the Series Completion task were taken from the Shipley Institute of Living Test (1986). There were 12 series of words, numbers, or letters, and participants were asked to provide the next word, number, or letter in each series. In the Relational Reasoning task (Salthouse, Mitchell, Skovronek, & Babcock, 1989), participants received eight word problems. Each word problem consisted of statements describing how pairs of letters were related. Participants were then asked to decide what effect a given change for one letter would have on another letter. For example, participants were told that B and C do the opposite, and A and B do the same. They were then asked, "If A increases, will C decrease?" The Progressive Matrices task consisted of three items from Raven's (1962) Progressive Matrices test. For each problem, participants were shown an incomplete pattern consisting of eight figures. The participant was shown eight other figures and was asked to choose the one that would complete the pattern made by the original eight figures.

Procedure

Participants were given 2 min to perform each of the 20 activities. They were not told that they would later be asked to recall the activities. There were two random presentation orders; half of the participants received each order.

Participants in each age group were assigned in equal numbers to each of two conditions. Following each activity, participants in Condition 1 received 1 min to answer a series of questions. First, they were asked to answer the question "How well do you think you did on the task that you just performed?" using a scale of 1 (very poor) to 5 (very well). They were then asked to answer the question "How well do you think you did compared to other people your age?" using a scale of 1 (much below average) to 5 (much above average). The third question asked them to answer "How much did you like or dislike the task that you just performed?" using a scale of 1 (disliked very much) to 5 (liked very much). The fourth question was, "Do you feel like you had enough time to perform this task?" (1 = no, 2 = yes). They were then asked, "What was your favorite thing about this task?" and "What was your least favorite thing about this task?" Participants in Condition 2 did not answer questions, but instead performed each activity for an additional 1 min. Condition 2 was included to ensure that answering the questions about activities did not influence the pattern of age relations.

Immediately after they had performed all of the 20 activities, participants were given as much time as they needed to write a description of each activity. An item was scored as correct if the activity could be identified from the description. The scorer was blind to the age of the participants. The scorer's consistency in identifying activities based on participants' descriptions was assessed in a previous study (Earles, 1996), in which participants performed 48 activities during encoding. Activity descriptions from 20 participants in that study were scored by the rater from the present study and a second rater. Of the 960 decisions about whether the participant recalled a particular activity, the raters had only three disagreements. Because of this high interrater agreement, there was little reason to be concerned about the subjectivity of the scores. Thus, in the present study only one scorer was used to evaluate the participant responses.

Results

Age Differences and Activity Type

The 20 activities were divided into four groups: knowledge tasks, memory tasks, speed tasks, and problem-solving tasks. The mean number of items correctly recalled for each type of activity for each age group is shown in Table 2.

A 2 × 2 × 4 (Age × Condition × Activity type) analysis of variance (ANOVA) revealed that younger adults recalled significantly more tasks than older adults, $F(1,76) = 64.94$, $MSE = 2.37$, $p < .05$. There was also a significant main effect of activity type, $F(3,228) = 22.13$, $MSE = 1.17$, $p < .05$. Participants recalled significantly more knowledge tasks than memory tasks, $F(1,79) = 16.24$, $MSE = 3.0$, $p < .05$; significantly more speed than memory tasks, $F(1,79) = 28.07$, $MSE = 1.06$, $p < .05$; and significantly more knowledge than problem-solving tasks, $F(1,79) = 43.86$, $MSE = 1.03$, $p < .05$. Recall by participants in Condition 1 (who rated each task) was not significantly different from recall by participants in Condition 2 (who did not rate each task). Thus, there was no significant effect of answering questions on recall of the activities for either younger or older adults. There were no significant interactions of age and condition, $F(1,76) < 1$; age and item type, $F(3,228) = 1.95$, $MSE = 1.17$, $p > .05$; condition and item type, $F(3,228) < 1$; or age, condition, and item type, $F(3,288) = 1.31$, $MSE = 1.17$, $p > .05$.

Activity Difficulty, Desirability, and Time Pressure

The relation between participants' answers to four of the questions about the activities and their memories of those

Table 2. Mean Activity Recall Performance

	Younger Adults		Older Adults	
Task Type	Mean	*SD*	Mean	*SD*
Total (all tasks)	13.45	2.25	7.90	3.71
Speed[a]	3.93	0.83	2.45	1.32
Knowledge[b]	3.95	1.04	2.28	1.58
Memory[c]	3.08	1.21	1.58	1.24
Problem-solving[d]	2.50	1.22	1.60	1.08

[a]Speed tasks were Digit Copy, Boxes, Digit Symbol, Letter Comparison, and Multiplication.

[b]Knowledge tasks were Picture Integration, Shipley Vocabulary, Definitions, Geography, and Current Events.

[c]Memory tasks were Size Judgment Span, Listening Span, Computation Span, Backward Digit Span, and Paired Associate Memory.

[d]Problem solving tasks were Remote Associations, WAIS-R Similarities, Series Completion, Relational Reasoning, and Progressive Matrices.

activities was assessed. The questions that were used were: "How well do you think you did on the task that you just performed?"; "How well do you think you did compared to other people your age?"; "How much did you like or dislike the task that you just performed?"; and "Do you feel like you had enough time to perform this task?" For each participant in Condition 1, an average response for each question was computed for those activities that the participant recalled. An average response for each question was also computed for those activities that the participant did not recall. For each participant, these averages were transformed into z scores, which were used to make the scales for the questions the same. For each participant, a difference score was computed for each question by subtracting the z score for responses for the nonrecalled activities from the z score for responses for the recalled activities. The mean difference scores, broken down by age group, are shown in Figure 1.

A 2 × 4 (Age × Question) ANOVA was conducted. This analysis revealed a significant main effect of age on the difference in overall attitudes toward those activities that were later recalled and those activities that were not, $F(1,38) = 6.28$, $MSE = 1.94$, $p < .05$. As can be seen in Figure 1, older adults tended to give more positive ratings for activities that they later recalled, whereas younger adults tended to give more positive ratings for activities they did not later recall. Thus, older adults were more likely to recall easy activities and younger adults were more likely to recall difficult activities. There was no significant main effect of question type, $F(1,114) < 1$, and there was no significant interaction, $F(1,114) < 1$. The pattern of age differences was similar for all of the questions. Older adults tended to give higher ratings for those items that they later recalled, whereas younger adults tended to give higher ratings for those items that they later did not recall.

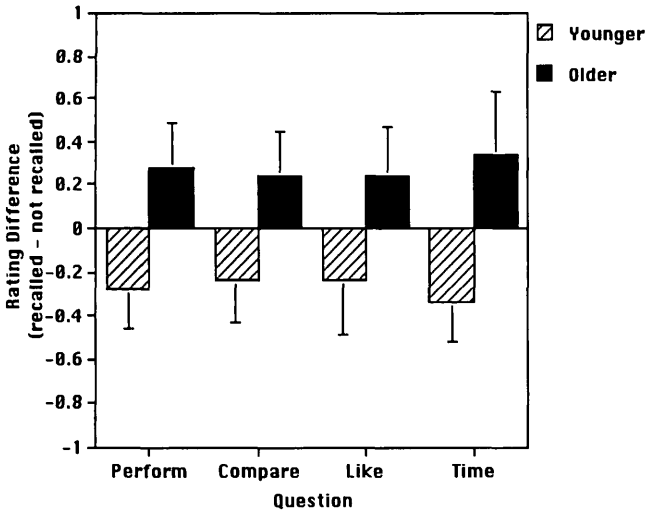

Figure 1. Average difference between z scores of ratings for activities that were recalled and activities that were not recalled for the four questions for each age group. Perform = "How well do you think you did on the task that you just performed?" Compare = "How well do you think you did compared to other people your age?" Like = "How much did you like or dislike the task that you just performed?" Time = "Do you feel like you had enough time to perform this task?" The bars represent standard errors.

Discussion

Because activity memory is so important for successful functioning in the environment, and because activity memory is poorer for older than for younger adults, it is important to determine the mechanisms for age differences in activity memory. The results of the present study showed that a simple classification of activities into broad categories such as knowledge tasks, memory tasks, and speed tasks is insufficient to reveal differential age effects in activity memory.

Both younger and older participants actually recalled more of the speed and knowledge activities than the memory and problem-solving activities. Thus, there was no support for the suggestion (Kausler & Hakami, 1983) that problem-solving tasks produce stronger memory traces.

When individual perceptions of activities were assessed, however, an interesting pattern of age effects emerged. When individual perceptions of activities were considered, older adults tended to remember those activities on which they perceived that they performed well and for which they felt little time pressure. Younger adults, on the other hand, tended to remember those activities on which they perceived that they did not perform well and for which they felt more time pressure.

Previous studies have shown that age differences in activity memory are related to an age-related decrease in processing resources (Earles, 1996; Earles & Coon, 1994). The present findings with older adults are consistent with the hypothesis that older adults had few processing resources available beyond those necessary to perform the most difficult tasks. As a result, older adults may have had difficulty forming memory traces of the activities. For example, they may have had difficulty relating difficult tasks to the context in which they were performed, later making these tasks difficult to recall. Younger adults, on the other hand, may have had adequate resources available to process even the most difficult tasks.

The processing-speed account could explain the results of the older adults but it cannot explain why younger adults remembered better those activities they perceived to be more difficult. An additional possible explanation for this pattern of findings is that the younger adults may have had low baseline levels of arousal in the present testing situation. Whitbourne (1976) found that young adults experience lower levels of test anxiety than do older adults. When anxiety is increased in participants who are not already anxious, their performance on memory tests often improves (Dobson & Markham, 1992). Difficult tasks may have increased the arousal of participants. Thus, when the younger adults performed difficult activities in which they felt pressured for time, their arousal levels may have been increased, helping them to remember these activities better.

On the other hand, too much arousal can impair performance (Leon & Revelle, 1985). Higher baseline arousal levels, along with limited processing resources, may have hindered the ability of older adults to remember performed activities, especially when the activities were difficult.

Eysenck (1979) has proposed that task-irrelevant thoughts associated with high levels of arousal result in a reduction of attention to information relevant to task perfor-

mance. Anxious participants may have more task-irrelevant thoughts that interfere with their task performance than do less anxious participants. As task demands increase, anxiety has increasing detrimental effects. Because they are sometimes more anxious than younger adults about task performance (Whitbourne, 1976), older adults may have more task-irrelevant thoughts than younger adults, especially during activities on which they believe they are not performing well. Processing of task-irrelevant information may result in fewer resources being available for task processing. This hypothesis is consistent with previous work showing that older adults have more difficulty than younger adults inhibiting task-irrelevant information (Earles et al., 1997; Hartman & Hasher, 1991).

Task-irrelevant thoughts may not only interfere with task performance, but they may also prevent older adults from encoding cues that would later help them remember the activities. Based on findings in the eyewitness testimony literature, Christianson (1992) proposed that in emotional situations participants tend to focus on the central action but do not attend to other details of the event. Consistent with this hypothesis, Mueller (1979) found that anxiety resulted in shallower processing; he found less elaboration under high-anxiety encoding conditions. It is thus possible that anxiety induced by difficult activities may prevent older adults from encoding enough details of the activities to later recall them. An increase in time pressure would also be expected to increase the anxiety associated with task performance and thus could also hinder the memory performance of older adults.

Therefore, when presented with a difficult task, older adults may use most of their processing resources to perform the task and for task-irrelevant, anxiety-laden thoughts concerning their performance. As a result, they may have few resources available for encoding the activity. It should be noted, however, that in the present study there were no direct measures of anxiety, and some studies have not shown an age-related increase in test anxiety (see Kausler, 1990). In order to clarify the potential relations among age, anxiety, and activity memory, further work needs to be conducted in which external measures of anxiety are utilized.

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