Journal of Gerontology: PSYCHOLOGICAL SCIENCES
1994, Vol. 49, No. 1, P32–P34

Adult Age Differences in Long-term Memory for Performed Activities

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Participants in two studies conducted by Salthouse (in press) were called 2 to 182 days after participation and asked to describe the activities that they had performed in the previous study. Hierarchical regression analyses were used to examine the prediction of activity recall from age, speed, and retention interval. Overall, age was associated with 20% of the variance in activity recall, and retention interval was associated with 19%, but there was no significant interaction of age and retention interval. When perceptual speed was entered into the regression equation before age, the age-related variance was reduced by 70%. A small, but statistically significant, amount of age-related variance in activity memory remained after controlling for speed and retention interval.

MEMORY for performed activities (e.g., cognitive tests) has been found to decrease with increased age when memory is assessed immediately after performance (e.g., Bromley, 1958; Kausler & Lichty, 1988). Kausler and Lichty hypothesize that subjects do not use rehearsal strategies to learn activities, so a memory trace is automatically formed during encoding. Age differences are hypothesized to occur because effort, such as strategy use, is required during retrieval, and older adults are less efficient at this effortful retrieval.

This hypothesis leads to the expectation that a large portion of the age-related variance in activity recall will be associated with an index of processing efficiency or effort. One possible index of processing efficiency is the speed of performing simple operations in perceptual speed tests (Salthouse, 1992). Perceptual speed in turn can be decomposed into a sensory-motor aspect and a more cognitive aspect.

One purpose of the current study was to assess whether perceptual speed measures of processing efficiency are associated with age differences in memory for activities. The hierarchical regression method was used because it was assumed that if the age-related variance in recall is greatly reduced when age is entered into the regression equation after another variable, then that variable is probably an important contributor to the relationship between age and recall. If a decline with age in the efficiency of effortful processing contributes to the age differences in activity memory, then perceptual speed, as an index of processing efficiency, should be associated with a large portion of the age-related variance in activity memory.

Other purposes of the current study were to examine longer retention intervals than those investigated in earlier studies of aging and activity memory and to use a continuous age range and regression techniques to evaluate age differences. Kausler and Wiley (1990), using a recognition test, found that older adults forgot some discrete actions after a 24-hour delay, whereas younger adults showed little or no forgetting. However, little is known about the effects of age on the retention of activities over longer intervals. The study presented below examined retention of memory for activities over intervals ranging from 2 days to 6 months.

METHOD

Subjects. — Participants in two studies conducted by Salthouse (in press) were contacted at varying intervals after their participation to determine how much they could remember about the activities they had performed. Subjects in the Salthouse studies had been recruited from newspaper ads, community organizations, and personal connections. An attempt was made to contact all of the adults who had participated in the Salthouse studies. From Study 1, 95 of the 246 original participants were contacted, and 92 agreed to participate in the follow-up study. From Study 2, 85 of the 258 participants were contacted, and 80 agreed to participate. Participation was voluntary, and no monetary compensation was given.

The current sample from Study 1 included 25 adults age 18–39, 33 adults age 40–59, and 34 age 60–87 (M = 51.5, SD = 16.3). The current sample from Study 2 included 23 adults age 18–39, 27 adults age 40–59, and 30 age 60–87 (M = 52.3, SD = 17.5). Sixty-one subjects from Study 1 and 55 from Study 2 were female. (Gender was included as a factor in several of the analyses, but because it was not significant, it is not discussed further.) During the original testing session, subjects rated their health on a scale of 1 (excellent) to 5 (poor), and they also reported the number of years of education completed. The follow-up sample was similar to the complete sample in terms of health (mean health rating for follow-up participants was 2.1 vs 2.0 for nonparticipants) and education (mean number of years of education for the follow-up participants was 14.6 vs 15.1 for nonparticipants).

Procedure. — Participants in the Salthouse (in press) studies were called on the telephone and asked to describe the activities that they performed in the previous study. At original testing, they were unaware that they would later be asked to recall the activities. The adults in Salthouse's Study 2 were called 2 to 34 days after participation. They had previously performed nine activities (i.e., Boxes, Pattern and Letter Comparison, Digit Copy, Digit Symbol Substitution, Associative Memory, Matrix Reasoning, Spatial Rotation, and Memory Search).

Participants in Salthouse's Study 1 were called 96 to 182 days after participation. These adults had previously completed 11 activities (i.e., Boxes, Pattern Comparison, Letter Comparison, Digit Copying, Digit Symbol Substitution, Associative Memory, Matrix Reasoning, Number Series Completion, Name Number Association, Cube Assembly, and Paper Folding). All activities from both studies are described in detail in Salthouse (in press).

The people who agreed to participate in the follow-up study were asked to describe the things they did during the previous study. After the participants described all they could remember about the activities, the experimenter said the name of each activity, and the subject was asked to describe it. The phone conversations, lasting approximately 5 to 10 minutes, were recorded, with the subjects' permission, and were later transcribed for subsequent analyses.

Results

The transcript of each conversation was evaluated by two raters. If the rater could identify the task described by the participant, a point was given for that task. Because of low performance on the free recall portion of the test (i.e., M = 12% of the tasks recalled), subjects were given a point if they recalled the task on their own or only after provision of the task name. Because of the similarity between the Letter and Pattern Comparison tasks, subjects were given one point for recall of either or both tasks. The correlation between raters for the subjects' recall scores was .89, and the ratings were within 1 point on 90% of the scores. A recall score was computed for each subject by taking the average of the scores from the two raters. Each score was then divided by the total number of activities to represent the proportion of activities that were recalled.

A composite motor speed score was computed for each subject using the average of the z-scores of the Boxes and the Digit Copying tasks. (The Boxes task involved drawing lines to complete squares, and the Digit Copying task involved copying digits into boxes.) A composite perceptual speed score was computed using the average of the z-scores for the Letter and Pattern Comparison tasks. (In the comparison tasks, the research participants inspected pairs of three to nine letters or line drawings and decided if the items in each pair were the same or different.) Z-scores were computed using the means and standard deviations from the original complete samples of subjects.

Subjects called at the shorter retention interval recalled an average of 43% of the activities (SD = .22) as compared with 26% (SD = .19) for subjects called at the longer retention interval. The similarity of the tasks at the two retention intervals makes it unlikely that differences in recall are due to task differences. However, because it has been shown that recall performance may be different for different tasks (Cohen, Peterson, & Mantini-Atkinson, 1987), results from each retention interval are presented, followed by combined results.

Correlations were computed between age, activity recall, motor speed, perceptual speed, and retention interval for both retention intervals and for the two intervals combined. The alpha level was set at .05. There was a significant negative correlation between age and activity recall (Short: $r = -.53$; Long: $r = -.47$; Overall; $r = -.45$). The correlation between age and perceptual speed was even higher (Short: $r = -.60$; Long: $r = -.62$; Overall: $r = -.64$), and there was a positive correlation between perceptual speed and recall (Short: $r = .43$; Long: $r = .39$; Overall: $r = .40$). Retention interval was not significantly correlated with age or with speed (i.e., $rs < .09$), so an increase in delay with increased age is not responsible for the negative correlation between age and recall. There was a significant negative correlation between retention interval and recall for the longer interval and for the combined data, but not for the shorter interval (Short: $r = -.10$; Long: $r = -.22$; Overall: $r = -.42$), probably due to the larger range of intervals in the longer interval (SD = 23.9 days) and in the overall data (SD = 64 days) than in the shorter interval (SD = 5.9 days).

Regression analyses were used to examine the prediction of recall from age and retention interval. The results of the analyses are summarized in Table 1. Age was associated with a significant amount of the variance in recall in both retention intervals and overall. Retention interval was associated with a significant amount of the variance in recall for the longer retention interval and overall. (Quadratic effects were not significant with either age or interval, $F < 1$.) There was no significant interaction between age and retention interval ($F < 1$), indicating that age and interval accounted for independent portions of the variance in recall.

The hierarchical regression method was used to examine the possibility that motor and perceptual speed mediate the relationship between age and recall. Because motor speed was considered to be a component of perceptual speed, its effects were examined first. Motor speed was associated with a significant portion of the age-related variance in recall, and perceptual speed was associated with an even larger portion of the age-related variance. There was no significant interaction of age and motor speed or of age and perceptual speed.

Finally, all of the variables were entered into the regression equation in the order of their hypothesized influence. The amount of variance in recall that was associated with age decreased from approximately 20% to 7% when age was added to the regression equation after the addition of both speed measures and retention interval. The combination of all of the variables was associated with approximately 46% of the total variance in activity recall scores.

Discussion

The results of this study suggest that the age differences found in immediate memory for activities (e.g., Kausler & Lichty, 1988) also exist after long retention intervals. Memory for activities decreased over time and with age. Although there was no immediate recall measure, there was no evi-

Table 1. Hierarchical Regression Analyses

	Shorter Retention			Longer Retention			Overall		
	R^2	R^2 Change	F	R^2	R^2 Change	F	R^2	R^2 Change	F
Age	.270		28.81*	.203		22.97*	.195		41.05*
Interval	.017		1.32	.049		4.66*	.188		39.35*
Age	.290	.274	29.69*	.270	.221	26.92*	.392	.204	56.59*
Motor Speed	.113		9.88*	.126		12.99*	.106		20.20*
Age	.277	.164	17.50*	.213	.087	9.78*	.203	.097	20.60*
Perceptual Speed	.181		17.21*	.155		16.56*	.161		32.60*
Age	.289	.108	11.76*	.216	.061	6.90*	.218	.057	12.42*
Motor Speed	.113		9.88*	.126		12.99*	.106		20.20*
Perceptual Speed	.185	.072	6.80*	.169	.043	4.59*	.166	.060	12.14*
Interval	.193	.008	.77	.203	.034	3.75	.328	.162	40.47*
Age	.305	.112	12.13*	.276	.073	8.73*	.401	.073	20.43*

Note. R^2 Change is the increment in R^2 associated with the addition of the variable to the regression equation. The F-value reported is that associated with the increment in R^2.

$*p < .05$.

dence in these data that memory for activities decays more rapidly for older than for younger adults.

The hypothesis that a decrease in processing efficiency is associated with the age-related variance in activity memory was supported by the results, when perceptual speed was used as an index of processing efficiency. The age-related variance in recall of performed activities was reduced by approximately 70% (i.e., R^2 = .195 to .057) when perceptual speed was added to the regression equation before age. If the speed measures are considered a reasonable index of resources available for processing, then the results are consistent with the Kausler and Lichty (1988) hypothesis that a decline in the efficiency of effortful processing contributes to the age differences in activity memory. This finding is also consistent with the finding by Salthouse (in press) that perceptual speed is associated with the age-related variance in recall of verbal items.

However, it is important to note that a significant portion of the age-related variance in recall remained even after the variance in speed was controlled. Other explanatory mechanisms, independent of speed, are needed to account for this remaining age-related variance in activity memory. The mechanisms by which perceptual speed may contribute to the age differences in activity memory also need to be explained. Salthouse (1992) suggested that reductions in speed may contribute to the decline in working memory that has been found to occur with increases in age. This decline in working memory may contribute to the decline in memory for activities. A decline in working memory may make it more difficult for subjects to integrate to-be-learned information with contextual cues or with other list items. A decline in working memory may also make retrieval more difficult because fewer retrieval pathways can be simultaneously explored or because fewer or less complex pathways were formed.

In summary, the results of this study indicate that there are significant age differences in activity memory. Furthermore, these data suggest that the rate of loss over time in activity memory is similar for younger and older adults. Finally, the results of this study are consistent with the hypothesis that much, but not all, of the age-related variance in activity memory is associated with the efficiency of effortful processing.

Acknowledgments

The first author was supported by an Institutional Research Training Grant (T32-AG00175) to the School of Psychology at The Georgia Institute of Technology. This research was supported by NIA Grant R37 AG06826 to Timothy A. Salthouse, whose assistance we gratefully acknowledge. We would also like to thank Jennifer Davidson and Matt Sayad for assistance on collection and scoring of data.

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Received May 18, 1993
Accepted July 12, 1993