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Frequency-of-Occurrence Memory over the Adult Lifespan[1]

DONALD H. KAUSLER[2], TIMOTHY A. SALTHOUSE[3], AND J. SCOTT SAULTS[2]

As part of a large scale normative study involving a number of cognitive tasks, 233 subjects, all noncollege students ranging in age from 20 to 79 years, performed two frequency judgment tasks. A modest, but statistically significant, age-related deficit was found, with the decrement in proficiency being largest from middle to late adulthood.

Automaticity is of concern to geropsychologists in that the proficiency of encoding relevant episodic events is commonly hypothesized to be immune to the age-related deficits characteristic of effortful components of episodic memory [3; 4]. The prototypal task for tests of this hypothesis has been that of memory for the frequency of occurrence of words in a study list. Evidence with this task has been conflicting, with some studies revealing negligible effects for age variation [1; 7], and other studies demonstrating statistically significant aging deficits [5; 6]. The present evidence regarding an adult age difference in frequency-of-occurrence memory was obtained in a large scale normative study [9] in which a frequency judgment task was one of a number of cognitive tasks administered to a large number of adults. Our objective is to present a more thorough examination of the frequency judgment results than was possible in the original report.

Our study differed from earlier studies on adult age differences in frequency-of-occurrence memory in two important ways. First, our young adults consisted of individuals ranging from 20 to 39 years who were not attending college. Previous studies have confounded age with student status by comparing elderly adults with college students. Second, our noncollege subjects spanned the entire age range of 20 to 79 years. Consequently, a regression analysis of the age-memory performance relationship was permitted, along with the more traditional comparison of mean performance scores of young, middle-aged, and elderly groups of subjects.

METHOD

Subjects

The 233 community-dwelling subjects entering into this analysis were part of the subjects in our normative study [9]. There were 79 in the 20–39 age range (34 men and 45 women; mean age = 28.6 years, $SD = 6.0$), 77 in the 40–59 age range (37 men and 40 women; mean age = 49.1 years, $SD = 5.8$), and 77 in the 60–79 age range (35 men and 42 women; mean age = 68.4 years, $SD = 5.2$). Means and standard deviations for years of formal education were 13.8 and 2.1, 14.1 and 2.7, and 12.6 and 3.1 for young, middle-aged, and elderly groups, respectively. The overall correlation between age and years of education was modest, but statistically significant, $r(231) = -.20$, $p < .01$. Means and standard deviations for a self-reported measure of health status (1 = excellent, 5 = poor) were 1.9 and 0.8, 2.0 and 0.9, and 2.1 and 0.9 for the three age groups. The overall correlation between age and health status was not significant, $r(231) = .08$.

Materials and Procedure

Two series of eight tasks were presented by means of an Apple IIc computer and performed by each subject. The series consisted of alternate forms of the following tasks: a digit symbol test, a verbal short-term memory test, a spatial short-term memory test, a number comparison test, a geometric analogies test, a series completion test, a paired-associate learning test, and a frequency judgment test. The use of temporally separated frequency judgment tests permitted an analysis of both practice effects and interlist consistency of performance (i.e., reliability) for frequency-of-occurrence memory at each age level.

The two lists for the frequency judgment task were identical to those employed earlier by Kausler and Puckett [7]. Briefly, each study list contained 81 items consisting of 9 words each exposed once, 9 words each exposed 3 times, and 9 words each exposed 5 times (2 sec rate). All subjects received intentional memory instructions, and they received a short practice list in advance of each study list. For each test phase 18 pairs of items were presented one at a time (self-paced). There were six types of combinations, three of each: 5:0, 5:3, 5:1, 3:1, 3:0, and 1:0 (numbers refer to frequency of exposure in the study list). For each pair subjects selected the member believed to have occurred more frequently in the study list.

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[2]From the Department of Psychology, University of Missouri-Columbia, Columbia, MO 65211, U.S.A.

[3]From the Department of Psychology, Georgia Institute of Technology, Atlanta, GA 30332, U.S.A.

TABLE 1

Summary Statistics for Frequency Judgment Scores (Percentage of Correct Selections)

	List 1		List 2		Average	
Age Group	Mean	*SD*	Mean	*SD*	Mean	*SD*
20–39	87.19	10.11	82.20	11.33	84.70	8.90
40–59	86.57	8.70	80.88	9.85	83.72	7.80
60–79	82.75	10.75	77.85	10.32	80.30	8.50

RESULTS

For each list, a subject's score consisted of the percentage of correct selections (out of 18 pairs) of the intrapair item having the larger frequency value. Means and *SD*s of these scores for each age group on both lists, and for scores averaged over the two lists, are given in Table 1.

A 3 (Age Groups) x 2 (Lists) ANOVA yielded a significant main effects for age, $F(2,230) = 5.91$, $p < .01$, MSe = 140.12, $\omega^2 = .048$. Bonferroni *t*-tests on mean average scores revealed significantly ($p < .05$) more accurate judgments by the young adults than by the elderly adults. The remaining between-group comparisons were not significant. Of interest is the close correspondence between the mean score on List 1 for the present elderly subjects (82.75) and the mean score for a single list for Kausler and Puckett's subjects [6] in their intentional memory condition (83.33). An additional analysis included test-phase pair type (e.g., 5:0, 5:1). No consistent pattern was found for variation in the age effect that was attributable to pair type.

The presence of an overall age effect was also evident from the significant correlation coefficient between age and average score, $r(231) = -.19$, $p < .01$ (intercept and slope values of the regression equation = 87.26 and −.089, respectively). This correlation remained significant after partialling out the effects of age variation in years of education. Thus there does appear to be a modest decline in proficiency of frequency-of-occurrence memory from young to late adulthood (about 5%). Even this modest decline is not pronounced, however, until after middle age.

The main effect for lists was also significant, $F(1,230) = 45.86$, $p < .0001$, *MSe* = 68.52, but the Age × List interaction effects did not approach significance, $F(2,230) < 1$. The list effect reflected superior scores, regardless of age, on the first list (overall mean = 85.54) compared to the second list (overall mean = 80.31). The absence of nonspecific positive transfer is not surprising, given the fact that its absence is one of the criteria established for automaticity [3; 4]. What is surprising is the significantly poorer performance on the second list. One possible reason is that the second list was simply more difficult than the first list (they were administered in invariant order). This seems unlikely, however, in that Kausler and Puckett [7] found the lists to be of equal difficulty. A more plausible explanation may be derived from the tenets of Ekstrand, Wallace, and Underwood's [2] frequency theory. Implicit associative responses to words in List 1 may have idiosyncratically included words that were components of List 2. The net effect would be the uncontrolled accrual of frequency units to various words in List 2, thus increasing the difficulty of discriminating among frequency values on the basis of actual list exposures.

Interlist correlations (*r*'s) between scores on List 1 and List 2 were .37, $p < .01$, .40, $p < .01$, and .27, $p < .05$, for the young, middle-aged, and elderly groups, respectively. Thus there was a moderate degree of consistency in performance across lists regardless of age. Such consistency is seemingly unexpected in terms of the criteria of automaticity of memory [see 10]. Also of interest are the correlations between scores on our frequency judgment task and scores on the paired-associate learning task that was part of the series of tasks received by all subjects. The latter scores are of interest in that paired-associate learning is commonly assumed to require effortful processing [3]. For this correlational analysis scores consisted of the average frequency judgment scores and the average percentage of correct responses on Trial 2 (of two trials) of the paired-associate task [see 9 for summary information about age differences in paired-associate performance]. The resulting *r*'s were .30, $p < .01$, for our young adults, .16, $p > .05$, for our middle-aged subjects, and .01, $p > .05$, for our elderly subjects. Interestingly, Kausler and Puckett [7] reported a trend toward a positive correlation ($r = .24$) between frequency judgment and paired-associate scores for their young adult subjects (college students) and a zero correlation for their elderly subjects (mean age = 70.6 years). Conceivably, performance on a frequency judgment task is more likely to involve an effortful process, perhaps in the retrieval stage, for young than for elderly adults.

DISCUSSION

The present results suggest that proficiency of memory for frequency information declines modestly over the adult lifespan. The decline may be sufficiently modest that it is detected in some, but not other, studies on adult age differences in memory for frequency-of-occurrence that employ relatively small samples of subjects. In addition, the pattern of this decline differs markedly from that found for word temporal memory in another segment of our normative study [8]. Word temporal memory is another form of memory commonly believed to be automatic and therefore age insensitive [e.g., 10]. In our study temporal memory was tested by presenting a series of 16 words one at a time. After this presentation, each subject attempted to reconstruct the temporal order in which the words occurred. A subject's score was the correlation coefficient (*r*) between the true order and the reconstructed order. The mean scores were .59, .45, and .40 for young, middle-aged, and elderly adults, respectively (the overall correlation between age and temporal memory scores was −.29). Thus the decline in proficiency from young adulthood to middle age was substantial (about 25%), with relatively little additional decline in late adulthood (about another 5%). Both the extent of age-related decline in proficiency and the rate of decline over the adult lifespan appear to vary considerably for different forms of presumably automatic memory.

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