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Encoding and retention factors in the early development of recall

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A serial recall task was used to investigate the role of encoding and retention in early age differences in recall. Two age groups of preschool children (3 years 3 months and 4 years 9 months) were tested. Older children shown greater improvements over trials than younger children, but the two age groups showed comparable declines in performance over the testing sequence. It was concluded that increases in the rate of encoding of information in memory contribute to early improvements in recall, but rate of forgetting is relatively invariant.

Although age differences in preschool children's recall have been documented in several studies (Perlmutter & Myers, 1979; Perlmutter & Ricks, 1979), researchers have scarcely begun to elucidate the factors responsible for this development. The mnemonic strategies that have received great explanatory weight in accounts of later improvements in recall (Flavell, 1970; Hagen, Jongeward, & Kail, 1975) are virtually absent from the behavior of preschoolers unless tasks are specifically designed to facilitate their use (Myers & Perlmutter, 1978; Wellman, 1977).The principal factor that has been identified in studies of the early development of recall is the growth of retrieval skills (Perlmutter & Myers, 1979; Sophian & Hagen, 1978). Yet retrieval is unlikely to be the only contributing factor, since age differences have been observed in preschoolers' performance even on recognition tasks that place minimal demands on retrieval processes (Perlmutter & Myers, 1976).

The present research examined the extent to which age differences in the encoding and retention of information in memory contribute to improvements in preschool children's recall. A serial recall task was used, in which children were asked to recall, in a predetermined order, pictures presented in each of six serial positions. Age differences in the rate of encoding information in memory were examined by comparing changes in performance over a series of trials on each list. To the extent that age differences in rate of encoding contribute to early memory development, older children should not only perform better than younger children on the first trial of each list, but they should also improve more over trials, as additional opportunities for encoding are provided. Age differences in retention were examined by comparing recall performance on items tested at different points in the testing sequence. To the extent that age differences in retention contribute to early memory development, older children's performance should decline more slowly over the testing sequence than that of younger children.

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METHOD

Sixteen children in each of two age groups were tested. The younger children were between 3 and 3.5 years of age (mean = 3 years 3 months), and the older children were between 4.5 and 5 years of age (mean = 4 years 9 months). Children lived in the vicinity of Minneapolis, Minnesota, and were tested at the Institute of Child Development of the University of Minnesota. There were approximately equal numbers of boys and girls in each group.

Colored drawings of common objects were used as stimuli. Six experimental lists, each consisting of six unrelated pictures, were used for testing. An additional two-item list of geometric shapes was used for practice.

All children were tested on six lists of items in a probed recall task administered by a female experimenter. The six pictures on each list were placed consecutively in front of the child and labeled by the experimenter, who then asked the child to repeat the label. After all six pictures were presented, the experimenter turned them over one by one, labeling each picture again as she did so. Pictures were always presented and turned over in a left-to-right sequence. The experimenter then probed items by pointing to each of the six overturned cards in a random order, asking the child to recall the hidden picture. This procedure was then repeated a second and a third time, with pictures presented in a constant order but tested in different orders across trials.

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The order in which the six serial positions were probed was Latin squared over lists, with a different Latin square for each subject. The order in which the six items on each list were presented was also Latin squared over subjects, but the order in which the six lists were presented was held constant.

RESULTS

The mean number of items correctly recalled by younger and older children at each point in the testing sequence on each trial may be seen in Figure 1.

Changes in performance over trials were examined in a 2 (age) by 3 (trials) by 6 (testing position) analysis. The main effects of age [$F(1,30) = 8.79$, $p < .01$], trials [$F(2,60) = 62.7$, $p < .001$], and testing position [$F(5,150) = 4.33$, $p < .005$] were all significant, as were the interactions of Age by Trials [$F(2,60) = 3.68$, $p < .05$] and Age by Testing Position [$F(5,150) = 2.79$, $p < .05$]. In general, older children performed better than younger children, and performance improved over trials and declined over the testing sequence. The interaction between age and testing position appeared to reflect the fact that for younger children no further decline in performance occurred from the fourth to the sixth item tested, whereas for older children even the fifth item tested was recalled significantly more often than the last one (Scheffé tests, $ps < .05$). This result may be due to floor effects in younger children's performance, particularly on the first trial. The interaction between age and trials reflected greater improvements by older than by younger children. Differences in the degree of improvement children showed from the first to to the third trial were not related to differences in their initial levels of recall ($r = -.18$, $p > .10$).

Regression analyses indicated that, overall, the rates of forgetting were highly comparable for the two age groups. Separate regressions were conducted to examine declines in recall over the testing sequence for younger and older children and on the data from each trial. There were significant and similar declines at the two ages on the first trial [younger children: $r = .24$, slope = $-.16$, $F(1,94) = 5.82$, $p < .05$; older children: $r = .23$, slope = $-.16$, $F(1,94) = 5.02$, $p < .05$], but there were no significant declines in performance on later trials ($Fs < 2$, $ps > .10$). The absence of a systematic decline in performance over probes on later trials may have resulted from the high probability with which items that had been recalled previously were again recalled, regardless of when they were probed. For both age groups, conditional probabilities of recall on the second and third trials, given that an item was recalled on previous trials, were significantly greater than the corresponding unconditional probabilities [younger children: Trial 2, $p(T2/T1) = .74$, $p(T2) = .40$, $Z = 2.40$, $p < .01$; Trial 3, $p(T3/T1 + T2) = .94$, $p(T3) = .49$, $Z = 3.18$, $p < .001$; older children: Trial 2, $p(T2/T1) = .83$, $p(T2) = .57$, $Z = 1.84$, $p < .05$; Trial 3, $p(T3/T1 + T2) = .88$, $p(T3) = .65$, $Z = 2.30$, $p < .05$].

These results indicate elements of both change and stability in early memory development. Differential improvements in performance over trials for younger and older children point to increases in rate of encoding that contribute to improvements in memory over the

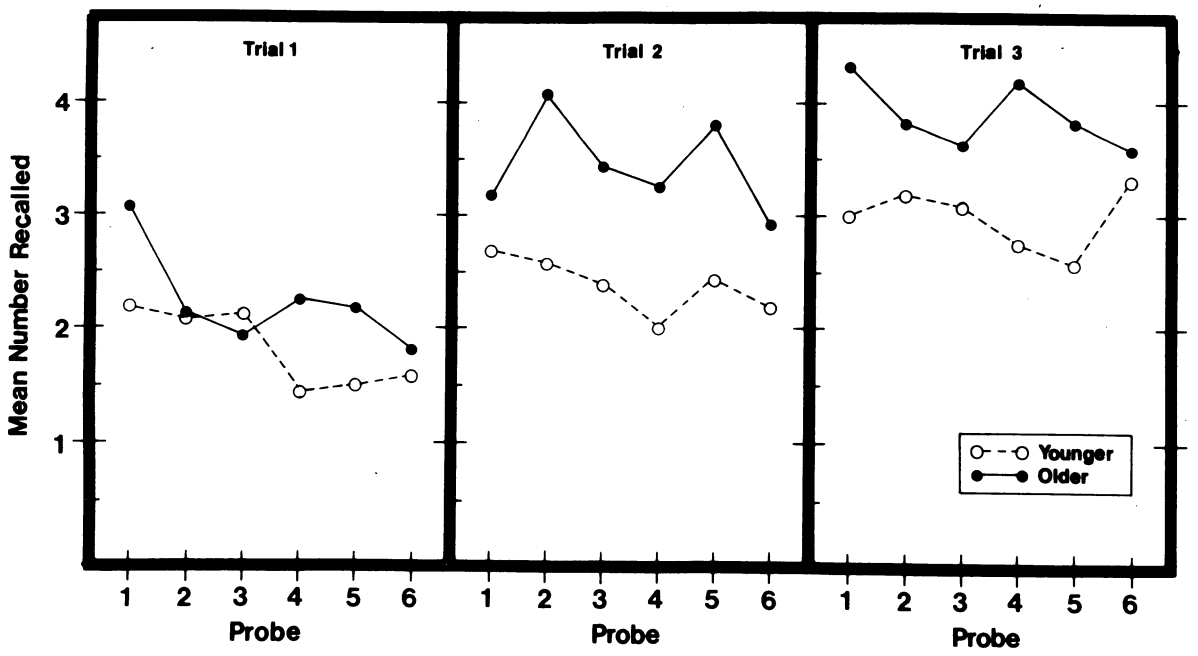

Figure 1. Mean number of items correctly recalled by younger and older children at each point in the testing sequence on each trial.

preschool years. This increase in encoding speed may be related to previously documented improvements in visual scanning over the preschool years (Vurpillot, 1976) or to basic changes in the temporal parameters of information processing like those that have been found to occur later in childhood (Wickens, 1974). Comparable declines in performance over the testing sequence for younger and older children point to a stability in rate of forgetting that extends previous findings of comparable forgetting rates across middle childhood (Belmont & Butterfield, 1969; Fajnsztejn-Pollack, 1973; Nelson, 1971) and the adult years (Hulicka & Weiss, 1965). This finding thus lends further support to the view that forgetting rate may represent a developmentally invariant aspect of memory functioning (Brown, 1975; Olson, 1976). Together, these findings of change and invariance suggest at least the beginning of an answer to the question of what ails the memory of young preschool children: It is not that they forget more than older children, they just do not get as much into their heads in the first place.

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