that the difference in rate was not the critical factor. More probably, it was in their use of 10-word, rather than 14-word, lists. The conjecture is that the relative advantage of interitem similarity for response learning in the case of lists of synonyms, which constitute semiexhaustive categories, may become offset by the similarity of the semantic retrieval cues, making interitem discrimination progressively more difficult as list length increases. The low utility of synonymity as a retrieval cue was further demonstrated when ratings, on a scale of 0-5, of the magnitude of synonymity of each of the 91 possible syn word pairs were obtained from 24 Ss. The correlation between the means of the word-pair scale values, which ranged from 1.48 to 4.15, and their frequency in recall was only .10. It appears justifiable to assume that Ss learning synonymous words tend to rely relatively heavily on their formal characteristics of the type here termed phonetographic. These were actually relatively abundant in the syn list used in the present study. In the case of the nonsyn items, discrimination was favored by the relatively large semantic differences and Ss were apparently able to detect minimal interitem associations. The balancing of advantages and disadvantages applied also to the ordering of the items shown in the recall protocols. This reasoning derives from the tenable assumption that retrieval cues, or what Underwood (1969) has termed attributes of memory, aid not only in the gaining of access to stored items, but also in promoting the sequential emission of groups of items having similar cues. It follows that shorter lists of synonyms should have an advantage over longer lists because relatively more time per item can be spent in the search for salient retrieval cues and fewer are needed. If this reasoning is correct, increasing the length of a presented list of synonyms beyond an optimal limit should result in a relative depression of both recall and ordering, as compared with that obtained with a suitable control list of minimally related nonsynonyms. In this undertaking, it would be advisable to equate the experimental and control lists with regard to their phonetographic characteristics.

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Free recall in children: Long-term store vs short-term store*

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A study was conducted on the effect of age on long-term store (LTS) and short-term store (STS) in free recall. Nineteen 5-year-old children and 25 6-year-old children were tested. Recall of words from the beginning and middle of the lists, the output from LTS, was significantly better for the older children. Recall of words from the end of the list, an index of output from STS, was similar for both groups. Age related changes in recall result, therefore, from changes in the efficiency of registering or retrieving information from LTS. STS is unaffected by age.

A two-storage model for free recall has been supported by a number of studies. In particular, it has been demonstrated that long-term store (LTS) is affected by a large number of variables—rate, list length, associativity of words (Glanzer & Cunitz, 1966; Glanzer & Schwartz, in press; Murdock, 1962, 1967; Raymond, 1969)—while short-term store (STS) is affected by a limited number of other variables, e.g., filled delay.

Craik (1969) has shown that the amount held in LTS declines between the ages of 22 and 65 but that STS is unaffected. Studies comparing children at different age levels have, however, given unclear results. This study examined the performance of 5-year-old and 6-year-old children in free recall. It was hypothesized that age has its effect on LTS and not on STS. From this, it follows that age should interact with serial position. In particular, it should have its effect primarily on early list positions.

SUBJECTS

The Ss were 36 children from middle-class families, divided into two groups: (1) Age five—19 Ss (7 boys, 12 girls); mean age, 5 years, 6.5 months; range, 5 years, 3 months, to 5 years, 10 months. (2) Age six—25 Ss (14 boys, 11 girls); mean age, 6 years, 6 months; range 6 to 7 years.

MATERIALS

Sixty-four cards bearing colored drawings of common objects were used. The names of the objects were one- or two-syllable words frequently used by children: apple, ball, balloon, bike, bird, etc. Fifty-four of the 64 cards were selected and ordered at random independently for each child. Pictures that children could identify immediately were selected on the basis of pilot work with 4-year-old children.

PROCEDURE

Twelve series of pictures, or lists, were presented, with the length of the list increasing from two to seven items and then decreasing from seven to two. Eight Ss, however, were given only the ascending order (see below). Each item was presented for 1.5 sec, with a 1.5-sec interitem interval. The S called out the name of each object and recalled the names immediately after the last item.

RESULTS

Preliminary analysis determined that the data from the ascending and descending orders did not differ and that the data from the eight Ss with only the ascending order did not differ from the others ($Fs < 1.00$). The data for both orders and all Ss were therefore pooled.

The serial position curves for List Lengths 2-7 for the 5- and 6-year-old group. The curves are shown in Fig. 1. The figures show clearly that, starting with lists of Length 4 or greater, the 6-year-olds recall more words than the 5-year-olds in the early part of the list but that this advantage disappears in the final list positions. At Lengths 2 and 3, a ceiling effect eliminates these differences.

The systematic effect of list length can be seen in Fig. 2, which combines the data for all the Ss. As has been found before with an increase in list length (Murdock, 1962), early list positions are depressed. The final list positions, however, remain the same.

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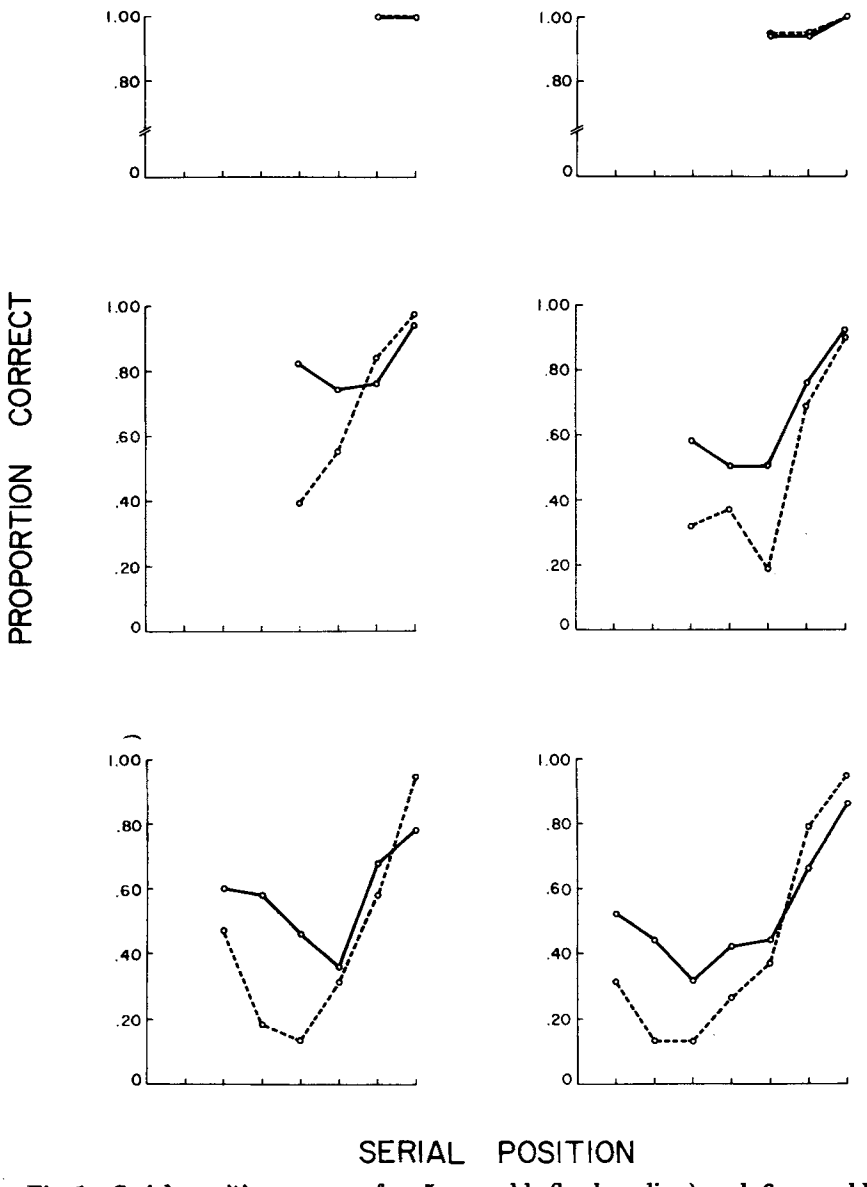

Fig. 1. Serial position curves for 5-year-old (broken line) and 6-year-old children (solid line) for each list length.

Comparison of the curves in Fig. 1 shows that the effect of list length holds both for the 5- and 6-year-old children.

To evaluate the effect of age, analyses of variance were carried out for each list length, with age a between-groups factor and serial position a within-groups factor. The results for List Lengths 3-7 are summarized in Table 1. Degrees of freedom = 1/42 for all ratios. Since the simple interaction effect is unfocused, a test was set up that fits the hypothesis more closely. This was the interaction of age with the first half and the second half of the list. For lists with an odd number of positions, the middle position was omitted from the analysis. The Fs obtained are also listed in Table 1.

Table 1
F Ratios for Effects in Each List Length

	Length				
	7	6	5	4	3
Age	78.50†	19.76†	10.75†	8.90†	0.00
Serial Position	17.60†	12.72†	18.36†	9.97†	1.73
Position by Age	1.95	3.07	1.32	6.13*	0.00
First Half vs Second Half by Age	9.05†	9.45†	1.88	15.05†	0.00

*$p < .05$, †$p < .01$

The statistical analysis of the results support the effects evident in Fig. 1. Age has an effect but only on the early part of the list, the output from LTS. The final sections of the list, which include output from STS, do not show systematic effects of age. The interaction supports the claim that children's performance changes with age because the efficiency of LTS changes. The capacity of the STS, however, remains constant. The findings agree with those for Craik (1969). He also found that age affected LTS but not STS in mature adults. The effect of age is like that of a number of variables—presentation rate, word frequency, associativity, and list length, the effect of which was also replicated here. It produces the same interaction effect with serial position. It produces an effect on LTS but not STS.

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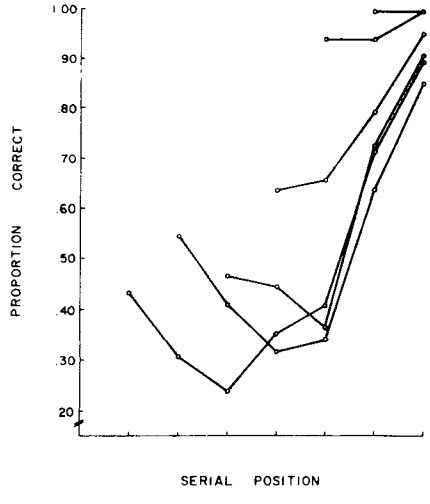

Fig. 2. Serial position curves each for List Lengths 2-7.