The effects of synonymity on item recall and sequential ordering in multitrial free recall

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A list of 14 synonymous and one of 14 minimally related adjectives were presented to respective groups for 16 multitrial free recall trials. Analyses of the two sets of data failed to reveal noteworthy differences either in item retention or in sequential ordering of recall. The results indicated that Ss given synonyms relied, to an appreciable degree, on the formal characteristics of the words as memory attributes, whereas those given nonsynonymous words responded more to minimal interitem associations. It was hypothesized that the differential effects of synonymity on performance depends mainly on list length.

This study dealt with the effects of intralist similarity, as determined by synonymity, on the characteristics of multitrial free recall (MTFR). A review of the relevant literature provided limited evidence for experimental hypotheses. Underwood & Goad (1951) reported that 14 synonymous adjectives were more difficult to learn in a fixed serial order than 14 nonsynonymous adjectives. On the other hand, Underwood, Runquist, & Schulz (1959) found that 10 of the same synonyms were learned relatively more rapidly in MTFR. These results apparently support the conclusion that synonymity retards serial learning but facilitates free recall. A consideration of this, as well as other, evidence appeared to justify one seemingly obvious prediction for the present study. This was a replication of the finding of Underwood, Runquist, and Schulz that synonymous adjectives should be more rapidly learned in MTFR than nonsynonymous adjectives. Tulving (1962) was the first to show that in the MTFR of minimally related words, Ss tend to develop sequential constancies in their recall when the presentation order of the words is changed from trial to trial. He termed this effect subjective organization. It is presumed to reflect the fact that Ss group items on the basis of interitem relationships or shared formal characteristics. Such organization was measured here in terms of the intertrial repetition of identical word bigrams (ITR) described by Bousfield & Bousfield (1966). No predictions seemed possible concerning the relative magnitudes of ITR. The expected advantage of synonyms in response learning might be offset by the difficulty of their stable hookup due to their relatively low semantic differentiability. This follows from the assumption that their retrieval cues should show a comparatively high degree of overlap. A pilot study gave unexpected results. There were no significant differences in item recall across 16 MTFR trials of 14 synonymous (syn) and 14 nonsynonymous (nonsyn) adjectives. Furthermore, the sequential ordering in the two sets of recalls, as measured by ITR, was highly similar. The subsequent experiment was a replication of the pilot study by a different E and with more extensive analyses of the data.

LISTS

The lists were the same as those of the pilot study. Both were selected from Underwood & Goad (1951), who used three syn and three nonsyn lists. They, in turn, obtained them from Melton (1940). The syn list comprised: blissful, carefree, cheerful, elated, festive, genial, gleeful, happy, hearty, jolly, laughing, pleasant, smiling, sunny. The nonsyn list comprised: adroit, bloated, equal, flaming, fretful, guilty, hybrid, inform, modern, neuter, pretty, shopworn, tiresome, warlike. Five randomizations of these two lists, as well as three randomizations of a practice list of 10 male first names, were reproduced on 35-mm slides for automatic projection at a 2-sec rate.

PROCEDURE

Twenty-five female undergraduate Ss, serving singly or in pairs, were assigned randomly to each of the two word lists. Each session began with three MTFRs of the practice list. These were followed by 16 MTFRs of one of the randomly assigned experimental lists. Instructions indicated that Ss were to recall as many words as possible in any order they chose. They were to write the words in a column, with each recall sequence on a separate page of a booklet. The words were to be covered with a cardboard as they were written. Two seconds after the last item of each presentation, the words, "start writing," on an additional slide signaled the start of a 45-sec recall period. After the last recall, Ss were asked to report on the methods they employed for learning and recalling the words.

RESULTS

Figure 1 shows the results for both items correctly recalled and sequential ordering as measured by obtained intertrial repetitions, O(ITR), for the syn and nonsyn lists. As was the case in the pilot study, item recall for the two lists showed a generally similar progression over trials. A comparison of the two conditions involved an averaging of the data over three successive blocks of 5, 5, and 6 recalls. List comparisons were based on a two-factor ANOVA (Lindquist, 1953, Type I, p. 267), with list conditions as the between-Ss and trial blocks as the within-Ss variables. The trial-block effect was significant ($p < .001$), as was the List by Block interaction ($p < .02$). A discussion of possible reasons for the interaction will not be undertaken in this report. The list effect was not significant ($F < 1.00$). Analyses were next made of the errors in recall. Item duplications within each of the 16 recalls were counted for each S. Mean totals of these errors were 13.16 and 10.76, respectively, for the syn and nonsyn lists. The difference, however, was not significant. The extralist intrusions, with means of .64 and .48, respectively, were too infrequent to warrant analysis. Response oscillation, i.e., the number of items recalled on Trial t but not recalled on Trial t + 1, was analyzed over the first five pairs of successive trials. The means were 21.3 and 21.1, respectively, for the syn and nonsyn lists. In summary, no significant differences emerged from the general analyses of item recall for the two lists.

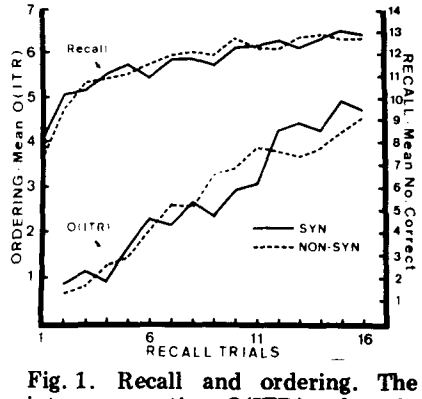

Fig. 1. Recall and ordering. The points representing O(ITR) values in successive trial pairs are placed above the second member of each pair of recalls.

Table 1
Recall Strategies Reported by Five or More Ss

Strategy	Synonymous List Number of Ss	Nonsynonymous List Number of Ss
1. Degree of expressed affect	12	0
2. Same first letter or sound	8	5
3. Alphabetic sequence	8	4
4. Same terminal letter or sound	7	1
5. Interitem association	6	14
6. Spontaneous grouping	0	5
7. Word length or appearance	0	6
8. Estimated frequency of usage	6	6
9. Difficult items needing special attention—usually emitted first	6	5
10. Order of presentation	3	5

The analyses of sequential ordering in recall as shown by ITR were in accord with the method suggested by Bousfield & Bousfield (1966). Figure 1 shows the increase in the mean number of obtained repetitions of word-bigrams, O(ITR), over successive trial pairs for the two lists. The significance of these means was assessed from the magnitudes of the differences between corresponding obtained and expected values, O-E(ITR). All O(ITR) values of .90 or more represented on the curves are significant at the $< .05$ level, and values of 1.15 or more at $< .01$. Condition comparisons, similar to those used for item recall, involved an ANOVA of the mean differences between the obtained and expected values, O-E(ITR), of three successive blocks of five trial pairs each. The list and List by Block interactions were not significant. The block effect, however, was significant with $p < .001$. These findings thus essentially replicated those of the pilot study.

The question next considered was that of possible differences between conditions in the recall strategies Ss reported. Means of 2.15 and 2.08 strategies per S were reported by the syn and nonsyn Ss, and only two in the latter group gave no report. Table 1 lists the 10 most frequently listed strategies. Degree of expressed affect, shown in the pairs "smiling-laughing" and "laughing-smiling," was reported exclusively by the syn Ss. The next three, here termed *phonetrographic*, a convention used by Razran (1949), were also more frequently reported by the syn Ss. On the other hand, nonsyn Ss tended to favor interitem association. This label probably should also include what Ss termed as "spontaneous grouping" or the equivalent, since the examples Ss gave involved the same pairs of words which other Ss termed as "associations." Nonsyn Ss favored word length, though the actual range was the same in the two word lists. The last three strategies tended to be relatively similar for the two groups.

Various analyses were made, not only of the relative incidence of the reported strategies, but also of the opportunities provided by the list words for their use, and of their apparent actual use as indicated by the sequences of the words in the recall sequences. It was belatedly discovered that the two word lists differed appreciably with regard to the phonetographic characteristics of their component words. The syn list words, according to our counts, provided opportunities for the emission of at least 47 different phonetographic word bigrams, i.e., separate pairs with one or two phonetographic attributes. For the nonsyn list, there were only 22 such possibilities. It may be assumed that the syn Ss reported more frequent use of phonetographic strategies because the syn list provided more opportunities for their use than did the nonsyn list. An uncomplicated statistical analysis of the extent to which Ss actually used their reported strategies in the sequential ordering of their recalls could not be found. Perhaps the simplest of the various attempts to determine extent of use of reported strategies involved a tabulation of the occurrence in the complete recall protocols for each list of the 10 most frequently grouped pairs of words. Each such pair was found to occur in both a forward (its more frequent) and a backward (its less frequent) order. The frequencies of each order were summed for each word pair to give its commutative total. Arranged on the basis of total frequency of occurrence from high to low, the most frequent syn pairs shown in their forward order were: smiling-laughing, carefree-cheerful, hearty-happy, blissful-carefree, sunny-smiling, genial-gleeful, blissful-cheerful, festive-genial, hearty-jolly, happy-jolly. The most frequent nonsyn pairs were: flaming-fretful, shopworn-tiresome, neuter-hybrid, tiresome-warlike, adroit-pretty, tiresome-fretful, warlike-shopworn, equal-modern, pretty-modern, warlike-guilty. The syn word compilation shows that all the pairs may be classed as phonetographic. The use of multiple cues is indicated by "smiling-laughing," which Ss reported as an example of degree of expressed affect. Only the first two pairs in the nonsyn tabulation could be regarded as phonetographic. The use of association is confirmed by the examples reported by Ss of adroit-pretty, pretty-modern, shopworn-tiresome, and warlike-guilty. Of these pairs, shopworn-tiresome also involves the phonetographic attribute. This, as well as other inspectional analyses, consistently supported the conclusion that Ss did, indeed, use the recall strategies they reported. It may also be said that the recall protocols of the syn Ss reflected the use of the relatively large number of phonetographic cues provided by the syn list. Insofar as the learning of the syn Ss was facilitated by the phonetographic cues, the effect was insufficient to increase significantly either item recall or ITR scores beyond the levels attained by the nonsyn Ss. It is even possible that without the relatively high incidence of phonetographic cues in the syn list the performance of the syn Ss might have been below that of the nonsyn Ss. The nonsyn Ss apparently relied relatively heavily on interitem associations, with many possibly involving what Adams & Montague (1967) have termed "natural language" mediators. It is reasonable to assume that in the compilation of the nonsyn list, Melton (1940) tried to avoid obvious interitem associations. In our judgment, little would have been gained by obtaining free associational norms for these words.

DISCUSSION

The results of this study indicated that in 16 MTFR trials of 14 synonymous (syn) and 14 minimally related (nonsyn) adjectives, there were no substantial differences either in item recall or in the sequential ordering of recall as measured by ITR. There was evidence of differences, however, in recall strategies reported by Ss, and there were indications in the data that Ss did, indeed, use their reported strategies. Thus, the syn Ss appeared to rely appreciably on phonetographic cues, which were relatively numerous in the syn words. The nonsyn Ss, on the other hand, appeared to rely more on the interitem associations. The lack of significant differences in item recall for the syn and nonsyn lists presents a problem of interpretation, especially since Underwood, Runquist, & Schulz (1959) reported more rapid MTFR learning for syn than for nonsyn adjectives from the same source as those used in the present study. However, their rate of presentation was, in effect, 4 sec/item, whereas we used a 2-sec rate. It is proposed here

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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