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Positive and Negative Part/Whole Transfer in Free Recall[1]

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Three experiments examined the effects of simultaneous and successive presentation on part/whole transfer in free recall. In the first two experiments, *Ss* received six or eight trials on the part list. The observed absence of negative transfer under any presentation condition was attributed to the fact that part-list subjective organization did not increase over trials. In Experiment III *Ss* received 16 trials on both lists and the groups represented all possible combinations of simultaneous or successive presentation on part and whole lists. Part-list subjective organization increased with practice in all conditions. Negative part-to-whole transfer was observed only when both part and whole lists were presented successively, suggesting that learning strategies determine whether or not part-list organization will interfere with whole-list learning.

Several free recall experiments have indicated that practice on part of a list disrupts subsequent learning of the whole list, at least on later trials (e.g., McLaughlin & Pierson, 1969; Tulving, 1966). To account for this negative part/whole transfer, Tulving (1966) has suggested that the subjective organization developed during part-list learning interferes with the development of optimal organization during whole-list learning and is, therefore, detrimental to whole-list recall. Tulving's hypothesis receives support from a study by Birnbaum (1968). She used lists with four-word categories and found that whole-list recall improved as the number of category exemplars present during part-list learning increased from one to four (i.e., as the number of exemplars increased, the congruence between part-list and whole-list organization units increased).

Recent studies concerning the strategies used to store, rehearse and retrieve material presented for free recall (e.g., Bower, Clark, Lesgold & Winzenz, 1969; Elmes & Wilkinson, 1971; Elmes & Wright, 1970; Rundus, 1971) suggest a slightly different way to view part/whole transfer. If, for example, *Ss* continue to rehearse whole-list items serially as they presumably did, in part, during part-list learning (Rundus, 1971), then disruption of whole-list performance should occur, because (a) old and new items (i.e., part- and whole-list items) are usually intermixed in the whole list, thereby encouraging the rehearsal of new groups of material and forcing *Ss* to develop new organization units, and (b) *Ss* typically attempt to retrieve whole-list items in groups of old and new items (i.e., part-list items are retrieved together, as are the new whole-list items, Birnbaum, 1968), which may be difficult with a serial rehearsal strategy. The idea that rehearsal and retrieval strategies are important factors in part/whole transfer receives support from the finding that positive part/whole transfer results when old and new items are blocked together during whole-list learning (Ornstein, 1970). Although it is possible to interpret Ornstein's results solely in terms of the congruence between part-list and whole-list

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organization, it seems likely that it is the rehearsal and retrieval strategies that determine the kind of organization and, therefore, influence part–whole transfer.

One way to test the notion that strategies are important in part–whole transfer is to present whole-list items simultaneously rather than successively. Simultaneous presentation should allow *S*s to readily perceive the part/whole relationship, and permit them to study the whole list idiosyncratically rather than in the paced, serial fashion that is almost demanded by successive presentation (Bower et al., 1969; Winograd, Conn & Rand, 1971). Thus, the primary purpose of the present studies was to determine the effects of simultaneous presentation on part/whole transfer in free recall. Because of the learning strategies that could be used under simultaneous presentation of the whole list, it was expected that simultaneous presentation would result in attenuated part/whole negative transfer.

Experiment I

Method

Design and subjects. The four independent groups each contained ten summer session students from Virginia Military Institute. All groups learned the same whole list of 22 words: two groups (one experimental, one control) received simultaneous presentation of the whole list; two groups (one experimental, one control) received successive presentation Part-list learning was always via successive presentation. The two experimental groups learned a part list comprised of 11 of the words in the whole list; while the two control groups first learned a list containing 11 words not in the whole list.

List design and procedure. The final list for all *S*s was identical to Tulving's (1964) List 3, and contained the following unrelated two-syllable nouns of various frequencies of occurrence: *action, bandage, country, dipper, effort, farrow, gambler, hamlet, island, kitchen, legion, miser, noodle, octroi, pilgrim, quinsy, rennet, stamen, trollop, voter, waiver* and *zenith.* The part list for the experimental *S*s contained the following common and uncommon words: *action, country, dipper, farrow, hamlet, island, noodle, octroi, rennet, trollop* and *voter.* The first list learned by the control *S*s was derived from Tulving's List 4, and it contained the following common and uncommon words: *answer, cherub, despot, ether, journal, letter, mantel, natron, person, umbra, xylem.*

The first list was presented and recalled six times as was the whole list. For all *S*s the part-list items were presented one at a time at a 1 5-sec rate via a slide projector and 45 sec was permitted for written free recall The successive whole lists were also presented at a 1.5-sec rate; while the simultaneous whole list, composed of words placed in the form of two concentric circles, was presented for a total of 33 sec on each trial. The *S*s were allowed 90 sec for written recall of the whole list. For both part and whole lists, a study cycle immediately followed the preceding recall period.

Standard free recall instructions were given for both part- and whole-list learning. The only additional instruction at the onset of whole-list learning was: "Now you will see another list of words that you are to remember."

On all trials input order of the items was different (in the simultaneous conditions the words appeared in different locations) Small groups containing from two to six *S*s were tested at a time.

Results and Discussion

The mean total numbers of correct responses on the part list appear in Table 1. The differences among the four groups were not reliable, $F(3, 36) = 1.98, p > .10$. The mean number of correct responses per trial on the whole list are also presented in Table 1. Recall was almost identical in the simultaneous and successive conditions when control and experimental performance for each condition are considered together, $F < 1$. It might be argued that the lack of difference between simultaneous and successive recall resulted from negative transfer due to change in presentation mode from part to whole lists in the simultaneous groups, but the Tukey (a) test indicated more correct responses by the simultaneous control group than by the successive control group.

Of particular interest is comparison of experimental and control learning of the whole list. Contrary to previous results, more correct responses occurred in the experimental than in the control groups, $F(1, 36) = 9.24, p < .005$. Although control *S*s were performing about as well as experimental *S*s by the final trial, resulting in a significant Trials × Control–Experimental interaction, $F(5, 180) = 6.63, p < .001$,

TABLE 1

MEAN NUMBERS OF WHOLE-LIST CORRECT RESPONSES IN EXPERIMENTS I AND II

Group	Mean	Whole-list trials								
Experiment I	Part-list	1	2	3	4	5	6	7	8	Mean
Suc[a]–Suc C	8 0	7.2	11.6	13 1	14.7	16.0	16.7	—	—	13.2
Suc–Suc E	8 5	13.1	14.7	16 5	17.1	18 1	18.4	—	—	16 3
Suc–Sim[b] C	8.5	8.6	12.4	15.3	15 9	16.5	18.0	—	—	14.5
Suc–Sim E	7.7	11.4	14.3	15.8	16.1	17.0	17.5	—	—	15.3
Experiment II										
Suc–Suc C	8.7	6 8	12 7	15.4	16.3	16.5	16 6	17.5	17.5	14.9
Suc–Suc E	8 7	12 7	15 8	16 5	18.0	17.9	17.9	18 9	19.5	17.2
Sim–Sim C	8.6	10.5	13.5	15 8	16.4	17 9	17.8	19 0	18.9	16.3
Sim–Sim E	9.2	14 6	17.2	18.3	18.5	19 4	20.0	20 5	20.2	18.6
Sim–Suc C	8 7	5.9	11.2	13.5	14.7	16.0	16 1	16 1	17.7	13.9
Sim–Suc E	8.7	11 3	13 8	14.7	15.0	15.7	18.0	17.6	17.6	15 5
Suc–Sim C	8 1	8 2	11 7	15 0	15 2	15.8	16 2	16.7	18.0	14 6
Suc–Sim E	8.0	12.6	13.5	15.2	15.7	16 7	17.2	17.7	17.9	15.8

[a] Successive presentation of the part list.

[b] Simultaneous presentation of the whole list.

control learning scores were still slightly lower than experimental on the final trial, $F < 1$.

It was expected that negative transfer would be attenuated with simultaneous presentation of the whole list. On the contrary, as shown in Table 1, there was a statistically not significant tendency toward less positive transfer on the whole list in the simultaneous than in the successive condition.

A possible reason for no negative transfer was the lack of subjective organization during part-list learning. The measure of subjective organization was the O–E intertrial repetition (ITR, Bousfield & Bousfield, 1966). The O–E (ITR) for the part list revealed no differences among the groups, $F < 1$, nor did subjective organization increase with practice, $F < 1$. Few, if any, inappropriate subjective units were formed by the experimental *Ss* during part-list learning; thus, whole-list learning was not disrupted because the maintenance of original rehearsal and retrieval strategies would not be detrimental to whole-list recall. A possible reason for the lack of organization on the first list is that with short lists the task involves short-term memory, and the *Ss* have little need to organize the items for easier retrieval. However, with as few as nine items in the part list, both Tulving (1966) and McLaughlin and Pierson (1969) have reported part/whole negative transfer. Presumably, subjective organization of the part list occurred in those experiments, but this information has not been reported.

EXPERIMENT II

In Experiment II the *Ss* received eight rather than six part-list trials because it was felt that increased practice would increase part-list subjective organization. With some part-list subjective organization, negative transfer should occur if the *Ss* attempt to learn the whole list in the same way that they learned the part list. Therefore, all possible combinations of simultaneous or successive presentation of part and whole lists were included in the design.

Method

Design and subjects The eight independent groups each contained 10 Washington and Lee University Introductory Psychology students. The eight groups (a 2 × 2 × 2 factorial) derived from all possible combinations of simultaneous or successive presentation on

part and whole lists with one experimental and one control group for each presentation combination.

List design and procedure. The list design and procedure were the same as in Experiment I except that there were eight presentations and tests of each list instead of six. Presentation time of the first list in the simultaneous conditions was 16.5 sec.

Results and Discussion

Mean total numbers of part-list items free recalled appear in Table 1, where it can be seen that there were small differences among the groups, $F(7, 72) = 2.02$, $p > .05$. Total recall was higher under simultaneous presentation than under successive presentation, $F(1, 78) = 4.56$, $p < .05$.

Table 1 also contains the mean number of correct responses per trial on the whole list. There was no negative transfer, as in Experiment I, and total recall was higher for experimental than for control *Ss*, $F(1, 72) = 14.68$, $p < .001$. The more rapid improvement over trials by control than by experimental *Ss* was reliable, $F(7, 504) = 17.11$, $p < .001$, suggesting the possibility that further whole-list testing may have resulted in negative transfer. However, as was the case in Experiment I, subjective organization failed to increase over part-list trials, $F < 1$, which according to Tulving's analysis should yield no negative transfer.

Experiment III

Experiment III was conducted along the same lines as Experiment II but with more trials on both part and whole lists.

Method

Design and subjects. The eight independent groups in the major portion of Experiment III were each comprised of Washington and Lee University Introductory Psychology students Except for the two successive–successive groups, which contained 20 *Ss*, each group contained 10 *Ss*. These eight groups received the same treatment as the eight groups in Experiment II except that 16 rather than 8 trials were given on each list. Four additional groups were tested with lists (hereafter called List B) that contained words different from those used previously in the present experiments. The two successive–successive groups (experimental and control) that learned List B each contained seven Lexington High School students, while nine Lexington High School students were in each of the two simultaneous–simultaneous groups (experimental and control) that learned List B.

List design and procedure. With the following exceptions the list design and procedure were the same as in Experiment II: (a) all *Ss* received 16 study-test trials on both lists; and (b) four groups received lists consisting of many words not previously used in this series of experiments (List B). The List B whole list contained the following 30 nouns that had a Thorndike and Lorge frequency of at least 50 per 1,000,000 words: *arm, battle, church, devil, duke, entrance, farm, garden, glass, habit, ice, island, journal, key, lamp, lion, meal, member, nest, office, pocket, rope, saint, servant, table, ticket, volume, wealth, winter, yard.* The part list for the experimental *Ss* contained the following words: *arm, battle, duke, farm, glass, habit, key, member, office, pocket, rope, saint, ticket, winter* and *yard.* The following part-list words for the control *Ss* were selected in a similar fashion. *artist, ball, coffee, earth, forest, horse, kitchen, number, oil, paint, queen, river, uncle, view, year.*

Simultaneous presentation for List B was in columnar form rather than in concentric circles (unpublished data collected at Washington and Lee indicate that the form of simultaneous presentation has little influence on correct free recall). Simultaneous presentation duration for List B was 22.5 sec and 45 sec for the part and whole lists, respectively.

Results and Discussion

Shown in the left-hand portion of each panel of Figure 1 are the mean total numbers of part-list correct responses. For the appropriate experimental-control comparisons, part-list recall was essentially the same, $Fs \leq 1.63$. By the last trial of part-list learning, 94% of the *Ss* had one or more perfect recall scores.

As shown in Figure 1, negative transfer occurred only when both part and whole lists were presented successively. The negative transfer effect appears to be smaller for the *Ss* who learned List B than when the other list was tested, but in neither instance is the negative transfer very striking. When either the part list or the whole list, or both lists, were learned under simultaneous presentation, strong positive transfer was obtained.

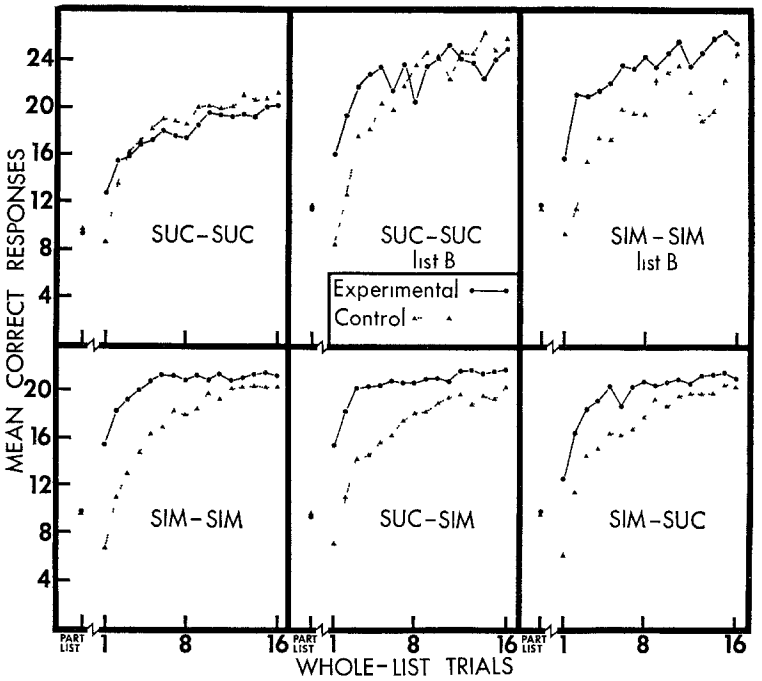

FIG. 1. Mean number of whole-list correct responses as a function of trials in Experiment III.

Examination of subjective organization by means of O–E ITR scores that disregard the order of pairwise events from trial to trial (Gorfein, Blair & Rowland, 1969) indicated that subjective organization on the part list increased with practice in the major portion of Experiment III, $F(14, 1008) = 17.27, p < .001$, and when List B was learned, $F(14, 405) = 2.98, p < .01$. The total amount of part-list organization was essentially the same in all groups, $F < 1$. The Groups × Trials interactions were not reliable, $F < 1$, indicating that the increase in part-list organization with practice did not differ among the groups. Since part-list subjective organization in the successive–successive conditions failed to differ from the organization in the other conditions, it would be inappropriate to account for the negative transfer in the successive–successive conditions in terms of the amount of part-list subjective organization.

The source of negative transfer may be better understood by examining whole-list clustering (O–E SCR, Bousfield & Bousfield, 1966) on the basis of old and new items by the *Ss* in the experimental groups. The *Ss* in the successive–successive groups did not organize their recall on the basis of old and new items as well as *Ss* in any other condition. For List B the mean clustering scores were 3.2 in the successive–successive condition and 4.9 in the simultaneous–simultaneous condition, $t(14) = 1.21, p > .10$. For the other list, the mean clustering scores were 4.5 in the successive–successive group and 7.2 for the remaining conditions, $F(3, 36) = 3.10, p < .05$. In the main portion of Experiment III, simultaneous presentation of the part list was beneficial to whole-list clustering, $F(1, 36) = 5.98, p < .025$.

These clustering results indicate that *Ss* learning under the two methods of presentation stored part-list items in different ways. In addition, it seems that method of part-list learning determined the way in which *Ss* attempted to learn the whole list. If positive transfer were observed only when the whole list was presented simultaneously, it would be possible to attribute the present results solely

to idiosyncratic whole-list study. Since positive transfer occurred in the simultaneous–successive condition (see Figure 1), some factor other than learning strategies might be involved. However, a consideration of the task confronting simultaneous–successive *S*s suggests that learning strategies were the important factor. The verbal complaints of the simultaneous–successive *S*s at the onset of whole-list learning indicate that they were chagrined to find the whole list presented successively. Since they were confronted with a more difficult task than during part-list learning, they used any strategy possible to learn the whole list (e.g., the clustering results indicate rehearsal and retrieval of blocks of old and new items). On the other hand, successive–successive *S*s apparently were complacent during whole-list learning; that is, they approached the whole-list task in the same way that they attempted to learn the part list (most probably a serial rehearsal strategy that disrupted retrieval on the basis of old and new items). Such a strategy was obviously self-defeating and resulted in negative transfer.

Conclusions

The present results indicate that part–whole negative transfer can be difficult to obtain. Moreover, positive part–whole transfer occurs when the part list, the whole list, or both lists are learned under simultaneous presentation.

Since the direction of part–whole transfer is dependent upon learning method, and since negative transfer occurred only when there was some part-list subjective organization, it seems that storage and retrieval strategies determine whether or not part-list organization will disrupt whole-list learning.

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