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Part-list recall following part-whole learning*

STEPHEN T. CAREY†
University of Toronto, Toronto, Ontario, Canada

and

RONALD OKADA
Atkinson College, York University, Downsview, Ontario, Canada

Following five trials of part-list free recall learning and six trials of whole-list free recall learning, Ss were asked to recall the part-list items on two successive trials. Experimental Ss whose whole list contained all of the part-list items recalled more part-list items than did control Ss whose whole list contained none of the part-list items. The data are inconsistent with current notion of subjective organization.

The part-to-whole transfer experiment has been cited by Tulving (1966) as providing evidence of the inadequacy of the classical principle of frequency while simultaneously demonstrating the paramount role that organization plays in free recall learning. This conclusion rests on the demonstration that experimental Ss who learn a whole list which includes all of the items of an acquired part list plus an equal number of new items exhibit less efficient learning than do Ss who learn a common whole list following acquisition trials on a part list which contains no words from the whole list. This finding departs from frequency predictions, it is argued, because frequency theory must predict positive transfer for the experimental group due to the fact that experimental Ss have already experienced several acquisition trials with one-half of the items from the whole list.

Tulving (1966) accounts for this finding by proposing that the organization imposed on the part list by the experimental groups is nonoptimal for the whole list and must be overcome in order that an optimal organization can be achieved for the whole list. "To learn the whole-list, the S must reorganize some of the existing units to accommodate the new material or integrate at least some of the existing S-units into larger units [Tulving, 1966, p. 197]."

Recently, Slamecka, Moore, and Carey (1972, Experiment II) provided evidence that positive transfer obtained in the part-to-whole paradigm if low criterion instructions were given for recall during whole-list acquisition. This study was interpreted as demonstrating that some items that were accessible during whole-list learning were not emitted because S was not certain whether they were members of the whole or the part lists. This reluctance by S to emit possibly inappropriate responses, it was argued, accounted for a portion of the inferior performance of the experimental group as contrasted with the control group, which was not hindered by this identity problem. Furthermore, to the extent that such a difference in criterion exists between experimental and control conditions, an unbiased test of the frequency and organization hypotheses is prevented.

An alternative method for testing the frequency and organization hypotheses would be to conduct a part-to-whole-to-part experiment, in which Ss are asked to recall the part list following acquisition trials on the whole list. If, as Tulving (1966) maintains, organization is the overriding factor and frequency is relatively unimportant, then the experimental group should prove inferior to the control group in final part-list recall. This follows from the premise that if experimental Ss must reorganize their S units so as to accommodate the new items in the whole list and recall is dependent upon the retrieval of S units, then experimental Ss must prove inferior at final part-list recall. Conversely, frequency theory must predict that the experimental group will prove superior in final part-list recall following whole-list trials, since their frequency count for part-list items is twice that of their control counterparts. It is, of course, requisite that the crossover effect be replicated during whole-list acquisition for there to be an unbiased test of Tulving's (1966) hypothesis.

METHOD

Subjects

The Ss were 152 students of both sexes at the Darcell Senior Public School in Toronto. They were assigned at random to two conditions of 76 each, with the restriction that each of the conditions be equated for males and females as well as number of Grade 6 and Grade 8 students. The Ss were tested in matched groups of 24-28.

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†Requests for reprints should be sent to Stephen T. Carey, Department of Psychology, Collège Universitaire, University of Alberta, Edmonton, Alberta, Canada.

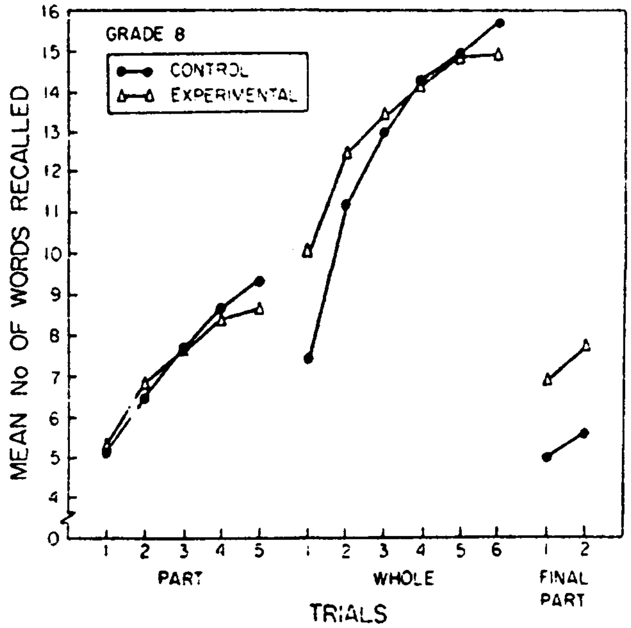

Fig. 1. Mean number of words recalled for Grade 8 Ss in part-, whole-, and final part-list recall.

Materials and Design

All Ss learned a common part list prior to the whole list. Experimental Ss learned a whole list which included all of the words from the part list plus an equal number of new items. Control Ss learned a whole list which had no words in common with the part list. All lists consisted of two-syllable nouns from the Thorndike and Lorge 1,000 most common words. First lists had 12 words and transfer lists had 24. To generalize across stimulus materials, two different sets of lists were used.

Procedure

All groups were treated similarly during List 1 learning. After standard free recall instructions were read, the first list was presented via tape recorder at a 1-sec rate. Following list presentation, 45 sec were allowed for written recall. There were five alternate training and test trials, with the items computer-randomized on each trial. For the transfer task, all groups were told, "We will now go on to a longer list. Listen and write down the words in any order after the list has been read." In keeping with Tulving (1966), no Ss were informed of the relationship the second list had to the first. Presentation of the whole list was via tape recorder at a 1-sec rate, and 90 sec were allowed for written recall. There were six alternate training and test trials, with items computer-randomized on each trial.

Following 90 sec of free recall of the sixth presentation of the second list, Ss were told to take the next page in their booklet and were then given these instructions: "You are now to write down the words from the first or shorter list that you studied in this experiment. Do not write any of the words from the longer or second list you heard. You may write these shorter list words in any order, but remember, do not write the words from the longer or second list you studied." Although the final part-list recall instructions might appear to be contradictory given knowledge of whole-list composition, no experimental Ss required further clarification regarding their task. After 2 min of free recall of the part list, Ss were asked to turn to the next page in their booklet. They were then again given the instructions to recall the part list in an attempt to determine if there was an interaction between final part-list recall trials and conditions.

RESULTS

An initial analysis of the data revealed a significant interaction of Grade by Trials for second-list acquisition [$F(5,740) = 4.46$, $p < .01$], indicating different learning rates for Grade 8 and Grade 6 students. Therefore, the data were analyzed separately for Grade 6 and Grade 8 students.

Grade 8 Analysis

First-List Performance

Total correct recall across all five trials did not differ between the two groups [$F(1,74) < 1$]. Mean correct on Trial 5 was 9.26 for the control group and 8.63 for the experimental group as shown in Fig. 1. Only trials proved significant [$F(4,296) = 113.48$, $p < .01$]. The Trials by Conditions interaction was not reliable [$F(4,296) = 1.63$, $p > .05$].

Second-List Performance

Transfer task performance as shown in Fig. 1 suggests a crossover effect. There was no difference in total recall between the experimental and control conditions [$F(1,74) < 1$]. Both the trials effect and Trials by Conditions interaction were significant [$F(5,370) = 109.07$, $p < .01$, and $F(5,370) = 6.08$, $p < .01$, respectively]. In order to obtain a direct test of a crossover effect, the recall performance of experimental and control Ss was compared on the first and sixth trials of the second list. On the first trial, experimental Ss recalled more items than did control Ss [$t(74) = 4.35$, $p < .01$]; however, on the sixth trial, there was no statistical difference in recall levels [$t(74) = 0.89$, $p > .05$]. In view of the late crossover for Grade 8 Ss, this latter finding is not surprising.

Final Part-List Recall

An analysis of the final part-list recall data showed the experimental group to be superior to the control condition [$F(1,74) = 11.06$, $p < .01$]. In addition, there was a significant improvement in part-list recall across final recall trials for both groups [$F(1,74) = 12.21$, $p < .01$] and an $F(1,74) < 1$ for the interaction of Trials by Conditions (Fig. 1). The mean final recall collapsed over the two recall trials for the part list was 5.28 for the control group and 7.26 for the experimental group.

Intrusion Analysis

Although intrusions were rare, an intrusion analysis was performed on the final part-list recall data for items from the whole list (see Table 1). An analysis of variance of the intrusion data found no difference between experimental and control conditions [$F(1,74) = 3.47$, p > .05]. Both experimental and control conditions showed an increase in intrusions across recall trials [F(1,74) = 13.91, p < .01], while the F for the interaction of Trials by Conditions was less than 1. Mean intrusion of whole-list members during part-list recall collapsed over trials was 0.40 for control Ss and 0.82 for experimental Ss.

Grade 6 Analysis

First-List Performance

Total correct recall across all five trials did not differ between the two groups [F(1,74) < 1]. Mean correct on Trial 5 was 7.37 for the control group and 7.65 for the experimental group as shown in Fig. 2. Only trials proved significant [F(4,296) = 69.68, p < .01]. The Trials by Conditions interaction was not reliable [F(4,296) < 1].

Second-List Performance

Transfer task performance as shown in Fig. 2 replicated the crossover effect. There was no difference in total recall between conditions [F(1,74) < 1]. The trials effect was reliable [F(5,370) = 86.33, p < .01], as was the Trials by Conditions interaction [F(5,370) = 18.43, p < .01]. On the first trial of the second list, experimental Ss recalled more items than did control Ss [t(74) = 6.24, p < .01]; on the sixth trial, control Ss recalled more items than did experimental Ss [t(74) = 2.52, p < .01]. Thus, the part-to-whole crossover effect has been replicated.

Final Part-List Recall

An analysis of the final part-list recall data again showed the experimental group to be superior to the control condition [F(1,74) = 7.48, p < .01]. Recall improved across recall trials for both groups [F(1,74) = 6.77, p < .05]. The interaction for Trials by Conditions was not significant [F(1,74) < 1]. The mean recall for part lists collapsed over trials was 4.48 for the control condition and 6.24 for the experimental group.

Intrusion Analysis

An analysis of intrusions (see Table 1) from the whole list during final part-list recall showed that although intrusions were infrequent, experimental Ss emitted more items from the whole list during part-list recall than did control Ss [F(1,74) = 4.38, p < .05]. Again, both groups made more intrusions during the second final part-list recall than during the first [F(1,74) = 4.74, p < .05]. Since all groups in this experiment showed an increase in intrusions across trials of part-list recall, we interpret the improvement in part-list items recall as due, at least in part, to a change in criterion of emission

Table 1
Mean Number of Intrusions of Second List Items During Part-List Recall

		Trial 1	Trial 2
Grade 8	Experimental	0.64 (13)	1.00 (17)
	Control	0.29 (8)	0.50 (13)
Grade 6	Experimental	0.97 (18)	1.18 (22)
	Control	0.34 (8)	0.63 (9)

Note–The numbers in parentheses refer to the number of Ss contributing intrusions to each cell; however, cell means are based on the data for all 38 Ss.

across successive recall trials. The F for the interaction of Trials by Conditions was less than unity. Mean intrusions averaged over trials were 0.49 for control Ss and 1.07 for experimental Ss.

DISCUSSION

The question at issue in this paper concerns the adequacy of the organization hypothesis, as advanced by Tulving (1966), to account for the crossover effect during whole-list learning in the part-to-whole paradigm and the predictions made by the organization theory with regard to subsequent part-list recall. As noted in the introduction, if Ss in the experimental condition must reorganize the S units acquired in the part list so as to establish an optimal organization for the whole list, this "integration of existing S-units into larger units" (Tulving, 1966, p. 197) should result in S's relative

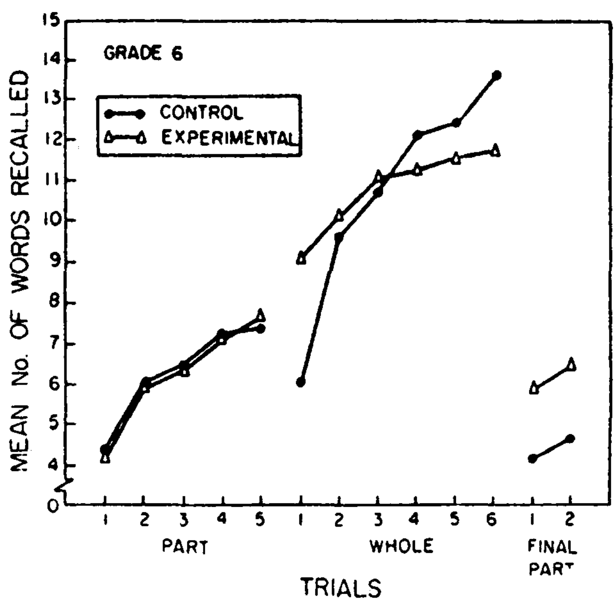

Fig. 2. Mean number of words recalled for Grade 6 Ss in part-, whole-, and final part-list recall.

inability to reproduce the previous S units of the part list, and since "recall performance is dependent upon the existence and the nature of S-units" (Tulving, 1966, p. 194), it follows that, compared with the control group which had no reason to modify their organization of the part list, experimental Ss must prove inferior at part-list recall. Clearly, this prediction is not supported by the data. Experimental Ss in both analyses were superior to control Ss at part-list recall.

An obvious criticism of the paradigm concerns the possibility that Ss in the experimental condition might search through their whole list and output only those items which were members of the part list in spite of instructions to the contrary. However, since "recall is dependent on the retrieval of S-units," such an explanation assumes that Ss can destructure the reorganized optimal S units of the whole list to yield the S units of the part list and thereby output the appropriate items from the part list. This assumption would logically be denied by Tulving's (1966) notion of the reorganization and integration of new S units which are optimal for whole-list learning.

Second, such an explanation assumes that Ss are aware that the part list is contained in the whole list, an assumption that is denied by both subjective reports and empirical evidence. For example, Wood and Clark (1969) and Novinski (1972) have shown that if Ss are aware that the whole list contains the part list, then the crossover effect will not be obtained in the first place.

Lastly, it might be expected that if experimental Ss were recalling the part-list items by searching through the whole list, an interaction of Trial by Conditions for part-list recall would be apparent due to the differential effect that a dissipation of RI would have on the two conditions. That is, if part-list recall depended on a search through the S units of the whole list for experimental Ss, we might expect that part-list recall would decrease, whereas control part-list recall would increase as second-list dominance dissipated. The data do not support such a view. For part-list recall, the F for the Trials by Conditions interaction was less than 1. Thus, the dissipation of RI did not differentially affect the two conditions. In an effort to determine what strategy S did employ to recall the part list, a detailed analysis of the intrusion data was performed.

In spite of the questionable status of intrusions and their relatively small numbers in this experiment, they provide some evidence (at least for the Grade 6 analysis) that the discrimination between the first and second list was more difficult for experimental Ss than for control Ss. That is, for the Grade 6 students, the mean number of intrusions was significantly higher for experimental Ss than for control Ss in final part-list recall. In addition, for the Grade 6 analysis, twice as many Ss from the experimental condition contributed intrusions as did Ss from the control condition. This finding is consistent with Slamecka, Moore, and Carey (1972, Experiment II), who proposed that the list identification problem was greater for experimental Ss than for control Ss, thereby giving rise to a higher emission criterion for experimental Ss.

The fact that Grade 8 students were more proficient at this list discrimination task is evident in both the lack of a difference between control and experimental Ss in mean intrusion rates as well as the equality in number of Ss from control and experimental conditions who contributed intrusions from the whole list. It may well be that the more rapid acquisition of the second list by eighth graders is also due to their more efficient list discrimination.

It is possible, however, to argue that the obtained intrusion scores are biased, since for the experimental Ss some of the intrusions from the whole list would be scored as correct items. These "unidentifiable intrusions" (Tulving & Osler, 1967) would, of course, inflate the experimental S's final part-list recall scores. A correction for this possibility would require that a true estimate of intrusions be calculated by doubling the number of obtained intrusions for the experimental Ss and comparing this value with the obtained mean intrusion rate for the control Ss (Tulving & Osler, 1967).

For the Grade 8 analysis, this would result in a mean intrusion rate from the whole list of 1.64 for the experimental Ss as compared with a mean intrusion rate of 0.40 for the control Ss. If we then correct the part-list recall scores for these "unidentifiable intrusions" from the whole list by subtracting the number of *obtained* intrusions from the number of recalled words, the *corrected* mean for the experimental Ss becomes 6.44 compared with the *uncorrected* control Ss' mean recall of 5.28 items of the part list in final recall trials.

If we apply a similar correction for intrusion rates for the Grade 6 analysis by doubling the obtained experimental mean intrusion rate, we obtain a mean intrusion rate of 2.14 for the experimental Ss as contrasted with a mean rate of 0.49 intrusions for the control Ss. If we then correct the mean part-list recall scores for the experimental group by subtracting the mean number of *obtained* intrusions (to correct for unidentifiable intrusions), we obtain a mean of 5.16 part-list words recalled for the experimental Ss and a mean of 4.48 words for control Ss. A reanalysis of final part-list recall with this conservative correction factor comparing obtained part-list recall minus obtained intrusions for experimental Ss with raw recall of part list for control Ss shows that the difference in the recall of the part list did not quite reach significance [$F(1,148) = 3.50$, $p > .05$]. As expected, Grade 8 students recalled more of the part list than did Grade 6 students [$F(1,148) = 4.58$, $p < .05$], which reflects their more efficient list discrimination. The Grade by Conditions interaction yielded an F of less than 1. All groups showed significant improvement across the two trials in final part-list recall [$F(1,148) = 8.86$, $p < .01$].

The results from this experiment lead to three conclusions. First, experimental Ss, in spite of the greater difficulty in discriminating first-list items from second-list items during whole-list acquisition, are capable of recalling more part-list items following whole-list acquisition than are control Ss. This finding is compatible with Slamecka, Moore, and Carey (1972), who found that negative transfer during whole-list acquisition was not due to part-list item inaccessibility, but rather due to an altered criterion of emission due to differential list discrimination. Second, the data question the hypothesis that Ss reorganize S units or integrate S units into larger units during whole-list learning. Rather, it appears that providing S with instructions to recall the part list provides sufficient context for him to reproduce the part-list schemata. Further support for this position is provided by Novinski (1972), who found that experimental Ss tended to cluster old words (words in both the part and whole list) and new words (words only in the whole list) during whole-list recall. Both of these findings are incompatible with Tulving's (1966) conceptualization of the role of subjective organization in part-to-whole transfer, but are compatible with the frequency principle (Slamecka, Moore, & Carey, 1972).

Thirdly, the finding of equal dissipation of RI across successive trials at final part-list recall for all groups may suggest that first-list organization is not differentially affected by second-list acquisition for experimental and control Ss.

In conclusion, these data suggest that whatever organization occurs during part-list acquisition is not undone in any permanent sense as a result of whole-list learning as suggested by Tulving (1966), since experimental Ss did as well if not better than control Ss at recalling the part list following whole-list learning.

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