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Interpretive Factors in Forgetting

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The results of two experiments point to interpretative factors operating during acquisition that determine long-term retention. In the first study, the profound decrement associated with forgetting a second-learned list, or proactive inhibition, was shown to be the product of poorer encodings assigned to List 2 than to List 1 pairs. Post hoc analyses suggested that the type of interpretation assigned to the stimulus is an important determinant of retention. The second experiment contrasted two study methods, one that emphasized the stimulus member of the pair with one that did not, and found superior long-term retention under the stimulus-determining learning method.

The present experiments are concerned with the problem of forgetting. It may be that outside the laboratory the most salient characteristic of memory is its fallability. We cannot remember names, directions, or supermarket lists. Students study for an exam and then cannot produce their knowledge at the time of the test. Although in the laboratory it is easy enough to demonstrate forgetting over both short and long retention intervals, finding variables that influence the amount of forgetting has not been so easy. For example, such variables as the age (Hasher & Thomas, 1973) and learning speed (Underwood, 1954) of the subject, the use of mnemonics (Olton, 1969), imposed pictorial elaboration (Forbes & Reese, 1974), or the meaningfulness (Underwood & Richardson, 1956) of the materials seem to affect the rate at which word lists are learned, not their retention.

Apart from the initial level of learning, the most reliable variable known to influence retention is the amount of similar material learned previously (Underwood, 1957). For example, students who have learned and recalled several paired-associate lists may retain less than 25% of the last list they learned even when retention is tested after only 24 hr (Keppel, Postman, & Zavortink, 1968) and when the last list enjoyed substantial amounts of overlearning (Jenkins, 1974).

Perhaps the most common situation used to investigate the effects of similarity of material involves having subjects learn two successive paired-associate lists in an A–B, A–D paradigm. In this case, substantial forgetting of the second list, relative to a single-list control, is a reliable experimental observation. According to classical interference theory, memory suffers when a stimulus is asked to serve as a cue for more than one event (e.g., A as a cue for both B and D), because the two responses may compete with each other when the subject is trying to recall one of them. The result of this competition process is a reduction in the probability of recalling either or both of the responses. Response competition has been the most widely accepted explanation of the detrimental effect that previous learning has on the long-term retention of later acquired material (cf., Keppel, 1968; Postman & Underwood, 1973). Among others, a major problem with this interpretation is the persistence of a negative effect from prior material under

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conditions designed to eliminate response competition (e.g., Koppenaal, 1963; Postman, Stark, & Fraser, 1968).

If not competition between responses at recall, what then might account for the difficulty subjects have in remembering the second-learned response to a stimulus? An acquisition process is one obvious alternative (Keppel, 1968; Postman, Stark, & Burns, 1974; Postman & Underwood, 1973). For instance, second-list associations or mediators or elaborators may be of a lower quality than those acquired in the first list. It is possible that the associations a subject generates to pairs in the second list may function well enough while the subject is intially learning the list, but they may be less stable over long retention intervals. Experiment 1 was a test of this possibility.

Experiment 1

An initial group of subjects learned two paired-associate lists that conformed to the A–B, A–D paradigm and, at the end of each list, reported the particular elaborators that had been used for each pair. These elaborators were then given to new subjects who learned and recalled a single list with the aid of a set of either first-generated or second-generated elaborators. If the elaborators generated during A–D learning are, in fact, inferior to those from A–B learning, then subjects given second-list elaborators should forget more than subjects given first-list elaborators.

Method

The experiment consisted of two phases, collection of elaborators and single-list retention. These will be discussed separately.

Phase 1: Elaborator Collection

Procedure. Two 12-item paired-associate lists were learned in succession to a criterion of one perfect trial. After learning each list, subjects were asked to produce the elaborators they had used for each pair. Instructions given at the beginning of the experiment explained the nature of elaborators, encouraged their use, and informed subjects that they would be asked to produce them after they had learned the list. Subjects were instructed to use one-word elaborators that either modified or added to the meaning of the stimulus and/or formed a link to the response.[1]

The study–test method of presentation was used with a 4-sec study interval and a 4-sec test interval. Materials were typed on 3 × 5-in. (7.62 × 12.70 cm) cards which the subject turned, pacing himself to recorded clicks. At the end of first-list learning, the subject was read, one at a time, each of the 12 pairs in the list. The subject was allowed as much time as he needed to produce the elaborators he had used. The second list was learned immediately after the elaborator-production phase. The same procedure was then followed for second-list learning and production of the elaborators.

Materials. Two sets of lists conforming to the A–B, A–D paradigm were devised. The lists were comprised of paired nouns selected from the Paivio, Yuille, and Madigan (1968) norms. The mean concreteness values for the 24 stimuli and the 48 responses were 5.92 and 2.62, respectively.

Each of the two sets of A–B, A–D lists was learned by four subjects. Because the order of the two lists in a set was counterbalanced, each list was learned by two subjects as their first list and by two other subjects as their second list. This procedure provided eight sets of elaborators generated from first lists and eight generated from second lists.

Subjects. Subjects were undergraduates at Carleton University who could earn extra credit in an introductory psychology course for their participation in experiments. In all, 20 subjects had to be run to get the 8 needed to generate elaborators. Subjects' protocols were discarded for any of several reasons: (a) failure to give elaborators for all pairs in both lists, (b) use of the same elaborator for more than one pair within a list, (c) failure to give one-word elaborators, (d) failure of equipment, and (e) experimenter error.

Phase 2: Single-List Retention

Procedure. Sixty-four subjects learned a single paired-associate list to a criterion of 9 out of 12 correct. All subjects were provided with elaborators to use during acquisition. The design was a 2 × 2 factorial with the source of the elaborator, first-or second-learned list, as one factor and the retention interval, 2 min or 1 wk, as the other. As in the first phase, 3 × 5-in. cards were used, with the pairs to be learned typed in capitals and centered on the card. The appropriate elaborator was shown in small letters, in parentheses, near the top of the card. During acquisition, the elaborators were provided on each study trial. They were not shown on the test trials. Subjects were instructed that they could increase their rate of learning if they used the elaborators provided. In all other respects the procedures used in the acquisition phase of this experiment were identical to those used in the collection phase.

[1] One-word elaborators were requested because of limitations of space for presenting elaborators on the study–trial 3 × 5 in. cards.

The retention test was a three-trial, stimulus- and elaborator-cued test of recall. All materials maintained the spatial and orthographic characteristics used on the study trials. Responses were not provided during the retention test. The test was paced at 4 sec per item, with a 4-sec intertrial interval.

In both phases of the experiment, four unique study- and test-trial item orderings were used. Care was taken to ensure that no item occurred in the same presentation position across successive trials. Two different starting orders were used. In both experiments, subjects were assigned to conditions so that all four conditions were filled with equal numbers of subjects before an additional subject was assigned to any condition.

Materials. Each of the eight sets of elaborators generated from first-learned lists, by subjects in Phase 1, was given intact to two subjects in the immediate retention condition and to two subjects in the delayed retention condition of Phase 2. The same procedure was followed for the eight sets of elaborators generated from second-learned lists. This resulted in 16 subjects in each of the four conditions in Phase 2. Subjects again were volunteers from undergraduate psychology courses at Carleton University. They were run individually in randomized blocks of the experimental treatment.

Results and Discussion

Elaborator-Production Phase

The learning scores in this phase of the experiment showed a standard pattern; the second list took fewer trials to learn than the first. There were no differences in performance among the lists used in the experiment.

Single-List Retention Phase

The acquisition scores for the four conditions are shown in Table 1. A 2 × 2 analysis of variance on the number of trials required to reach criterion showed no significant effects, all *F*s $(1, 60) \leq 1.13$, $MS_e = 4.50$. The critical rejection region in this, and all other analyses, was $p < .05$. Thus, subjects learned at equal rates whether the elaborators they were provided with came from a subject who had learned that list as his first or his second list. A similar finding was seen in criterial-trial performance. No differences were found among the conditions, all *F*s $(1, 60) \leq 2.86$, $MS_e = .66$. Thus, at the end of acquisition the two elaborator conditions were equated in their terminal levels of performance.

The retention test scores are also shown in Table 1. Initially a 2 × 2 analysis of variance was performed on the Trial 1 retention scores because this was viewed as the most sensitive index of forgetting. The main effect of elaborator source was significant, $F(1, 60) = 4.23$, $MS_e = 4.02$, as was that for time, $F(1, 60) = 141.80$. The Elaborator Source × Time interaction was not significant, $F(1, 60) = 2.05$. Thus, depite equal levels of learning, retention was superior for those subjects who had learned with List 1 elaborators, whether they were tested shortly after learning or 1 wk later, than for those subjects who had learned with List 2 elaborators. These same effects were also seen in an analysis performed on Trial 1 loss scores, a measure of the difference between each subject's criterial and retention scores.

A 2 × 2 × 3 repeated measures of analysis of variance was performed on the retention scores across the three successive test trials. In this analysis the effect of elaborator source fell short of significance, $F(1, 60)$

TABLE 1

MEAN ACQUISITION AND RETENTION PERFORMANCE

Condition	Trials to criterion	Correct at criterion	Retention: Trial 1	Retention: Trial 2	Retention: Trial 3
Immediate recall					
First-list elaborators	4.75	9.44	9.50	9.44	9.81
Second-list elaborators	4.44	9.75	9.19	8.88	9.63
Delayed recall					
First-list elaborators	3.87	10.12	4.25	4.19	4.81
Second-list elaborators	4.69	9.75	2.50	2.94	3.44

$= 3.47$, $MS_e = 11.36$. Significant forgetting was still observed, $F(1, 60) = 138.19$. In addition, there was significant improvement across the three test trials, $F(2, 120) = 17.31$, within-subjects error $= .39$. No other effects approached significance. Analyses on the loss scores showed parallel effects.

Although there was a significant effect of elaborator source on Trial 1, the borderline nature of the elaborator source effect in the repeated measures analysis prompted further analyses. It seemed possible that the effect of elaborators on retention might be different for fast-learning as compared to slow-learning subjects. The median number of trials to criterion for the four conditions was obtained; subjects above the median were called fast and those below the median were called slow. On the average, fast subjects took 2.88 trials to reach criterion, whereas slow subjects took 6.00. Performance at criterion was reanalyzed using speed of learning as a factor. There were no differences among the conditions, all Fs $(1, 56) < 2.78$, $MS_e = .68$. The mean number correct on the criterion trial was 9.84 for the fast subjects and 9.69 for the slow subjects.

The retention scores were then reanalyzed using the subject variable as an additional factor. Again, there were main effects seen for forgetting, $F(1, 56) = 165.24$, between-subjects error $= 9.50$, and for improvement across test trials, $F(2, 112) = 13.5$, within-subjects error $= .50$. Lists learned with first-list elaborators were better retained than those learned with second-list elaborators, $F(1, 56) = 4.15$. On the average fast subjects recalled an item more than slow subjects, a difference that proved significant, $F(1, 56) = 4.95$. The main effects for elaborator source and subject type must be interpreted in light of their significant interaction, $F(1, 56) = 7.25$. Fast learners given List 1 elaborators recalled an average of 6.90 responses, whereas those fast learners given List 2 elaborators recalled 7.19 responses. The slow learners who were given List 1 elaborators recalled 7.10 responses, whereas those who were given List 2 elaborators recalled 5.00. Thus, elaborator source influenced retention only for slow learners. If slow learners are given List 1 elaborators, they retain about as much as fast learners given either set. Slow subjects show poor retention when they are given the second-list elaborators. This interaction might be accounted for by assuming that slow learners are less likely to "embellish" the elaborators than are fast learners and, thus, the manipulation of elaborator type is more effective for the slower subjects.

The present experiment demonstrates that first- and second-list elaborators differ in quality when passed on to new subjects to be used in learning a single list. Suppose the first-list elaborators were more similar than were the second-list elaborators to those generated by the new subjects. It is possible then that subjects would tend to use the first-list elaborators more than the second-list elaborators (Schwartz & Walsh, 1974); thus, subjects given List 2 elaborators would be more disrupted at the time of recall than those given List 1 elaborators. Alternatively, elaborators that are influential in the retention of a single list are not necessarily those that are influential in the retention of a second list. Although the present design does not rule out these two possibilities, the results clearly lend support to the hypothesis that retention of a second list in an A–B, A–D paradigm may suffer because less stable elaborators are generated for A–D than might be.

Thus, it is increasingly plausible that the loss of recently acquired information cannot be accounted for solely with a mechanism, such as response competition, that operates at retention (e.g., Dillon, 1973; Postman, Stark, & Burns, 1974). The pronounced retention deficit produced by previously learned information (proactive inhibition) may be the result of conditions that prevail at the time a second list is learned which operate to reduce the quality of the interpretation assigned to the pairs during acquisition.

The idea that the quality of first- and second-list relationships may differ has been presented previously (e.g., Keppel, 1968; Postman & Underwood, 1973). The implicit assumption in these discussions is that the subject uses his best mediational devices in learning the first paired-associate list. Thus, the subject must rely on lower quality mediators in learning the second list. Consequently, these associations should be more likely to be forgotten than the stable, first-list ones (Keppel & Zavortink, 1969). The present experiment verifies the notion that the quality of the first- and second-list mediators may certainly differ. Of course, the next most obvious question is, How do they differ? What is a subject's best mediational or elaborative device? One seemingly reasonable hypothesis is that the best device utilizes the most salient or most vivid aspects of the stimulus. This would necessarily leave only some less salient or less vivid aspect of the stimulus to be used during second-list learning.

An alternative view of the qualitative differences between first- and second-list elaborators could be derived from an extension of ideas presented in Martin (1968) and Greeno, James, and DaPolito (1971). Assume that the way in which a stimulus term is encoded depends at least in part on the particular response with which it is paired. Further assume that once the subject has encoded a meaningful stimulus, he is likely to maintain his earlier encoding during List 2 learning (cf., Goggin & Martin, 1970; Postman & Stark, 1971). Thus the encoding assigned a stimulus paired with two responses is likely to be maximally appropriate for the first rather than the second response.

The former hypothesis assumes the most salient aspects of the stimuli are used up on the first list and, thus, predicts a difference in the degree of stimulus-relatedness of first- and latter-list elaborators; the second hypothesis predicts that the first- and second-list elaborators will be similar in stimulus-relatedness but differ in response-relatedness, with the second-generated elaborators being less response related than are the first-generated elaborators.

In order to obtain some data relevant to these speculations, five raters (none of whom served in the earlier parts of this study) were asked to look at each elaborator used in Experiment 1, along with the pair for which it had been generated, and to classify it as being related to the stimulus term only, the response term only, or to both members of the pair. An additional category, unrelated, was also provided in case the rater could specify no relation. Each elaborator was then classified as one of these four events if three of the five raters agreed on a classification. If there was no agreement, the item was classified as unratable. The distribution of these five categories across the two sets of elaborators is shown in Table 2. As you can see, the first list tends to show more stimulus-related elaborators than the second list. In addition, the second list tends to show more response-related elaborators. Although clearly not conclusive, these rating data tend to support the first hypothesis above, namely, that good mediators are related to the stimulus terms and tend to be replaced by poorer mediators (perhaps those determined primarily by responses) during second-list learning.

TABLE 2

FREQUENCY DISTRIBUTION OF RATED ELABORATOR TYPE BY LIST

Elaborator type	List 1	List 2
Stimulus	69	54
Response	39	54
Both	22	20
Not related	12	15
Unclassifiable	50	49

In Experiment 1, learning a second response to a stimulus resulted in a relatively poor elaborator or encoding of the stimulus. Experiment 2 was an attempt to influence the interpretation of the stimulus in a different situation.

EXPERIMENT 2

Consider the study trial in the standard study-test method of paired-associate learning. A stimulus word is arbitrarily paired with a response word and they are presented simultaneously. There is a good opportunity for the response term to influence the initial interpretation of the stimulus. Consequently, the aspects of the stimulus which the subject thinks about may not always be the most common or salient. For example, think of the pair *canary–thimble*. The subject may focus on the fact that canaries are small in order to establish a relationship between canary and thimble. Later, on the retention test, when the subject is presented with *canary* alone, he may think about a yellow bird that sings and fail to consider the animal's size. Thus the interpretation of the stimulus at the delay is not consistent with the primary interpretation at acquisition; recall of the response might then suffer.

Suppose, however, that the subject thought of the stimulus at acquisition in terms of one of its primary attributes. For example, a canary is a yellow bird that sings. Then, in order to make a relationship between canary and thimble, the subject might imagine a tailor singing while he works. In this case, chances should be greater that the characteristics of the stimulus considered after a delay would be those considered earlier, and so would be appropriate for generating the response.

In Experiment 2, we contrasted the retention of a single paired-associate list learned by the standard study–test method with that of a list learned by a modified method which we believed would increase the importance of the stimulus term in determining the interpretation assigned the pair. During the study trial in the standard study–test method of paired-associate learning, each stimulus and response are presented simultaneously. This allows the subject to arrive at whatever elaborators he chose, be they stimulus related, response related, or linked to both. We know, of course, from Experiment 1 that a subject who is learning his first paired-associate list is likely to use more stimulus-related elaborators than any other type. To increase the probability of stimulus-related encodings, we used a successive method of pair presentation in which the stimulus term appeared alone first followed by the response term. We believed that subjects in the successive condition would be even more likely than subjects in the standard condition to use stimulus-related elaborators. The beneficial effect of stimulus codes were expected to facilitate long-term retention.

Method

Design. The design was a 2×2 independent groups factorial. Subjects learned a 12-item paired-associate list by the study–test method to a criterion of 8 out of 12 correct. Two methods of presentation were used on the study trials. In the standard method, the two members of each pair were presented simultaneously. In the successive method, the two words were presented in succession, with the stimulus term preceding the response. Retention was then tested for half of the subjects in each of the two training conditions immediately after criterion was reached, and for the other half after 7 ± 1 days.

Materials. Two 12-item paired-associate lists were comprised of nouns selected from the Paivio et al. (1968) norms. The stimulus terms had a mean concreteness value of 4.37, the response, 4.99. However, the range of these values was more limited for the stimulus than for the response terms—4.00–4.94 versus 4.08–5.95, respectively. Each list was used equally often in each condition of the experiment.

Two different study- and test-trial orders were constructed so that each item occupied a different position on each trial. Each order was used as the initial trial for half of the subjects learning each list.

Procedure. The subjects were run individually. Materials were projected on a blank wall by a slide projector that was regulated by a synchronizer. On the study trials for both the successive and simultaneous procedures, each pair was allotted a total of 3 sec. This was accomplished as follows: For the successive condition, three slides were shown in immediate succession, each for 1 sec—the stimulus, the response, and a blank. For the simultaneous condition, a pair was presented for 2 sec followed by a blank slide shown for 1 sec. The test-trial procedure was identical for the two practice conditions. Each stimulus was shown alone for 2 sec. The subject responded orally.

Retention was tested at both the immediate and delay intervals by the same procedure. Two successive trials on a self-paced, stimulus-cued recall test were used. No feedback about correctness of responses was provided.

Subjects. The subjects were undergraduates enrolled for the summer term at Temple University. They were paid $2 for their participation. Subjects were assigned randomly across the four conditions in the experiment until each condition contained 12 subjects.

Results and Discussion

Acquisition Performance

The number of trials to reach criterion is shown for the four conditions in Table 3.

The 1.5 trial difference in learning rates between the two conditions was significant, $F(1, 44) = 8.45$, $MS_e = 3.56$. Learning was slower under the successive presentation condition than under the simultaneous condition.

Inspection of performance on the criterial trial (Table 3) reveals only minute differences among conditions in the terminal level of learning. An analysis of variance detected no significant differences, all $Fs < 1$.

TABLE 3

MEAN ACQUISITION AND RETENTION PERFORMANCE

Condition	Trials to criterion	Correct at criterion	Retention	
			Test 1	Test 2
Immediate recall				
Simultaneous	3.08	10.67	10.75	10.83
Successive	5.58	10.50	10.58	10.58
Delayed recall				
Simultaneous	4.00	10.67	5.17	5.58
Successive	4.67	10.67	7.58	8.08

Retention Performance

Memory for these lists was analyzed with respect to two dependent measures, retention and the more sensitive loss scores. Using a $2 \times 2 \times 2$ analysis of variance design that included repeated measures on the two test trials, we found the same effects for both dependent measures. Retention performance may be seen in Table 3. Substantial forgetting was found over the week's retention interval, $F(1, 44) = 44.17$, $MS_e = 9.06$. The Method $\times$ Interval interaction indicated that the amount of forgetting was greater under the simultaneous than under the successive presentation condition, $F(1, 44) = 4.71$.

Significant improvement across the two retention trials was seen, $F(1, 44) = 12.50$, within-subjects error = .12, and this improvement was greater for the delayed retention conditions than for the immediate conditions, $F(1, 44) = 8.67$. This warm-up-like effect in recall, which was also present in Experiment 1, is often seen in retention studies (e.g., Postman & Stark, 1969). The determining conditions remain to be specified.

The most significant finding in this experiment was the superior retention seen for subjects who learned under the successive presentation condition as compared with the simultaneous condition. Thus, under learning conditions where there is reason to believe the stimulus term has an advantage in determining the interpretation of the pair, retention is facilitated.

The results are also open to an alternative interpretation. Under the successive method, the study trials can function as covert test trials in that when the subject sees the stimulus, he can try to think of the response before it appears. There is evidence that test trials in paired-associate learning facilitate long-term retention (Allen, Mahler, & Estes, 1969). It is possible, as Allen et al., have argued, that the recall of a response increases as a function of its frequency of occurrence on test trials. If subjects in the successive condition used the delayed occurrence of the response as an opportunity to generate it themselves, then superior retention might have been the by-product. Although we do not favor this interpretation, research currently in progress should enable us to distinguish between the testing and stimulus functions of the successive procedure.

Some indication that stimulus relatedness is important can be seen in a subsequent study where one-word elaborators were collected under both simultaneous and successive procedures for both of the lists used above. These were given to new subjects who rated them on a 5-point scale where one extreme indicated an elaborator that was primarily related to the stimulus and the other extreme an elaborator primarily related to the response. Whereas the mean difference was not statistically significant, there was a trend for both lists in the predicted direction. Elaborators contributed by subjects in the successive presentation condition were rated slightly closer to the stimulus than were those from the simultaneous condition. In comparing these rating data with those reported in Experiment 1, there is a similar small but reasonable trend. It should be possible to develop a rating procedure that is more sensitive to potential differences in elaborator characteristics than those used here.

General Discussion

The results of these two studies support the general proposition that retention is critically dependent on factors determined at acquisition. In the first experiment, there was less forgetting with first-generated elaborators and in the second experiment there was less forgetting when the stimulus preceded the response on study trials. What these two situations presumably have in common is a greater likelihood, relative to their respective comparison conditions, that the stimulus term will receive an interpretation which will reoccur after long intervals.

The emphasis placed here on stimulus-related interpretations is simply a product of the typical experimental procedure in which the experimenter presents the stimulus as a cue for the response. Were the situation reversed, the representation of the response term would become the most important determinant of recall of the remaining member of the pair. In addition, learning something new often results in a redefinition of the elements involved. That is, a response, by virtue of the learning process, becomes part of the definition of the stimulus and vice versa. Any part of this meaning unit, including aspects resulting from the unique combination of the two elements, could, under some circumstances, serve as a useful cue for the memory of the event.

However, in situations such as the long-term retention of paired-associates, it is probably best for the subject to try to find a specific and meaningful relationship between two items based on a salient dimension of whichever component is most likely to occur in isolation later. If two elements are simply (or even elaborately) linked in an arbitrary way that is quite remote from reasonably likely interpretations of either, there is not much reason to suppose on logical grounds that either element will serve as a good cue later.

Thus, two words like *canary* and *teakettle* should probably be linked together via their common and more salient ability *to sing* rather than their common property of *being smaller than a breadbox* (unless size is going to be the cue for delayed recall). This argument assumes that, given the cue word *canary* after a substantial retention interval, the subject is more likely to access the meaning domain of canary which includes tea kettle in the former than in the latter case. In other words, to maximize the chance that a person will remember some event, that aspect of the event that is most likely to occur later is the one that should serve to determine the overall interpretation assigned to the event. Insofar as possible, the responses in standard paired-associate learning should be incorporated into a very frequent or salient meaning domain of the stimulus. In the absence of any specific information about factors which later might systematically bias one interpretation over another (e.g., a changed semantic context, as in Light & Carter-Sobell, 1970), this should be the most direct way to minimize the very critical problem of stimulus reinstatement (cf., McGeoch, 1932; Melton, 1963).

Similarly, a reduction in the usual forgetting produced when successive lists are learned should be obtained if subjects are kept from changing their stimulus interpretations from one list to the next and rather are encouraged to build larger organizational units incorporating successive responses around a salient aspect of the stimulus cue. Such a mechanism may be responsible for the reduction in retroactive inhibition seen when a subject is allowed to continue practicing his first list while learning a second (Postman & Parker, 1970).

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