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Inhibition from Part-List Cues and Rate of Recall

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Subjects recalled words from studied lists for 10 min. in a free-recall situation or in the presence of other list or extralist words. The presence of both types of context words reduced recall relative to free recall, but list-word context had a greater inhibiting effect than extralist word context, and only the list-word context produced a lower rate of approaching the asymptote of the cumulative recall function. The inhibition of recall attributable to the context words was diminished but not eliminated when the restriction to recall only target items was removed. The results of two experiments were generally in substantial agreement with the idea that part-list cues or context words exert their damaging effect by competing with target words at retrieval.

An interesting curiosity in recent research on human memory is Slamecka's (1968, 1969) demonstration of the ineffectiveness of part-list retrieval cues. In these experiments, subjects are presented with a list of words and are then tested for recall under either free-recall or part-list cued recall conditions. In the latter, a part of the list words is given to subjects as retrieval cues and the subject's task is to recall the remaining target items. The number of target words recalled by subjects in the part-list cuing condition is compared with the number of these same items recalled under noncued conditions. The general finding in this research is that recall of the remainder of the list is unaffected or actually impaired by part-list cues as compared to recall of control subjects engaged in free recall. The only exception is when cuing allows access to more higher order units (Tulving, 1964) than could have been recalled unaided (see Roediger, 1974, pp. 262–266, for a review).

The ineffectiveness of part-list cues in facilitating recall within higher order units is interesting, since most extant theories of free recall include the notion that under ordinary circumstances the presentation of list words results in the creation of associations among list items, either within smaller groups of words (higher order units, Tulving, 1964) or in the form of a rich and complex network (e.g., Anderson, 1972). Since these associations are assumed to play a role in retrieval, it is most surprising that the presentation of some words from the list does not facilitate recall of the remaining words.

Attempts to reconcile Slamecka's (1968, 1969) part-list cuing results with organizational theories of memory have been based on the hypothesis that facilitative effects of cues are cancelled out by certain inhibiting processes activated by part-list cues (Roediger, 1973; Rundus, 1973; Tulving & Hastie, 1972). This hypothesis is supported by the observation that under certain conditions part-list cues can facilitate recall (e.g., Blake & Okada, 1973).

The present experiments were designed to gain further information on this curious

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inhibiting effect exerted by part-list cues.[1] Performance in previous part-list cuing experiments has always been measured after a fixed and often short period of time. Therefore, it is not yet known how the amount of time for recall affects the inhibition produced by part-list cues. Inhibition of recall may simply reflect a slower output process, especially since subjects in the part-list cued condition are likely to spend time during the recall period studying the cues, while free-recall subjects are not similarly occupied. In order to determine how part-list cues affect the rate at which items are recalled it is necessary to use another method, namely to record recall cumulatively over a long period of time. This will provide two measures of performance: final level of recall (providing a lower bound estimate of availability) and the rate at which this final level is approached. From earlier research (e.g., Bousfield & Sedgewick, 1944) we can assume that cumulative recall curves can be described by the exponential equation

$$n(t) = n(\infty)\ (1 - e^{-\lambda t}), \qquad (1)$$

where $n(t)$ represents the number of items that have been recalled by time t, $n(\infty)$ is the asymptote of the function (the lower bound estimate of availability), e is the base of the natural logarithm, and λ is the rate of approaching the asymptote, a constant. This equation is not perfect in describing performance in episodic memory situations (see Indow & Togano, 1970), but it may do as a first approximation. Hypotheses have been offered as to what psychological processes can be identified with the two parameters, $n(\infty)$ and λ, in Equation 1 (e.g., Indow & Togano, 1970), but for present purposes we shall just be using these as measures of two different aspects of recall.

The first experiment reported here was designed to see how the presentation of part-list cues affects the asymptote and rate parameters of the cumulative recall function relative to free recall. In the part-list cuing situation the list of cues presented to subjects is referred to as the *cue set*, while the other items, the ones the subjects are to recall, are the *target set*. In the free-recall situation the target set is the entire list. Since the target set for part-list cued subjects is smaller than the target set for free-recall subjects, the asymptotic level of cumulative recall is necessarily less for part-list cued subjects than free-recall subjects on their respective target sets.[2] What is not known is how the other parameter in Equation 1, λ (the rate of approaching the asymptote), is changed when the asymptote is reduced.

Three possible variations in λ are pictured in the three panels of Figure 1. Each panel represents a pair of hypothetical exponential functions in which recall, $n(t)$, is plotted against time t. The asymptote, $n(\infty)$, is 80 for one function in each panel and 40 for the other. The far left panel depicts the case where the rate of approaching the asymptote is greater for the function with the smaller asymptotic level of recall. Previous research has established this as the typical finding: The greater the asymptotic level of recall, the slower the rate of approaching the asymptote (e.g., Bousfield & Sedgewick, 1944; Indow & Togano, 1970). If presentation of part-list cues resulted in an effect of this sort, it would mean that the negative effect of presenting part-list cues occurs relatively late in the recall period and would only manifest itself with longer periods. Early in the recall period part-list cued subjects may almost keep pace with free-recall

[1] Strictly speaking, an ineffective or inhibiting retrieval cue is a misnomer. A more appropriate term would be "retrieval context," since recall of a certain set of learned words (target words) is attempted in the presence of another set (list-word context, or extralist word context). We will, however, use the term *cues* (as in part-list cues or extralist cues) for the sake of continuity with the previous reports on this topic, even though these cues do not, and sometimes cannot even be expected to, facilitate recall.

[2] This is not the inhibition effect to which reference has been made. The inhibition effect refers to the disadvantage displayed by part-list cued subjects when both they and free-recall subjects are scored on the basis of the part-list cued subjects' target set, or when both are scored on proportion recalled from their respective target sets.

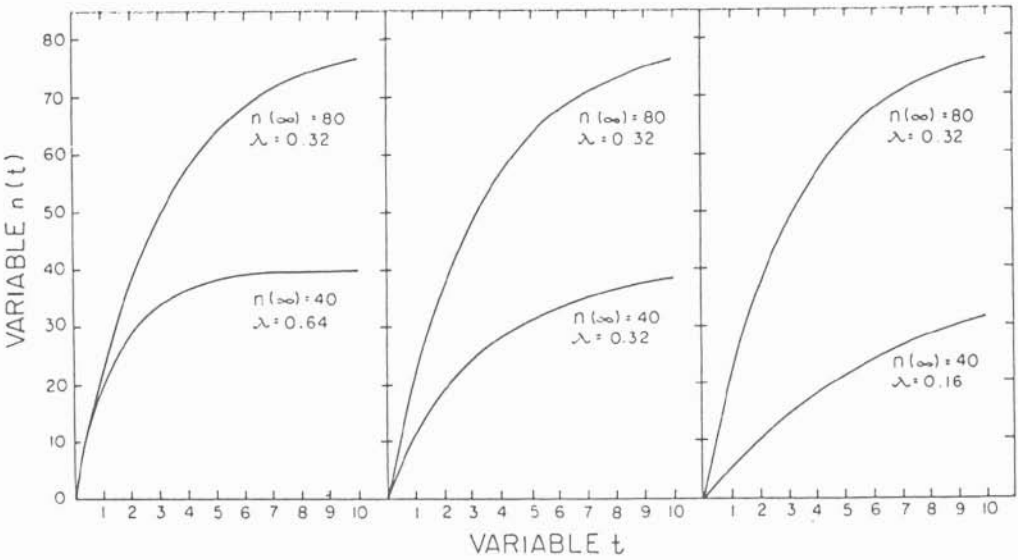

Figure 1. Hypothetical cumulative recall functions fit by Equation 1 where $n(\infty)$ is fixed at 40 or 80 and λ varies (t = time).

subjects but suffer an increasing disadvantage as recall proceeds. Since recall periods in part-list cuing experiments have typically been relatively short, the outcome pattern depicted in the left panel seems unlikely, despite the fact that it has been found in many other word retrieval experiments.

The second panel in Figure 1 illustrates a case where some variable affects the asymptote of the cumulative recall function but leaves the rate of approach unaffected. Such a result has been reported by Metlay, Handley, and Kaplan (1971) in an experiment in which subjects had to recall from a larger memorized set a specific subset of words containing certain letters. For example, in one condition subjects were told to recall those names of the United States presidents that contained the letter *y*. This requirement defined a target set of 5 names. In other conditions the target sets were specified by the letters *s* and *e* which gave rise to target sets of 11 and 15 names. The specification of a target set on the basis of constituent letters of a name produced cumulative recall curves with different asymptotes but similar approach parameters, λ. A reasonable interpretation of this pattern of data is that subjects were implicitly generating (retrieving) names of presidents at the same rate in the different conditions, but were overtly recalling only those names that satisfied the recall criteria.

This interpretation may also be reasonable for the part-list cuing situation if one assumes that the "cues" do not provide access to additional information but only serve as instructions to the subjects as to which of the implicitly retrieved items to produce overtly. Subjects given part-list cues may retrieve words in the same manner as free-recall subjects, but part-list cued subjects must also check each retrieved item against the cue set and recall only those that are not members of the cue set, that is, those belonging to the target set. As in the Metlay et al. (1971) experiment, this would affect the asymptote of the cumulative recall function but not the rate. However, the time taken by part-list cued subjects to check retrieved items against the cue set might reduce the rate slightly and thus produce the inhibition effect. With a very long recall period such as effect should disappear or, if the cues also provide access to new information, part-list cued recall with a long recall period may conceivably even be greater than performance of free-recall subjects when scored on the same items.

The right-hand panel in Figure 1 represents a case that has apparently never been reported. Here some variable reduces both the asymptote of the function and the rate of approach. Part-list cues may have this effect if they reduce the rate at which subjects are able to produce new candidates for recall.

It is not known which of the possibilities represented in Figure 1 and just discussed is the most accurate representation of the effect of part-list cues on the temporal course of recall, since previous experiments have used short periods and cumulative measures have not been taken. The first experiment reported here was designed to determine this. One very interesting possibility is that with an extended recall period there may be no inhibiting effect of part-list cues if the inhibition is due to some simple factor such as reduced rates of recall (relative to free recall) from studying words in the cue set or from checking retrieved items against those in the cue set.

Experiment 1

Subjects were presented with two lists of 48 unrelated words and were provided at recall with 0, 16, or 32 items from the list as cues for the remainder. A long (10 min.) recall period was provided and rate of recall was measured in order to determine cumulative recall functions.

Method

Subjects. The 96 subjects were recruited from a pool of high school and college students living near Purdue who had agreed to serve in psychological experiments for pay. All served in another experiment, just before this one, involving recall of categorized lists.

Materials. The two 48-word lists were constructed from concrete words from the norms of Paivio, Yuille, and Madigan (1968). All words had concreteness values greater than 6.10. The words were randomly assigned to lists except that high associates were excluded from the same list as much as possible. Thus the lists were of unrelated words.

Design. Subjects recalled the lists under one of three experimental conditions. For one group of subjects no list items appeared on their recall sheets as part-list cues (free recall). A second group of subjects received 16 items from the list on their recall sheets as part-list cues, while a third received 32 items as part-list cues (Conditions 16 and 32 list cues, respectively). There were 32 subjects in each group who recalled both lists under the same conditions.

Procedure. After participation in the first experiment all subjects were given the same general instructions concerning the second. They were told that they would hear two lists of 48 unrelated words presented at a fairly slow rate and that each list would be presented twice. They were further told that after the second presentation of each list they were to perform another task (to be specified later) before they were to recall the list. They were also instructed that at the time of recall some of them would have a blank recall sheet, while others would have items from the list written on it. If the sheet contained no items they were told to recall as many items from the list as possible in any order. If the sheet contained items they were told that "these words should serve as clues in helping recall the other items from the list. Please study them carefully and recall all the other items from the list that you can . . . in any order you want." Finally they were warned that the recall period was to be very long, 10 min., and that they would be asked to draw a line every minute below the last word they had written and to number the lines 1 through 10. They were encouraged to keep trying throughout the recall period.

The lists were presented twice at a 3-sec. rate and the items were presented in a different random order the second time. Half the subjects heard and recalled one list first and then the other, while the other half experienced the lists in the reverse order.

After each list was presented for the second time all subjects were engaged in an interpolated task for 2 min. involving recall from semantic memory (either United States presidents or professional sports teams) before turning to their recall sheets. Only then did subjects discover in what condition they were serving (free-recall or part-list cued recall). Some subjects received no cues while others received either 16 or 32 cues written in several rows across the tops of their recall sheets. After the 10-min. recall period the subjects were informed that the entire procedure would be repeated. They were not told whether or not they would serve in the same condition, but in fact all subjects served in the same condition after each list.

Four different sets of cues were randomly selected from each of the two lists for the 32-item part-list cuing condition. Then four sets of 16-item cues for each list were randomly selected from the sets of 32-item cues. Thus there were 16 "critical" items (the target set of the subjects who received 32 cues) on which all subjects could be scored. Of course there was nothing critical to the subjects about these items, since they were randomly selected from the larger set. Eight subjects in each of the part-list cuing conditions received one of the four sets of cues.

Results and Discussion

Presented in Figure 2 are the mean cumulative recall functions pooled over the two lists in each of the three conditions (free-recall or recall with 16 or 32 item cues). The same pattern of results was obtained for each list. The points are simply connected by straight lines. The parameter values providing the best fit for Equation 1 for each of the functions are given in Table 1 for recall of both target items and critical items.[3] A χ^2 goodness-of-fit test indicated significant fits at the .01 level for the mean data as well as 99% of the individual cases for each of the functions. Although providing a satisfactory fit statistically, the best-fitting functions systematically overestimate the middle points in the cumulative recall function by a slight amount and similarly underestimate the last few points.

It is apparent from the data in Figure 1 and the estimated $n(\infty)$ parameters in Table 1 that presentation of part-list cues greatly reduced recall of items from the target set relative to free recall. At the end of the recall period free-recall subjects had recalled 22.3 items whereas subjects receiving 16 or 32 item cues recalled 14.8 and 5.9, respectively. This was expected, of course, since the size of the target set also decreased with the presentation of part-list cues. The question of primary interest is how presentation of item cues affected the rate of approach to the asymptote or λ. An analysis of variance on the λ parameter estimated for individual subjects' cumulative recall protocols indicated reliable variation ($p < .05$) among conditions, $F(2, 93) = 11.01$, $MS_e = .063$. Newman-Keuls tests further indicated reliable differences in the λ parameter between subjects receiving 32 list cues (.44) and the other two conditions (free-recall, .65; 16 list cues, .62). The difference between these latter two conditions was not reliable, but the rate parameter was somewhat lower for subjects receiving 16 list cues than for free-recall subjects. Thus it is apparent that part-list cues reduce not only the asymptotic level of target item recall relative to free recall, but also reduce the rate of approaching this asymptote. This

Table 1
Parameter Estimates for Recall of Target Items and Critical Items in Each Condition in Experiments 1 and 2

Condition	Target items		Critical items	
	λ	$n(\infty)$	λ	$n(\infty)$
Experiment 1				
Free recall	.65	21.42	.65	7.16
16 list cues	.62	14.31	.58	6.80
32 list cues	.44	5.86	.44	5.86
Experiment 2				
Free recall	.71	26.47	.69	8.79
32 list cues	.51	6.37	.51	6.37
32 (list) cues	.62	28.38	.47	7.74
32 extralist cues	.65	23.51	.67	7.61
16 list + 16 extralist cues	.73	27.90	.46	6.73

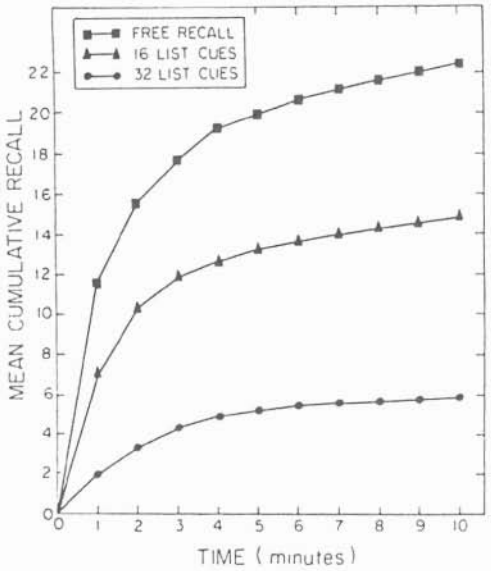

Figure 2. Cumulative recall functions for target item recall in Experiment 1.

[3] The mean values of λ estimated for individual subjects' cumulative recall functions in the various conditions differ slightly from the estimate of λ obtained from group cumulative recall functions, as in Figures 2–4. The values in Table 1 are based on group cumulative recall functions.

conditions in allowing recall of many more items than if a typical short recall period had been used. Judging from the literature, most experimenters requesting free recall of a list of 48 unrelated words would probably allow a recall period of 2 or, at most, 3 min. With a 3-min. recall period in the present experiment, free-recall subjects would have recalled only 79% of the items recalled after 10 min., and even at 10 min. the cumulative recall function for free-recall subjects was still increasing. Theoretically, the fact that subjects are eventually able to recall so much information seems consistent with the view (e.g., Buschke, 1974) that recall failures result primarily from difficulties in gaining access to stored information (retrieval difficulties) rather than loss of information from storage.

Experiment 2

The primary finding of the first experiment was that presentation of part-list cues reduced both the asymptotic level of target item recall and and the rate of approach to the asymptote relative to free-recall subjects' performance. A secondary outcome was the confirmation of Slamecka's (1968) and others' finding of inhibition in recall of critical items by presentation of part-list cues relative to free recall. The inhibition effect was substantial in the first experiment, at least when 32 cues were presented. The primary purpose of the second experiment was to evaluate three hypotheses that might account for the inhibition effect produced by part-list cues. A secondary purpose was to replicate and confirm the effect of part-list cues on the rate of approach to asymptote in cumulative recall.

One hypothesis that might account for part-list cued subjects' poor performance in recall of critical items (relative to that of free-recall subjects) is that part-list cued subjects are required to perform an extra mental operation during output (Anderson, 1972, pp. 359–361). Since part-list cued subjects are required to recall only words that are not members of the cue set, they must check each word retrieved against the cue-set items before recalling it. This extra step may require time and thus slow recall. For example, a particular cue may remind the subject of another word that appeared in the list, but before the subject can write down this newly retrieved word he or she is required to check the cue list to see whether or not it also appears as a cue. (Presumably both free-recall and part-list cued recall subjects are also monitoring their output to determine whether or not newly retrieved items have already been recalled.) As already discussed, the task requirements for the part-list cued subject might resemble those of subjects in the Metlay et al. (1971) experiment who were required to recall items containing certain letters from a larger set. This extra checking operation required of part-list cued subjects could account for the depressing effect of presenting part-list cues on λ, the rate of approach to the asymptotic recall level. (This effect was not observed in the Metlay et al., 1971, experiment, but the checking task in their experiment may have been easier than in the part-list cuing situation.) It would also account for the finding that greater inhibition is associated with increased number of cues (e.g., Roediger, 1973), since it would be necessary with more cues to check each retrieved word against more items before it is recalled. However, since the part-list cuing decrement in the first experiment was not eliminated with a very long recall period, this weakens the hypothesis that slowed recall due to an extra checking operation is the only source of interference for the part-list cued subjects.

A second interpretation of the part-list cuing decrement has been suggested by Tulving and Hastie (1972), Rundus (1973), and Roediger (1973), but Rundus' (1973) account of the process is the most explicit. The general idea is that presentation of part-list cues produces competition at retrieval by increasing the accessibility of ("strengthening") the representations of cue items so that they tend to be retrieved to the relative exclusion of other items, This hypothesis assumes that retrieval is of limited capacity in terms of the number of items that can be simultaneously retrieved and held in working memory and that the retrieval process involves sampling with

replacement (see Rundus, 1973). This approach attributes the part-list cuing decrement to processes occuring during retrieval, not to those intervening between retrieval and recall.

A third interpretation of the part-list cuing decrement has recently been presented by Watkins (1975). He examined cued recall of categorized lists with three different types of cues: intralist items as in most part-list cuing experiments, extralist items from the same categories, or both types of cues. In two experiments he reported that recall of target items was impaired with both intralist and extralist cues and, further, the impairment was of the same magnitude with either type of cue. Watkins (1975) proposed that both list and extralist cues are stored as additional list members (despite the temporal separation of presentation) and that this effectively lengthened each category. Thus inhibition in part-list cued recall is, he argued, due to the same (unspecified) mechanism that produces the usual length/difficulty effect in memory experiments, the depressing effect that lengthening a list has on the probability of recalling any particular item from the list during a limited amount of time.

These three hypotheses of the part-list cuing effect are not mutually exclusive and combinations of these ideas might be necessary to account for the part-list cuing decrement. The second and third hypotheses may not be as different as they seem at first glance since Shiffrin (Note 1) has proposed a hypothesis similar to Rundus' (1973) as the mechanism responsible for the length/difficulty relationship. At any rate, all three hypotheses seem able to provide a satisfactory account of the primary result of the first experiment, that part-list cues depress the rate of approach to the asymptote in cumulative recall relative to free-recall performance. This could be due to slowed output necessitated by an extra checking operation imposed on part-list cued subjects between retrieval and recall, or to subjects being slowed in retrieval of additional items because of the competition produced by part-list cues, or to the effectively increased list length from presentation of part-list cues, which typically reduces the λ parameter (Indow & Togano, 1970). Experiment 2 serves more to evaluate the three hypotheses than to pit them against one another.

After presentation of 48-item lists, subjects were divided into five different recall conditions on the basis of the instruction and, in four conditions, cues, at the top of their recall sheets. Two conditions, free-recall and 32 list cues, were identical to conditions in the first experiment. In another condition, subjects were also provided with 32 list cues to study for 1 min. before they were required to recall all items, both the items presented as cues and the others. This condition is denoted as the 32 (list) cues condition, since the cues were not present during recall. If the decrement resulting from presenting part-list cues is due solely to subjects having to check retrieved items against the cue set items before recalling them, then there should be no decrement in recall of critical items in the 32 (list) cues condition, since the requirement to recall only the critical items has been removed. On the other hand, since subjects were required to study the list cues, the representation of these items should still have been strengthened or they should have been encoded as new list members, as is maintained by the other hypotheses, so the prediction from these hypotheses is that inhibition in recall of critical items should still be found in the 32 (list) cues condition relative to the free-recall condition.

The two other conditions were designed primarily to evaluate Watkins' (1975) proposal that part-list cues depress recall because they are encoded as new list members. He was led to this by the finding that in categorized list recall presentation of extralist cues from the same category as the to-be-recalled items depressed recall to the same extent as presentation of an equal number of list cues from the same category. In two conditions of the present experiment subjects were presented with either 32 extralist cues or 16 extralist and 16 list cues, with instructions to recall as many of the 48 list items as possible. Watkins' (1975) hypothesis predicts that presentation of an equivalent

number of extralist cues or a mixture of extralist and list cues should have the same effect as presentation of only list cues. So critical item recall in the 32 extralist cues condition and 16 list + 16 extralist cues condition should reach the same asymptote at the same rate as recall under the 32 list cues condition. On the other hand, no decrement from extralist cues in the 32 extralist cues condition would be expected (relative to free-recall) according to the other hypotheses, since there is no need to check retrieved items against extralist cues before recall and there is no prior episodic representation of these items to be strengthened. Of course there is absolutely no reason to expect that these extralist "cues" should facilitate recall, since they are unrelated to the to-be-remembered words.

Method

Subjects. The subjects were 120 introductory psychology students participating for course credit.

Design. A groups by trials design was again used, with each group of 24 subjects randomly assigned to one of five experimental conditions: free-recall, cued recall with 32 list cues with either the list of cues present [32 list cues] or not present [32 (list) cues] during recall, and finally, cued recall with either 32 extralist cues or 16 list and 16 extralist cues present during recall. Each subject recalled two lists under the same conditions.

Materials. The materials were 160 high-imagery two-syllable nouns selected from the same source as in the first experiment. The words were randomly placed into one of four sets. Two sets of 48 words were the lists presented to subjects, while two other sets of 32 words were used as extralist cues. List order was counter-balanced across subjects. Subjects in the list-cued conditions received 32 items randomly selected from the list. There were several different cue sets randomly selected for different subsets of subjects. Subjects receiving both list and extralist cues received items randomly selected from both sources.

Procedure. Much of the procedure, including general instructions, presentation of the lists, and so forth, was identical to that of the first experiment. After each list had been presented twice, subjects were instructed to read carefully the instructions at the top of their answer sheets. These instructions directed all subjects to perform another task for 1 min. before they were to recall the list. Free-recall subjects were told to perform mental arithmetic problems for 1 min. before they were to turn to the next page (when instructed) and recall as many items from the list as possible. For subjects in the other four conditions involving cued recall, the instruction stated that they were to study the cues on their answer sheets for 1 min. before they were to recall the list. Subjects were instructed as to the nature of the cues (list, extralist, or both) and were told in each case that they should study the cues carefully, since they should be of aid later in recalling the items from the list.

After 1 min. of studying the cues, three groups of subjects (those receiving 32 list cues, 32 extralist cues, or 16 list + 16 extralist cues) began recall below the list of cues and could refer to the cue set during recall. Subjects receiving 32 list cues were instructed to recall only list items not presented as cues. The subjects who received either 32 extralist cues or 16 list cues +16 extralist cues were told to recall the entire presented list of 48 items. So, in the latter case, 16 of the to-be-recalled items were presented as cues throughout the recall period. After studying their cues for 1 min., subjects who recalled without the list of cues present, the 32 (list) cue subjects, were instructed to turn to the next page of their answer booklets, which was a blank, and to recall as many list items as possible there, including both cue items and noncue items. These subjects were also told not to look back at their cue lists. All subjects were told that they could recall items in any order they wanted. Total time for recall was 10 min., with intervals demarcated by subjects drawing lines every 30 sec during the first 2 min. of recall and at 1-min. intervals thereafter, on instructions from the experimenter.

After recall of the first list a second list was presented and the entire procedure repeated. A few minutes after recall of the second list, subjects were unexpectedly given a final free-recall test for both lists. This lasted 15 min. and subjects again drew lines every 30 sec for the first 2 min. and at 1-min. intervals thereafter.

Results and Discussion

Initial recall. Presented in Table 2 is recall in each of the five conditions separated into various components. Total item recall (the far right-hand column) was slightly greater for subjects who received part-list cues and were later allowed to recall these same cues [32 (list) cues and 16 list + 16 extralist cues] than for free-recall subjects, who in turn recalled more than subjects given 32 extralist cues. Of course, subjects in all four conditions recalled many more target items than subjects who received 32 list cues and were required to recall only the other (critical) items. The best-fitting parameter estimates to Equation 1 for the cumulative recall functions of target items

Table 3
Cumulative Proportion of Components of Initial Recall, Experiment 2

Condition	Time (minutes)											
	½	1	1½	2	3	4	5	6	7	8	9	10
Free recall												
32 noncritical items	.16	.29	.38	.42	.47	.50	.52	.54	.55	.56	.56	.57
16 critical items	.15	.29	.37	.42	.46	.49	.51	.54	.56	.57	.57	.58
32 list cues												
16 critical items	.11	.17	.23	.25	.31	.33	.36	.37	.38	.40	.41	.41
32 (list) cues												
32 cue items	.21	.33	.42	.48	.56	.61	.62	.63	.65	.65	.66	.67
16 critical items	.10	.18	.26	.31	.36	.40	.42	.44	.46	.48	.49	.50
32 extralist cues												
32 noncritical items	.16	.25	.31	.35	.40	.44	.46	.48	.49	.40	.51	.52
16 critical items	.14	.25	.31	.36	.40	.42	.44	.46	.47	.48	.49	.50
16 list + 16 extralist cues												
16 cue items	.33	.58	.74	.81	.87	.88	.89	.89	.89	.90	.90	.90
16 other items	.10	.15	.23	.27	.34	.38	.39	.40	.41	.41	.42	.42
16 critical items	.08	.13	.21	.27	.32	.36	.38	.39	.40	.41	.42	.42

overall advantage of subjects receiving 32 (list) cues or 16 list + 16 extralist cues to free-recall subjects was not large, though, because of an apparent tradeoff in recall of cue items for critical items. Recall of cue items evidently depressed recall of critical items.

A more detailed examination of this tradeoff between recall of cue items and noncue items in the part-list cued conditions is available in Table 3, where the cumulative proportion recalled of different types of items is presented. It is apparent that early in the recall period, subjects in both the 32 (list) cues condition and the 16 list + 16 extralist cues condition recalled cue items to the relative neglect of noncue items. This evidence is in good agreement with the idea that part-list cues exert their damaging effect due to their being strengthened and retrieved to the exclusion of other items (Roediger, 1973; Rundus, 1973; Tulving & Hastie, 1972). Both groups of subjects required to recall list cues recalled more cue items and recalled them earlier in the recall period than did free-recall subjects when scored on these same items. Recall of critical items was delayed and made less probable in the 32 (list) cues and 16 list + 16 extralist cues condition (relative to free recall) by recall of cue items, in agreement with the idea that the interference produced by part-list cues is similar to output interference (Roediger, 1974).

Another interesting aspect of Table 3 is that critical item recall for 32 (list) cues subjects was quite similar to that for the 32 list cues subjects early in the recall period, even though the latter subjects were not required to overtly recall cue items. It may well be that retrieval of information was much the same for both groups of subjects but that the 32 list cues subjects only recalled critical items and had to edit the cues. This notion is buttressed by another observation. Although λ for 32 (list) cues subjects is different from that for 32 list cues subjects when the former are scored on all items, when both sets of subjects are scored on only critical items the rates are quite similar (see Table 1). The 32 (list) cues condition may externalize what typically occurs in part-list cuing experiments: Cue items are retrieved to the relative exclusion of noncue items.

Extralist cues had a reliable inhibiting effect on critical item recall in the present experiment as in Watkins' (1975) experiments, but there were some differences between our results and his. He found equal amounts of inhibition in his experiments when the cues were the same number of list

recall subjects. It was suggested that retrieval by subjects in the 32 (list) cues condition was similar to that of subjects cued in the typical manner (32 list cues) and that in each case recall of critical items was inhibited as a consequence of information about cue items being repeatedly retrieved and clogging the retrieval mechanism.

Postman (1975) has termed this approach to explaining the part-list cuing decrement as "a radical departure from established principles" and "counter-intuitive in denying the operation of interitem associations in recall" (p. 325). He adds, "An early question to consider is how applicable this interpretative schema is to the recall of noncategorized lists. There is an obvious risk that principles derived from results obtained with categorized lists may prove to have limited generality." The present results serve to extend the competition-at-retrieval interpretation of the part-list cuing decrement to the case of unrelated word lists.

There is one aspect of the data from the second experiment that the competition-at-retrieval hypothesis cannot account for in a satisfactory manner, at least without extension. This is the damaging effect of extralist cues relative to free-recall performance in both initial and final free recall. This is similar to the (unexplained) phenomenon found when subjects are asked to recall a list of singly presented words either with no cues or in the presence of weakly related cues. The consistent finding is that subjects perform better under free-recall conditions than with the weakly related cues (e.g., Tulving & Osler, 1968). The cues in the second experiment here were, of course, completely unrelated, but the effect is the same. Since there are no prior representations of the cues to be incremented, the competition-at-retrieval hypothesis as currently formulated (Rundus, 1973) appears mute with regard to this result. There is no reason, of course, that hypotheses of part-list cuing should necessarily generalize to the case of extralist cue presentation, but a hypothesis applicable to both types of cues would have the advantage of parsimony.

The most compelling account for the extralist cuing decrement is the third hypothesis considered here, that of Watkins (1975), who suggested that cues (whether list or extralist) simply add to the length and reduce the probability of recall of any individual word from the list. As previously mentioned, Shiffrin (Note 1) has extended a model similar to that of Rundus (1973) to account for the list-length/difficulty relationship, so it is an easy step to incorporate Watkins' (1975) idea into the Rundus model. But, there are at least two difficulties in applying Watkins' (1975) hypothesis to the results of Experiment 2. First, subjects who received 32 extralist cues recalled reliably more critical items than subjects recalling with 32 list cues. It could, of course, be plausibly argued that subjects ignored the cues more in this experiment than in Watkins' (1975) experiment where the extralist cues were categorically related to target items. So this problem is not serious. But a second difficulty is that subjects who received 32 extralist cues approached asymptote in critical item recall at a greater rate than subjects who received 32 list cues (see Table 1). If poorer recall were due to an addition of list members in both cases, there should be comparable reduction of λ in each case. So apparently extralist cues, which are unrelated to the to-be-remembered words, affected recall in a different manner than part-list cues. The extralist cuing decrement probably awaits satisfactory explanation.

One final implication of the present results concerns their relationship to those of Tulving and Hastie (1972), who were interested in the effects of presenting some items twice within a list on the recall of once-presented items. They found that presenting items twice enhanced recall of these items but reduced recall of once-presented items relative to recall of control lists where all items were presented once. Furthermore, the inhibition in recall of once-presented items increased with the density of twice-presented items. This result agrees well with the notion that strengthening some to-be-recalled items decreases the accessibility of others. However, in later experiments