Release from Proactive Interference: Insufficiency of an Attentional Account

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The attentional hypothesis claims that the release from proactive interference is due to increased processing when subjects perceive a change in the items to be remembered. The present study manipulated attention by inserting a color cue before the final trial of a sequence in Wickens' paradigm. Relative to the corresponding conditions with no such cue, the cue affected performance neither when a category shift (release) nor when no category shift (control) was involved. These results disconfirm the prediction made by the attentional hypothesis.

The paradigm used to study the release from proactive interference was developed by Wickens, Born, and Allen (1963) and involves a series of trials for short-term memory, usually four trials in succession. If, for example, the experimenter is interested in the effects of a shift in taxonomic category on recall (e.g., Loess, 1967), then the first three trials would all consist of triads of items from a single category, while the final trial would consist of a triad of items from a different category. As Keppel and Underwood (1962) have demonstrated, recall declines across trials on similar material because of a progressive buildup of proactive interference. However, with a shift in material (e.g., category) on the final trial, a marked improvement in recall often results (relative to a situation where no shift occurs). Wickens (1970, 1972) suggests that the magnitude of this improvement, designated as the effect of the release from proactive interference, is an indication of the salience of that particular dimension as an encoding dimension.

Encoding is currently a critical issue in the investigation of human verbal memory (see, e.g., Melton and Martin, 1972). Since Wickens' paradigm is presently used as a procedure for discovering encoding dimensions, it is important to determine whether it does in fact examine encoding. One particularly compelling alternative to the *encoding* hypothesis underlying that paradigm is the *attentional* hypothesis (Kintsch, 1970, p.

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174; Wickens, 1970), which claims the release from proactive interference to be the result of extra rehearsal of items that are perceived as distinct from prior items. Thus, according to the attentional hypothesis, the subject need not be encoding along a given dimension to be aware of a shift, but he must notice the shift if he is to produce such release. According to the encoding hypothesis, however, release from proactive interference can occur even when the subject does not notice the shift, since he will differentially encode and store (Epstein, 1972) items following a shift on a salient encoding dimension.

Anecdotal evidence, in the form of subjective reports, contradicts the attentional hypothesis (Gardiner, Craik, and Birtwistle, 1972; Reutener, 1972). These reports suggest that release from proactive interference may occur independently of whether or not the subject recalls being aware of the shift on the final trial. However, as Spielberger (1962) points out, the extent to which subjective reports are reliable indicants of awareness is unclear. What is required, therefore, is a direct manipulation of attention in Wickens' paradigm.

A recent study from the literature on retroactive interference (Strand, 1970) showed that a contextual interruption between the learning of two lists was sufficient to sharply reduce retroactive interference, which, apparently, can be dissipated by some type of attentional demarcation of the two lists. To extend this argument, if an attentional cue affects retroactive interference, perhaps a similar mechanism underlies release from proactive interference. The present study tested this hypothesis by inserting an attentional cue before the final trial in Wickens' paradigm.

METHOD

Subjects

The subjects were 192 University of Washington undergraduates whose participation partially fulfilled a course requirement. There were 48 subjects assigned in order of appearance to each of the four experimental conditions, according to a predetermined random order. Each subject was tested individually.

Stimuli and apparatus

Twelve items were chosen from each of two categories, vegetables and animals, in the Battig and Montague (1969) norms, with the restriction that every item have four to seven letters. For each category, four triads were formed with the restrictions (a) that no triad contain items beginning with the same letter, and (b) that mean frequency be fairly constant across triads. The slides of each of the eight triads were prepared with the three items typed one above the other in upper case letters. An externally paced Kodak Carousel projector was used to present the slides.

Design

The experiment employed a 2 × 2 × 2 factorial design, with attentional cue (present or absent) and taxonomic-category shift (present or absent) as the two major between-subject variables. Category (vegetables or animals) was a counterbalancing variable included to prevent item bias. Thus, collapsed over this counterbalancing variable, there were four groups: the subjects in *group C/S* had a cue and a shift; those in *group NC/S* had no cue but did have a shift; those in *group C/NS* had a cue but no shift; and those in *group NC/NS* had no cue and no shift.

Procedure

Of the 48 subjects in each of the above four groups, 24 had animals and 24 had vegetables as the category for the first three trials. For each of the NS groups, every ordered combination of the four triads was used once. For each of the S groups, every ordered combination of three of the four triads was used once; the fourth (shift) triad was selected randomly from the other category, with the restriction that every triad be used equally often as the shift triad. For every subject, the first three trials consisted of triads from the same category, while the fourth trial was either the remaining triad from that category (the NS groups) or one of the four triads from the other category (the S groups). Each subject had only one sequence of four trials.

Each of the four trials consisted of the following sequence of slides: first, a warning slide, consisting of three asterisks (2 sec); second, a triad (2 sec); third, a three-digit number, from which the subject was to count backward by threes as rapidly as possible (18 sec); and fourth, a question mark, during which the subject was to recall orally the triad, its items in correct serial order (8 sec). The intertrial interval was as close as possible to 0 sec.

Orthogonally varied with the category-shift variable was the attentional-cue variable. Before the fourth trial for groups C/S and C/NS, a bright red warning slide replaced the white warning slide used before all other trials. A change of color was chosen as the attentional cue because Reutener (1972) has demonstrated that release from proactive interference occurs when the background color of the triad on the final trial is different from that on previous trials. Consequently, a change of color should serve as a potent cue if the attentional hypothesis is correct.

RESULTS

The data were scored in two ways: correct items only, and correct items plus correct order. The latter system adds one extra point to the score on a given triad only when all three items are recalled in the correct order (Goggin and Wickens, 1971); thus, a perfect score is *four* points, one for each of the three items and one for the correct order. The analyses reported are based on the system where order is counted, but it should be noted that the conclusions under the two systems were identical.

A 2 × 2 × 2 × 3 analysis of variance (category × attentional cue ×

category shift × trial number) was conducted on the data from the first three trials (i.e., from those trials preceding all manipulations); see Figure 1. The main effect of category was significant [$F(1, 184) = 7.44, p < .01$] but accounted for only 3% of the between-subject variance ($\omega^2 = .034$). Since none of the interactions involving category was significant, this main effect simply indicates that mean performance on the category 'animals,' 2.75, was superior to that on the category 'vegetables,' 2.50. Neither the main effect of attentional cue nor that of category shift was significant [both Fs < 1]. All the interactions were nonsignificant except that of attentional cue by category shift [$F(1, 184) = 4.50, p < .05$]. This significant interaction was not anticipated for the data from the first three trials, and no explanation is offered because the experimental manipulations had not yet occurred; however, it should be noted that this interaction accounted for less than 2% of the between-subject variance ($\omega^2 = .019$).

Most important, the main effect of trial number was highly significant [$F(2, 368) = 190.57, p < .001$] and accounted for roughly 49% of the within-subject variance ($\omega^2 = .494$). Planned orthogonal comparisons

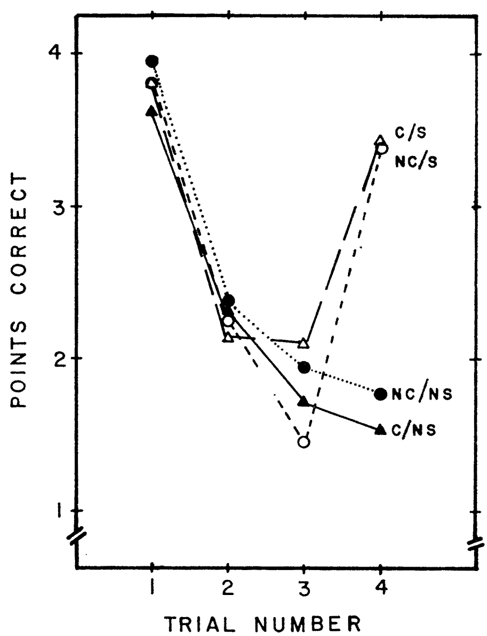

Figure 1. Points correct (based on three points for item recall and one point for order) as a function of trial number

revealed that performance on the first trial was significantly better than on the second and third trials [$F(1, 368) = 362.27, p < .001$] and that performance on the second trial was significantly better than on the third trial [$F(1, 368) = 19.49, p < .001$]. Taken together, these results clearly show the requisite buildup of substantial proactive interference across the first three trials.

The data from the fourth trial were analyzed in a separate $2 \times 2 \times 2$ analysis of variance (category $\times$ attentional cue $\times$ category shift). Again, the main effect of category was significant [$F(1, 184) = 11.46, p < .001$], showing that mean performance on the category 'animals,' 2.67, was superior to that on the category 'vegetables,' 2.12. However, since the category variable accounted for less than 4% of the variance ($\omega^2 = .037$) and since no interaction involving it was significant, the category variable will not be mentioned further.

Turning to the main effects of primary interest on the fourth trial, category shift was highly significant [$F(1, 184) = 87.80, p < .001$], accounting for approximately 30% of the variance ($\omega^2 = .304$). However, attentional cue was not a significant variable [$F < 1$]. Percent release values (Wickens, 1972) were calculated for each of groups NC/S, C/S, and C/NS relative to the controls, group NC/NS. As inspection of Figure 1 suggests, the presence of a cue without a shift (group C/NS) resulted in a nonsignificant negative release from proactive interference, 11.42%. The remaining two groups (i.e., the two shift groups) demonstrated significant and equivalent percent release values, 61.64% for group NC/S and 63.93% for group C/S.

DISCUSSION

According to the attentional hypothesis, release from proactive interference should have occurred in groups C/S, NC/S, *and* C/NS, relative to the controls, group NC/NS. However, the encoding hypothesis maintains that a shift in material is the requisite for release from proactive interference, so that release should have occurred in the shift groups (C/S and NC/S) but not in the no-shift group (C/NS). Although release was obtained with a shift in taxonomic category, thereby replicating Loess (1967), the insertion of an attentional color cue preceding the fourth trial neither produced release from proactive interference (group C/NS versus group NC/NS) nor affected the amount of that release (group C/S versus group NC/S).

The interpretation of these results is straightforward. Certain changes in the form, context, or semantic characteristics of the items themselves on the final trial of a series of trials for short-term memory will produce release from proactive interference. This does not seem merely an attentional phenomenon. Unlike the 'release from retroactive interference' that is observed in long-term memory when an attentional marker is provided to distinguish the lists (Strand, 1970), no release from proactive interference was observed when an attentional marker was provided preceding the final trial. Although the situations are not completely analogous, it nevertheless is not immediately apparent why so fundamental a process as attention has such different effects in these two interference paradigms.

To summarize, the central finding of the present study is that the attentional hypothesis does not provide an adequate explanation of the phenomenon of release from proactive interference. Although virtually all subjects in groups C/S and C/NS reported being aware of the attentional cue, they nevertheless demonstrated no release from proactive interference on the trial following this cue (unless there was also a category shift on the final trial). While this result does not provide direct support for Wickens' encoding hypothesis, it does disconfirm the primary alternative, the attentional hypothesis.

Notes

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