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Retrieval cues and release from proactive inhibition

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Data from a replication and extension of a 1972 experiment by Gardiner, Craik, and Birtwistle are used to support the arguments that Wickens' shift effect as a measure of encoding may underestimate the number of attributes primed in the course of successive Brown-Peterson trials; that the encoding of such primed attributes is obligatory rather than optional; and that the shift effect, in conformance with the principle of encoding specificity, is a joint phenomenon of both storage and retrieval.

The release from proactive inhibition as the effect of a shift of attributes is of interest to students of memory for at least two reasons. First, the existence of this shift effect creates the problem of its explanation, thereby serving as a touchstone for theories of memory (e.g., Bennett and Bennett, 1974; Keppel and Underwood, 1962). Second, it is thought to provide information about the encoding of attributes of words, thereby serving as an important diagnostic instrument in research on memory (Wickens, 1970, 1972). These two aspects of the effect are in principle separable: it is possible to explain a phenomenon without using it for understanding other things; and it is equally possible to use a tool without knowing what makes it what it is. Recent research has suggested, however, that the two may be interrelated in practice and that the use of the shift effect as a measure of encoding is critically dependent upon its properties as a psychological phenomenon. The purpose of the present paper is to examine this interrelation in light of data from a simple experiment.

The experiment is a replication and extension of one by Gardiner, Craik, and Birtwistle (1972). In their experiment, Gardiner et al. showed that an effect resembling the typical shift effect (Wickens, 1970) could be obtained in the absence of any difference in the materials studied by the experimental and control groups on the critical trial. Besides a third group, whose results are of less immediate relevance, there were two groups of subjects in their experiment. Both groups were tested with materials drawn from one subcategory of a larger category on three pre-

shift trials and were then shifted to another subcategory on the critical fourth trial. For instance, subjects studied and recalled names of indoor sports on preshift trials, after having been told that these were names of 'sports,' and were then exposed to the names of outdoor sports. The experimental group (designated CR) was given the name of the appropriate subcategory (e.g., 'outdoor sports') after the interpolated task and immediately before recall on the critical trial, whereas the control group was given no additional information at any time. The experimental group's recall showed a large increment on the shift trial, whereas the control group's was at the same level as on the immediately preceding trial.

The fact that the shift effect was obtained by Gardiner et al. only when that special information about (cues for) retrieval was provided suggests the possibility that the subjects did encode the words to be remembered by their subcategory membership but that the results of this encoding became manifest only under special conditions for retrieval. If this interpretation is correct, it is possible that in other experiments, too, the release from proactive inhibition has failed to materialize because of inadequate information for retrieval, and not because of inadequate encoding.

This interpretation and the wider implications of results of the study by Gardiner et al. are weakened by the possibility that the obtained cues effect in their experiment may reflect the operation of a mechanism different from those underlying the typical shift effect. The cues might have had their effect quite independently of any shift in the subcategories. Gardiner et al. did not have any control groups that had no shift on the fourth trial but were given appropriate subcategory names. It is possible that the cues in their experimental groups served an alerting or arousal function, motivating the subjects to try harder. Such shift*like* effects could probably be produced under Wickens' paradigm, effects that may have little bearing on the encoding of words' attributes. Tulving and Bower (1974), for instance, have pointed out that increasing the study time on the critical trial might well produce an increment in recall on that trial, but this shiftlike effect would not be interpreted as 'release from proactive inhibition.'

The present replication and extension of the experiment by Gardiner et al. was undertaken to find out whether cues for retrieval like those used in that earlier experiment do have an effect on recall independent of an actual shift of subcategories on the critical trial. If they do, the results of Gardiner et al. would pose no obvious problems to the use of the shift effect as a method for fathoming the nature of encoding in Wickens' paradigm; if they do not, then the usefulness of that method becomes somewhat more problematic.

We will return to the problem of the relation between the nature of the shift effect and the shift method as a measuring instrument after describing the experiment and its results. At that point, we will also consider some other issues that have been raised in discussions of the shift effect, such as the possibility that the obtained shift is a 'retrieval effect' (Gardiner et al., 1972) and the question of the extent to which the encoding of words' attributes is 'automatic' (Underwood, 1972; Wickens, 1972).

METHOD

Design

The two experimental groups used by Gardiner et al. (1972) were complemented with two additional groups of subjects. The latter were provided with subcategory names as retrieval cues, but the subcategories were not shifted on the critical trial. Thus, there were four experimental conditions, defined by the treatment of subjects on the critical trial: *shift presentation* (SP), in which the subcategory shifted and a cue (subcategory name) was given at presentation of the material to be remembered; *shift recall* (SR), in which the subcategory shifted and a cue was given only at recall; *nonshift presentation* (NP), in which there was no subcategory shift but a cue was given at presentation; and *nonshift recall* (NR), in which there was no subcategory shift but a cue was given at recall.

There were four groups of 24 subjects each. All were tested on three successive *blocks* of four trials, each block representing one of the experimental conditions, according to the following scheme: for group 1, SR, NP, SR; for group 2, SP, NR, SP; for group 3, NR, SP, NR; and for group 4, NP, SR, NP. Thus, each of the four experimental conditions was represented in each of the test blocks; subjects were not given any advance notice as to the conditions of testing in a particular block. Subjects were randomly assigned to one of the four groups.

Stimulus materials

The stimulus materials were drawn from three categories — 'sports,' 'flowers,' and 'birds' — and each subject was presented words from a different category on each of his/her three blocks of trials. The sets of words from the categories 'sports' and 'flowers' were the same as those used by Gardiner et al. (1972), with the exception of a few substitutions made for words the experimenters felt would be unfamiliar to Canadian students. Words from the additional category 'birds' were drawn from Battig and Montague's (1960) norms, subject to the restrictions that they have three or four syllables and be relatively familiar. These names were then divided into the subcategories of 'song' and 'nonsong' birds, on the basis of the judgments of two of the experimenters and five subjects not subsequently tested. A word was selected for use in the experiment only if all seven judges agreed about its subcategory.

Thus, words in each category were from two subcategories: (a) indoor and outdoor sports, (b) wild and garden flowers and (c) song and nonsong birds. In the two shift conditions (SP and SR), 6 unique sets of four triads were constructed for *each* of the three categories. In each set, nine words (three triads)

were drawn from one subcategory and three words (triad used on the shift trial) were drawn from the complementary subcategory. Of these 6 sets, 3 reflected a shift in one direction (e.g., from wild flowers to garden flowers) and the other 3 sets reflected a shift in the opposite direction. Also constructed were 6 unique sets of four triads for *each* of the three categories, sets that served as materials for the nonshift conditions. Here all dozen words were randomly drawn from a single subcategory, 3 unique sets of triads constructed from one subcategory and 3 from the complementary subcategory. Altogether, then, there were 36 different sets of four triads of words used in the experiment. Within the general design, each of these sets was used eight times.

Subjects

The subjects were 96 undergraduates at the University of Toronto, who volunteered to serve in the experiment. None of them had ever been in a Brown-Peterson experiment before. They were tested individually.

Procedure

The same procedure was followed in each test block except for the varied presentation of the subcategory names as cues. At the beginning of the experimental session, all subjects received identical instructions. They were told that the experiment involved two unrelated tasks, a perceptual task and a memory task. They were also told that the materials to be remembered were words from categories and that on certain trials they might be given category names, either at the time the words to be remembered were presented or at the time of recall. It was suggested to the subjects that they might use these names as cues or aids to recall. Subjects were not warned in advance, however, about any shifts in subcategories. All subjects were given practice on a distractor task before testing.

The first trial of each test block began with all subjects seeing a card bearing a category name (e.g., FLOWERS). On the second and third trials, this card was blank. A blank card was presented on the fourth trial as well to subjects in the cued-at-recall conditions (SR, NR); in the cued-at-presentation conditions (SP, NP), subjects were shown a card with the subcategory name (e.g., WILD FLOWERS).

All the words were printed in block capitals on white 3-by-5-in. index cards, one word per card. Subjects were shown the triad of words to be remembered, one word at a time, for a total duration of 2 sec. Subjects read aloud each word as it was presented. After the presentation of the third word of a given triad, the subject immediately began the distractor task. This task, similar to that used by Gardiner et al. (1972), consisted of attempting for 15 sec to read aloud a list of words that were spelled backward. After this interpolated activity, subjects were shown a card with either a question mark and WORDS in the cued-at-presentation conditions (SP, NP) or the subcategory name (e.g., WILD FLOWERS) in the cued-at-recall conditions (SR, NR). Subjects read aloud the contents of the card ('words' or the subcategory name) and then attempted to recall orally the three words. The card with WORDS or the subcategory name remained visible for 2 sec. Subjects were allowed 10 sec to recall the three words.

Thus, the subcategory name or the WORDS card was presented for 2 sec, the triad for 2 sec, the retention interval lasted approximately 15 sec, and the recall period was 10 sec. Each trial, therefore, lasted about 30 sec.

RESULTS

The proportions of words correctly recalled on four trials in each experimental condition in the three test blocks, as well as the data pooled over all three blocks, are shown in Figure 1. In scoring the data, one point was given for each word correctly recalled, regardless of output position.

Although there appears to have been a general reduction in recall on the first trial across the three test blocks, the overall similarity of the patterns of data was sufficiently high for us to consider only the pooled data and to disregard the differences across successive test blocks. Figure 1 shows that recall declined rapidly over the first three trials, suggesting a reliable buildup of proactive inhibition. In both conditions in which the subcategory was shifted (SP and SR), recall scores on the fourth trial were considerably higher than those on the third trial, thus demonstrating the shift effect. There was, however, no evident discrepancy between scores on the third and fourth trials in the two conditions in which the subcategory remained constant over all four trials (NP, NR).

Statistical analysis revealed no significant differences between the SP and SR conditions, or between the NP and NR conditions, whereas the difference between shift (SP, SR) and nonshift (NP, NR) conditions was highly significant. Release from proactive inhibition in the shift conditions

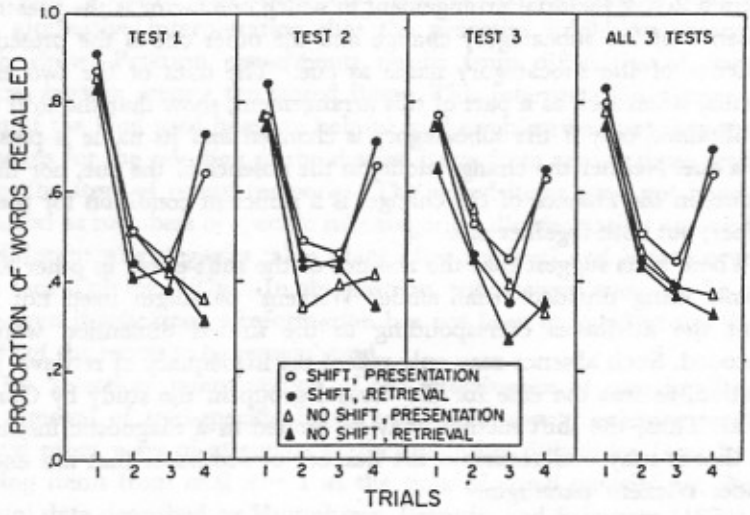

Figure 1. Proportion of words recalled as a function of trials in four experimental conditions, shown for three successive test blocks as well as averaged over the three tests

(SP and SR) was calculated by dividing the difference between scores on the third and fourth trials for each experimental condition by the amount of loss from the first to third trial. This rather conservative procedure yielded a recovery of 76% for the SR condition and a recovery of 61% for the SP condition. These results are comparable to the findings by Gardiner et al. (1972), who reported a recovery of 55% in their SR condition and 62% in their SP condition.

At the end of the experiment, subjects were questioned as to their awareness of subcategories and changes in subcategories on any trial in the experiment. No subject reported any such awareness. Subjects denied having noticed subcategory shifts even in the SP condition. These observations agree with those of Wickens (1970), whose subjects seldom could verbalize the encoding categories.

DISCUSSION

The results of the experiment can be summarized as follows. First, release from proactive inhibition, or the shift effect, was obtained in conditions where the subcategories were changed on the critical trial; this finding replicates that of Gardiner et al. (1972). Second, the magnitude of the shift effect was quite similar for the cues presented at study and cues presented at recall; this also replicates the results of Gardiner et al. Third, the shift effect was not obtained in conditions where the subcategory stayed the same; this finding means that shift effects cannot be attributed merely to the presentation of subcategory names as cues.

The study by Gardiner et al. and the present one, considered together, form a 2 × 2 factorial arrangement in which one factor is the presence or absence of the subcategory change and the other one is the presence or absence of the subcategory name as cue.[1] The data of the two experiments, when seen as a part of this arrangement, show that the shift effect is obtained only if the subcategory is changed *and* its name is presented as a cue. Neither the change alone, in the absence of the cue, nor the cue alone, in the absence of the change, is a sufficient condition for the shift effect; but both together are.

These facts suggest that the absence of the shift effect in other experiments using unaided recall under Wickens' paradigm need not mean that the attributes corresponding to the shifted dimension were not encoded. Such absence may only reflect the inadequacy of retrieval information, as was the case for the control group in the study by Gardiner et al. Thus, the shift method may be limited as a diagnostic instrument in that it may underestimate the number of attributes that are encoded under Wickens' paradigm.

This suggestion does not contradict Underwood's (1972) idea that the shift method may also overestimate the number of attributes that are encoded when words are presented for study singly. Experimental evidence is now available (Bennett and Bennett, 1974) to show that release from proactive inhibition occurs because of a priming of attributes shared by items on preshift trials, thus reinforcing the possibility that the apparent multiplicity and automaticity (Wickens, 1970) of encoding may be absent in situations in which no particular priming exists. Thus, it is highly likely that the norm for single words is encoding selectivity rather than encoding multiplicity. The encoding of primed attributes under Wickens' paradigm, however, might well be labeled 'automatic' in the sense that it need not depend on a strategy deliberately adopted by the learner. The fact that subjects in our experiment reported no conscious awareness of differences between subcategories supports the idea that the encoding of attributes shared by the items to be remembered is obligatory rather than optional.

Our suggestion that the shift method may underestimate the number of attributes encoded under Wickens' paradigm is strengthened by our finding that the effectiveness of cues depended on the actual change in the subcategories on the critical trial, so that the shiftlike effect with the cues does represent a typical release from proactive inhibition. We are assuming here that the attributes of the subcategory were encoded on the critical trial, even in the groups receiving the subcategory names as cues only at recall. This assumption requires that we consider, and reject, the alternative interpretation that the proactive inhibition observed in such Brown-Peterson experiments results from difficulties of temporal discrimination among the stored items. This interpretation assumes that cues of the kind used here are helpful to the subject because they provide a means for the *selection* of the desired items from among those retrieved from the store of recent memories. The stored items need not have been encoded as members of specific subcategories; discrimination among items of different subcategories takes place after retrieval and before overt recall (see Tulving, 1976). In this fashion, subcategory cues can be effective even if subcategory information has not been encoded at the time of study of the words to be remembered.

This 'selection' interpretation of the effectiveness of cues implies that the removal of trial-specific recall restrictions should enhance recall, as should other ways of attenuating discrimination difficulties (e.g., by presenting items from trial $n - 1$ at the time of recall on trial n). Experimental data described by Humphreys, Petrusic, and Schwartz (1972) and by Dillon (1973) show that this predicted enhancement of recall does not

occur. Moreover, Watkins and Watkins (1975, Experiment II) have shown that recall varies inversely with the number of items presented on a Brown-Peterson trial even when there are no trial-specific recall restrictions. For these reasons, we are inclined to dismiss the selection interpretation and assume that the function of cues in the situation discussed here is to provide *access* to information that would be inaccessible without the cues. We assume that this access is possible only if subcategory cues are a part of the information that is stored on the critical trial even when the experimenter does not suggest that the subject store them. The fact that the effect of cues presented at study and at recall was the same is consonant with this assumption. The encoding of specific information about subcategories, however, is not by itself a sufficient condition for recall of the material, a fact well known from other experiments on cuing (e.g., Tulving and Pearlstone, 1966).

The overall pattern of data in the study by Gardiner et al. and in the present experiment conforms to the principle of encoding specificity (Tulving and Thomson, 1973). Not only does the effectiveness of retrieval cues depend on the encoding of items to be remembered, but conversely, encoded items can be retrieved only in conjunction with appropriate retrieval cues. Because of this pattern, we disagree with Gardiner et al. (1972, p. 783) that release from proactive inhibition, not only in their experiment but others as well, is a "retrieval effect." But neither can we agree with Dillon (1973, p. 81) that proactive inhibition and release from proactive inhibition "are not retrieval phenomena." Since in the experiment by Gardiner et al. and the present one, the effect of cues depended on the format of encoding, the release from proactive inhibition is neither a matter of storage alone nor of retrieval alone, but like all other phenomena of memory, it is a joint manifestation of what has been encoded and how what has been encoded is being retrieved.

Notes

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1. Neither experiment provided data for one of the four conditions in the 2×2 arrangement, one in which subcategory stayed constant and no subcategory cue was presented, but the data for this condition can be rather accurately estimated from other conditions, on the basis of a large number of previous experiments.

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