Recall cued by selectively attended and unattended attributes

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Three experiments were carried out to investigate the effects upon subsequent recall of categorizing a stimulus at presentation by one of its attributes. The results indicated that a previously reported finding of categorized cue superiority for integral stimuli in an incidental learning paradigm may not be a robust one. Two experiments employed either intentional or incidental learning paradigms. In both, attributes that had been categorized at presentation did not differ in effectiveness as subsequent recall cues from those that had not. In a third experiment, with incidental learning, categorized cues were less effective than uncategorized cues. Thus, observed effects of categorization appear to be sensitive to minor differences in experimental procedure between studies.

Spyropoulos and Ceraso (1977) have recently reported the results of a series of novel experiments comparing the efficacies of categorized and uncategorized attributes as retrieval cues. Their major finding was that for a certain type of material—unitary stimuli—an attribute that had been used to categorize a stimulus at presentation was subsequently a more effective retrieval cue than one that had not been used in this way. That is, for one perceptually defined class of stimuli (but not for another class, that of nonunitary stimuli), a procedure that involves selectively attending to one part of a stimulus does not increase the likelihood that the attended part will be correctly recalled when another part is given as a retrieval cue (indeed, performance is depressed, numerically at least, relative to the nonunitary case), but it does increase the likelihood that the unattended part will be recalled when the attended part is given as a retrieval cue.

This result is of considerable theoretical importance, since it points to a powerful relation between attentional and mnemonic mechanisms, contingent upon the perceptual nature of stimulus materials, which appears to require the extension of current theories concerning both the attentional (e.g., Garner, 1974; Lockhead, 1972; Martin, 1978; Monahan & Lockhead, 1977; Treisman, 1977; Treisman, Sykes, & Gelade, 1977) and the mnemonic (e.g., Anderson, 1976; Anderson

& Bower, 1973; Flexser & Tulving, 1978; Jones, 1976, 1978; Tulving & Watkins, 1975) processing of multi-component stimuli. Accordingly, a series of experiments carried out to investigate the phenomenon further is reported here.

Figure 1 displays examples of three different types of relevant stimuli. Spyropoulos and Ceraso (1977), adopting stimuli used previously by Asch, Ceraso, and Heimer (1960), used unitary stimuli (color and form coextensive) and nonunitary stimuli (color and form side by side). The present study used stimuli of these two types together with included stimuli (color included within form), also used previously by Asch et al. (1960).

The basic procedures of each of the experiments reported by Spyropoulos and Ceraso (1977) and of those to be reported here were similar and may be exemplified by Experiment 1 of Spyropoulos and Ceraso (1977). In that experiment, there were two groups of subjects; each person was shown a set of either unitary or nonunitary stimuli. The stimuli were presented successively, and before each one, the experimenter said either “color” or “form” (with equal frequency). The subject had to name the values of both attributes and then place the stimulus card in a box labeled with the value of the attribute the experimenter had spoken. This was termed the categorized value, and the other, the uncategorized value. After a delay, the

Figure 1. The three types of stimuli.

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subject was provided either with all the color values as retrieval cues for the corresponding form values or the reverse. Thus, for each subject, half the cues were categorized values and half were uncategorized values.

It was found that for nonunitary stimuli it made no difference whether recall was instigated by a categorized cue (55.0% correct, mean latency of correct answers = 4.5 sec) or by an uncategorized cue (56.9%, 4.6 sec). For unitary stimuli, however, recall was much better following a categorized cue (82.5%, 3.8 sec) than following an uncategorized cue (47.5%, 9.6 sec). For both the percentage correct and the latency measures, both the main effect of categorization and its interaction with the unitary-nonunitary factor were significant. In addition, all subjects who received integral stimuli recalled both more accurately and more quickly with the categorized cues than with the uncategorized cues.

This result is perhaps surprising in that, as Spyropoulos and Ceraso (1977) note, an explanation in terms of the possibly greater availability (Asch & Ebenholtz, 1962) of the categorized values would predict the reverse effect (i.e., that the uncategorized cues should be more effective). Nevertheless, Spyropoulos and Ceraso (1977) successfully replicated the effect in their Experiment 2. This resembled Experiment 1, except that an additional recall test was added at the end. A subject who had been cued with all the colors was then cued with all the forms, and vice versa. The combined results were similar to those of the previous experiment. For nonunitary stimuli, it made no difference whether recall was instigated by a categorized cue (59.4%, 4.8 sec) or by an uncategorized cue (58.1%, 4.7 sec). For unitary stimuli, however, recall was much better following a categorized cue (78.8%, 4.0 sec) than following an uncategorized cue (40.0%, 9.0 sec). In three other experiments (Experiments 3, 4, and 5), Spyropoulos and Ceraso (1977) used only unitary stimuli; in each case, they found that categorized cues led to more accurate and faster recall.

Spyropoulos and Ceraso (1977) propose that the high level of recall for unitary stimuli (with categorized cues) results from such material's being more cohesive in memory (Asch et al., 1960). The poor recall of such stimuli (but not of nonunitary stimuli) with uncategorized cues is thus attributed to a difficulty in trace access. It is unclear, however, why uncategorized cues should be poor at accessing traces of integral stimuli but not those of nonintegral stimuli. Thus, an experiment is reported here that used included, as well as unitary and nonunitary, stimuli. The former type is, in some respects, intermediate in nature between the latter two types, and hence it would appear useful to determine whether it resembles unitary or nonunitary stimuli more with respect to the effects of categorization.

EXPERIMENT 1

In each of their experiments, Spyropoulos and Ceraso (1977) used an incidental learning method, and

subjects were not instructed about recall until after presentation was complete. A problem with this method is that only one set of stimuli may be shown to each subject. In order to overcome this, the present experiment employed an intentional learning method that enabled each subject to contribute many more data.

Method

Subjects. The 12 subjects were members of the Oxford subject panel and were paid for their services.

Material. Three arrays of stimuli were prepared (unitary, nonunitary, and included). Each array consisted of all 144 combinations of the 12 colors beige, black, blue, brown, gold, gray, green, orange, pink, purple, red, and yellow, and the 12 forms arrow, circle, crescent, cross, diamond, heart, oval, rectangle, semicircle, square, star, and triangle. The array was segmented into 12 sets of 12 stimuli each, using a Graeco-Latin square. Thus, in each set, all 12 colors and 12 forms occurred, with each combination of color and form occurring over sets once. The unitary stimuli consisted of forms cut from colored paper and stuck to white cards. The nonunitary and included stimuli consisted of outline forms drawn in black ink on white cards with a colored strip stuck either alongside or inside, respectively. Two arrays of nonunitary stimuli were prepared, one with color on the left and form on the right, and one with the reverse; each array was employed for half the subjects in the nonunitary condition.

Procedure. Subjects were given a set of instructions that fully informed them of the nature of the experiment. Equal numbers of subjects were presented with the three different types of stimuli. The stimuli of each set were presented at 5-sec intervals by the experimenter, who simultaneously categorized them by saying "color" for six of the stimuli and "form" for the other six in randomized orders subject to the constraints that there be no more than two consecutive categorizations of the same type, and that there be an equal number of occurrences of each type of categorization at each presentation serial position, summed over sets. For half of the subjects, the color and form categorizations of the other half were interchanged, so that, summed over subjects, each item was categorized by color and by form equally frequently. The subjects had to say aloud the two attribute values of each stimulus, half of them saying the categorized value first and half the uncategorized value first. The subject then had to place each card on the pile appropriate to its categorized value, face downward. There were 24 piles, the 12 colors (colored strips stuck to white cards) and the 12 forms (black outlines on white cards) positioned on different sides of the table between experimenter and subject.

Following the presentation of each set, the subject counted backward in sevens for 30 sec. The subject was then provided in turn with all 12 values of either the colors or the forms, and in each case had to attempt to recall aloud the corresponding value of the other attribute, guessing if necessary. The order in which the 12 stimuli of each of the 12 sets were cued was balanced using a Latin square. For each subject, six sets were cued by color and six by form, in a random order. For each of the three groups of subjects (in fact, for each of the six categorized-first and categorized-second subgroups), the random sequence of cue orders for one half of the subjects was complementary to that for the other half. Thus, over subjects, each stimulus was cued equally often by its categorized and its uncategorized cue. The latency of each answer was measured with a stopwatch.

Results

As assessed by both accuracy and latency measures, categorized and uncategorized cues were approximately equally effective, for all three types of stimuli. The percentages correct and mean latencies of correct answers were as follows, with the categorized cue measure given

first and the uncategorized cue measure given second in each case: unitary stimuli, 44.8% and 50.7%, 4.2 sec and 3.9 sec; nonunitary stimuli, 30.6% and 28.1%, 3.7 sec and 3.5 sec; included stimuli, 49.3% and 49.7%, 4.5 sec and 4.6 sec.

Two separate analyses of variance yielded results consistent with the above impression of equality. Whether a cue was categorized was not significant either as a main factor [$F(1,9) = .49$ for percentages correct, and $F(1,9) = .53$ for latencies] or in interaction with type of stimulus [$F(2,9) = 1.82$ for percentages correct, and $F(2,9) = .54$ for latencies]. In addition, the relatively insensitive between-subjects main factor of type of stimulus was not significant [$F(2,9) = 1.68$ for percentages correct, and $F(2,9) = 1.29$ for latencies].

The data concerning only the first of the 12 sets that each subject received were also analyzed separately, in case an effect of categorization did not appear in the overall data because it was nullified by some strategy learned during the course of the experimental session (although it should be noted that a reliable difference is less likely to be found in these supplementary data because of the relatively small number of observations). Even in this first set, categorized and uncategorized cues were approximately equally effective, for all three types of stimuli. The percentages correct and mean latencies of correct answers were as follows (categorized cue measures first): unitary stimuli, 41.7% and 54.2%, 3.4 sec and 2.8 sec; nonunitary stimuli, 29.2% and 25.0%, 4.6 sec and 5.2 sec; included stimuli, 20.8% and 20.8%, 5.7 sec and 4.7 sec. Analysis of variance carried out on the percentages correct data yielded results consistent with the above impression of equality, with no significant effects of categorization [$F(1,9) = .32$], of categorization by stimulus type [$F(2,9) = 2.86$], or of stimulus type [$F(2,9) = 1.03$]. Some subjects produced no correct answers for one of the two types of cue, and so the latency data were not subjected to analysis of variance.

Discussion

This experiment was carried out to investigate whether the effects of categorization for included stimuli resembled more those for unitary or for nonunitary stimuli. However, no effect was detectable for any of the types of stimuli. This finding was the same as that of Spyropoulos and Ceraso (1977) for nonunitary stimuli, but it differed for unitary stimuli. However, the present experiment differed in several respects from those of Spyropoulos and Ceraso (1977), perhaps most importantly in assessing intentional rather than incidental learning. Thus, a further experiment was carried out, using an incidental rather than an intentional method.

EXPERIMENT 2

The method of this experiment was as close as possible to that for the integral stimuli condition of

Spyropoulos and Ceraso's (1977) Experiment 1 (in which type of stimulus was a between-subjects factor).

Method

Subjects. The 16 subjects were either members of the Oxford subject panel or Oxford students and were paid for their services.

Material. The stimuli consisted of 10 forms cut from colored paper and stuck to white cards. They comprised a black square, blue cross, brown arrow, gray circle, green triangle, orange diamond, pink semicircle, purple crescent, red rectangle, and yellow oval.

Procedure. Subjects were given a set of instructions that informed them that a first experiment concerning the "categorization of visual material" was to be followed immediately by one concerning multiplication problems. No subsequent recall test was mentioned.

The stimuli were shuffled for each subject and presented at 5-sec intervals by the experimenter, who said "color" for five of the stimuli and "form" for the other five. Each stimulus was categorized as color or as form for equal numbers of subjects. The subject said aloud the two attribute values of each stimulus, the categorized value and the uncategorized value being first for equal numbers of subjects. The subject then posted the stimulus card through a slot appropriate to its categorized value. There were 10 slots on the top of a large box positioned on the table between experimenter and subject, with five slots for colors (indicated by colored strips) and five slots for forms (indicated by black outlines) on opposite sides. The use of only 10 slots meant that two different sets of labels for the slots had to be used for equal numbers of subjects, so as to correspond with the 10 categorized values.

Following the presentation of the 10 stimuli, the experimenter removed the box, and the subject carried out a series of multiplication problems for 5 min. The subject was then provided in turn with all 10 values of either the colors or the forms, and in each case had to attempt to recall aloud the corresponding value of the other attribute, guessing if necessary. Equal numbers of subjects received color and form cues, and the order of these was randomized for each subject. The latency of each response was measured with a stopwatch.

Results

As assessed by both accuracy and latency measures, categorized and uncategorized cues were approximately equally effective. The percentages correct and mean latencies of correct answers, with the categorized cue measure given first and the uncategorized one given second in each case, were 53.8% and 63.8%, and 3.3 sec and 3.7 sec. Two separate analyses of variance yielded results consistent with the above impression of equality. Whether a cue was categorized did not significantly affect either percentages correct [$F(1,15) = 1.36$] or correct latencies [$F(1,13) = .94$] (two subjects failed to correctly respond either to any categorized or to any uncategorized cues and were deleted from the latency analysis).

Discussion

The results of this experiment failed to show the expected advantage of categorized over uncategorized cues. One important respect in which the present experiment may have differed from Experiment 1 of Spyropoulos and Ceraso (1977) concerns the removal by the experimenter at the end of the stimulus presentation of the labeled slots into which the stimulus cards

were posted by the subject. Spyropoulos and Ceraso did not state whether this was done in their experiments. Thus, a second experiment was carried out in which the labeled slots were not removed. This could have two possible effects. First, the continued availability of the categorized values might be expected to favor the use of uncategorized cues, since such values are correct responses for uncategorized cues but incorrect responses for categorized cues. Second, however, it is possible that the presence of the categorized values might in some way impair the selection of particular categorized values as responses to uncategorized cues in a manner analogous to the part-list cuing inhibition effect (Mueller & Watkins, 1977; Roediger, Stellon, & Tulving, 1977; Slamecka, 1968).

EXPERIMENT 3

Method

The method of this experiment was identical to that of Experiment 2 except that after the presentation of the stimulus cards, the experimenter did not remove the box with labeled slots into which the stimulus cards had been posted.

Results

The percentages correct and mean latencies of correct answers, with the categorized cue measure given first and the uncategorized cue measure given second in each case, were 32.5% and 57.5%, and 4.9 sec and 4.7 sec. Uncategorized cues produced a significantly higher level of recall [$F(1,15) = 13.89$, $p < .01$], but the two types of cue did not differ significantly in their associated latencies [$F(1,12) = .52$] (three subjects failed to correctly respond either to any categorized or to any uncategorized cues and were deleted from the latency analysis).

Discussion

Failing to remove the labeled slots after presentation produced an uncategorized cue superiority, presumably due to enhanced response availability for that type of cue. Hence, the categorized cue superiority finding of Spyropoulos and Ceraso (1977) cannot be attributed to this particular factor.

GENERAL DISCUSSION

The results of each of three experiments failed to show the superiority of categorized cues for the recall of integral stimuli previously found by Spyropoulos and Ceraso (1977). The negative finding of Experiment 1 is readily explained by the use of an intentional, as opposed to an incidental, learning method, which may have encouraged the use of strategies that neutralized any effect of categorization. The negative finding of Experiment 2 is more puzzling, since its method was intended to be as similar as possible to that of the inte-

gral stimuli condition of Experiment 1 of Spyropoulos and Ceraso (1977). Spyropoulos and Ceraso did not state whether the labeled slots into which stimuli were categorized were removed prior to recall, and so Experiment 2 was repeated with the difference that in Experiment 3 the labeled slots were not removed. This procedure, however, produced a categorized cue inferiority, and hence the negative finding of Experiment 2 cannot be attributed to the effect of removing the labeled slots.¹

The present results indicate that the effect of categorization upon subsequent cue efficacy must be sensitive to apparently minor differences between the methods employed in the two sets of studies. Perhaps the most obvious of these is the difference in subject population; all of Spyropoulos and Ceraso's (1977) subjects were undergraduates (in Experiments 1, 2, 4, and 5, undergraduates studying psychology). Other possibly relevant differences are in the materials used (Spyropoulos and Ceraso did not state the 10 colors and forms that they used) and in the instructions given to subjects. Clearly, further research is needed to investigate the possible effects of these factors. At present, however, it appears premature to assume that the effect of prior categorization upon cued recall is as robust as would be desirable for it to be used as the basis for drawing theoretical conclusions of a general nature.²

REFERENCE NOTE

1. Ceraso, J. Personal communication, June 13, 1979.

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NOTES

1. The procedure of Spyropoulos and Ceraso did, in fact, resemble that of the present Experiment 2 rather than Experiment 3 (Ceraso, Note 1).
2. Professor Ceraso has also failed to replicate the effect in recent unpublished experiments (Ceraso, Note 1).

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