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AUTHOR	Hall, James W.
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ABSTRACT

This study examined children's use of category information as a discrimination cue to avoid intrusions in recall and false alarms in recognition of items outside given categories. Forty-eight children in grades 1 and 4 were administered one of three conditions of a recognition task in which all study words were members of one of two familiar categories. Conditions were: (1) a fully categorizable list of words (animals and occupations) along with full information as to the categorizability of the list; (2) the same categorizable list but without such information; or (3) a partially categorizable list in which that category information could not function as an effective discriminative one. All children were given the same recognition test list that included old words, new words taken from the study categories, and new words not from the study categories. Analyses of error patterns indicated that in all three conditions children extracted and used category information, but that only in the Categorizable Informed condition did category information function as a discriminative cue to avoid false recognition of new words outside the study categories. (Author/SB)

Abstract

Children's Use of Category Information As a Discriminative Cue for Memory

James W. Hall

Northwestern University

In a fully categorizable list category information can be used as a discriminative cue to avoid intrusions in recall or false alarms in recognition for items outside the study categories. To examine such use, children in grades 1 and 4 were administered (1) a fully categorizable list (animals and occupations) and were fully informed as to the categorizability of the list, (2) the same categorizable list but without such information, or (3) a partially categorizable list such that category information could not function as an effective disciminative one. All children were given the same recognition test list that included Old words, New words taken from the study categories, and New words not from the study categories. Analyses of error patterns indicated that in all three conditions children extracted and used category information, but that only in the Categorizable Informed condition did category information function as a discriminative cue to avoid false recognition of New words outside the study categories.

Children's Use of Category Information

As a Discriminative Cue for Memory

James W. Hall

Northwestern University

Superior recall of categorizable (vs. unrelated) words has been demonstrated repeatedly for individuals as young as 7 years (e.g., Cole, Frankel, & Sharp, 1971). A variety of mechanisms, varying in their presumed automaticity, complexity, and locus (encoding vs. retrieval) have been proposed to account for that finding. In reviewing these possibilities Postman (1972) has pointed out the difficulty in experimentally isolating the operation of any particular mechanism and has suggested the likelihood that the various mechanisms operate simultaneously under ordinary circumstances. The latter suggestion was meant to apply to the normal adult; the young child seems likely to be quite a different story. In fact, it is unlikely that these various mechanisms would become operative simultaneously as the child develops. Instead, one would expect first the operation of relatively simple and automatic associative mechanisms such as have been described by Underwood (1972), followed, perhaps much later, by the emergence of more complex strategic encoding and retrieval mechanisms. Such a developmental sequence has been suggested by others, and some evidence in support of it has been accumulated (e.g., Neimark, Ulrich & Slotnick, 1971; Moely, Olson, Halwes, & Flavell, 1969; Kobasigawa, 1974).

Our experiment is intended to add to that evidence by examining developmentally the operation of one particular strategic use of category information in the service of memory. The mechanism of concern here is that by which category information can be used during recall or recognition testing, not as a retrieval cue, but as a discriminative cue. To elaborate, if all to-be-remembered items are members of categories known to the subject, then any retrieved items falling outside those categories can be rejected out of hand with perfect accuracy. Operationally, that would result, in the case of recall, in no intrusions outside the relevant categories, and in the case of recognition, in no false alarms to distractors outside those categories. Although the questions regarding strategic mechanisms were raised in the context of free recall, a recognition task is used here to investigate the use category information as a discriminative cue by children in grades 1 and 4. The advantages of the recognition task are the experimenter's control over the particular items to be discriminated (rejected) and the fact that there are generally more false alarms in recognition than there are intrusions in recall.

If category information is to function as a discriminative cue, all study items must be identifiable as members of a relatively small number of familiar categories. Accordingly, a study list was constructed such that 12 of the 24 words were names of familiar animals and the remaining 12 were labels for various common occupations (e.g., carpenter). That list was presented in random order, followed by a test list that included new items that were not members of the study categories. To determine the extent to which these children employed category information as a discriminative cue it was necessary to compare their responses to new noncategory items with those of a control condition in which the children could not use category information as a discriminative cue. In that control condition the children were presented a study list that was only partially categorizable, in that half the study items were names of animals (or occupations) and the remainder were unrelated familiar nouns. A lower frequency of false alarms to the new noncategory items for the fully categorizable than for the partially categorizable condition would indicate that the children could and did employ category information as a discriminative cue. However, should such a difference not be found, between these two conditions one would be uncertain as to whether the necessary category information was present but not used in this fashion or whether the child did not possess the necessary category information at the time of testing. Thus, a third condition was included that was identical to the first (the fully categorizable condition) except that all the necessary category information was provided by the experimenter. That is, the children were fully and repeatedly informed that all of the study words were either animal names or names of "people who do different jobs." They were not instructed as to the use of that information, however, so that if they were able to avoid false recognitions to new noncategory items it could be concluded that they had spontaneously employed the category information as a discriminative cue.

Method

Subjects. Forty-eight children in each of grades 1 and 4 served as subjects. Although somewhat above national norms in achievement and social class as a group, the children were drawn randomly from their respective classrooms, and there was considerable variation among the children in these respects. Assignment of subjects to the three conditions was made randomly except to ensure equal ns.

Design and materials. Each subject was presented a study list of 24 words followed by a test list of 48 words. In 2 of the 3 between-subjects conditions the study list consisted of 12 words in each of 2 categories, animals and people ("who do different jobs.") The animal items were SNAKE, GIRAFFE, SHEEP, PIG, TURTLE, GOAT, FOX, SPIDER, ELE-

PHANT, CHICKEN, ZEBRA, and SQUIRREL. The people items were LAWYER, BANKER, POSTMAN, DOCTOR, MINISTER, TEACHER, FIREMAN, CARPENTER, SOLDIER, ACTOR, COWBOY, and SINGER.

In one of these conditions (the Categorizable Informed or CI condition) the subjects were fully informed of the categorizable nature of the list. In the second categorizable condition (the Categorizable Uninformed or CU condition) the children were not so informed. In the third condition (the Partially Categorizable or PC condition) 12 of the study items were instances of one category whereas the remaining items were not categorizable. Those uncategorizable study items were SHOE, BLOSSOM, MOON, TRAIN, TABLE, TREE, CARPET, BOTTLE, BED, TARGET, KITCHEN, and CANDLE.

In the PC condition a counterbalanced design was used such that half the subjects at each grade level received one of the two sets of category items used for the Categorizable conditions (animals or people), and the remaining half received the other set.

Insert table 1 about here

The test list, shown in table 1, was identical for all subjects and contained the following item types (in relation to the study list words); Old words (words from the study list), New Category words (new words from the study list categories), New Associates (words semantically or associatively related to certain of the study items), and New Unrelated items (new words bearing no systematic relationship to any of the study or test items.) The letters immediately to the right of the test words shown in table 1 indicate these various functions for the CI and CU conditions. The two sets of letters in parentheses in that table indicate the functions of the test words corresponding to the two counterbalancing sub-conditions within the PC condition. Note that whereas there were 12 test words of each type on the CI and CU conditions, there were only 6 such words for each child in the PC condition, with the remaining words functioning as filler (F) items. For example, FOX functioned as an Old item for all CI and CU children but only for half of the PC children. And BOTTLE was a New Unrelated word for all children in the CI and CU conditions, but was an Old word for those who had received the partially categorizable study list. Finally, for the PC condition the Old items consist equally of Old Category words and Old Noncategory words.

Procedure. The study items were presented at the approximate rate of 3 sec per word. After a filler task occupying about 1 min, the test items were presented at about a 6 sec per word rate. In all conditions the children were instructed to listen carefully to the study items then, for the test list, to indicate by "yes" or "no" whether or not each item was from the study list. A tape recorder was used for the above presentation. In addition, during the study list instructions the CI children were told that the words would be familiar ones all of which were either names of animals or of "people who do different jobs," and the words FOX and DOCTOR were given as illustrations. Following presentation of the study list the children were asked the names of the categories. All responded correctly. The children in the CU and PC conditions were given no information regarding the nature of the study list except that the items would be familiar ones. For the CI and CU conditions the words FOX and DOCTOR were given as illustrations, and for the PC condition one of those words was given, depending on the counterbalancing condition involved.

Results

The mean proportions of "yes" (old) responses for each condition within each age level and for each test item type are shown in table 2. Two comparisons within that table are critical insofar as the discriminative cue function of category information is concerned. If the CU children made any such use of category information, then the frequencies of their false positives to New Unrelated words and New Associates should be lower than in the PC condition wherein such use was not possible. They were not. Given that finding, if the CI children made such use of category information their false positives to these words should be less frequent than those of the CU group. They were; only 3 of the CI children compared with 22 of the CU children, falsely recognized any of the New Unrelated words or New Associates, $\underline{X}^2$ (1) = 2.37, $\underline{p} < .01$. Further, and somewhat surprising, these conclusions are equally applicable for the two age (grade) levels.

Insert table 2 about here

Several additional comparisons indicate that the categorical relationships among items did influence performance in other respects and in all three conditions. First, in the PC condition the Old Category words were correctly recognized more frequently (78%) than were the Old Non-category words (61%), $\underline{F}$ (1, 30) = 8.9, $\underline{p} < .01$. Second, in both the CU and PC conditions the New Category words were falsely recognized far more frequently than were the New Unrelated words, $\underline{F}$ (1, 60) = 21.86, $\underline{p} < .01$. Was this due to the conceptual relationships among items or to associative relationships among them? As in other such experiments, an unequivocal answer cannot be given due to the confounding of the two (see Lange, 1973 for a discussion of this issue). But there are reasons to suspect that the conceptual relationships among the items were involved. The various items within the categories were selected so as to minimize direct associative relationships among them. Unfortunately, in the absence of appropriate normative word association data the author's judgement had to be relied upon. Note, however, that false positives to the New Category words also greatly exceeded those to the New Associates, and the latter were selected (again mainly by the author's judgement) to maximize such pre-experimental associations. In fact, the New Associates and the New Unrelated items did not differ in frequency of false positives, suggesting that in this task pre-experimental associations played a relatively minor role in determining false recognitions. A third finding suggesting that considerable category information was extracted and used by the CU and PC children is the fact that those conditions did not differ significantly from the CI condition in the frequency of hits to the Old Category items.

Correct recognitions of Old Category words and false recognitions of New Category words were higher at grade 4 than at grade 1, but those differences did not reach significance. However, in the case of the Old Category words a ceiling effect may have operated to obscure such differences. And in the case of the New Category words the age effect did approach significance, F (1, 90) = 2.18, .15 $> p >$ .10. This, whether category information was extracted and used to a greater extent by the older children is uncertain.

Discussion

The primary purpose of the experiment was to clarify the nature of those processes by which memory performance is enhanced by the categorical structure of the to-be-remembered information. In particular it was to examine the discriminative cue role of such information. The results indicate that across the 7-10 age range category information does not function as a discriminative cue under the usual conditions in which enhanced performance has been observed, namely, under the conditions of the Uninformed Categorizable group. Why is such information not used in this apparently simple and obvious fashion? Such use requires the generation and application of a rule to the effect that items outside the represented categories can be confidently rejected as incorrect ("new"). The performance of the Informed condition indicates that even 7-year-olds are capable of the generation and application of that rule. Whether they do so or not depends on the category information that they possess. However, it appears probable that the Uninformed children who did not generate and apply the discriminative cue rule, did in fact possess considerable category information. But even if those children were aware, as seems likely, that there were numerous animal names and names of occupations (people) on the list, that information by itself was not sufficient for the generation of the discriminative cue rule. Such generation requires also that the individual know that only those categories were represented, knowledge that was provided in the Informed condition but not in the Uninformed condition. The basis for the spontaneous induction of that generalization no doubt is formed during the encoding of the study items. That basis would be complete, thus the generalization highly probable, if the appropriate category label were produced to each study item, e.g., if "animal" were to occur as an implicit associative response (IAR) to each animal name. In fact, however, it appears relatively unlikely, even in the case of an adult, that every item would be thus encoded. The word SPIDER, for example, seldom elicits the response ANIMAL in free association testing (Palermo & Jenkins, 1964). Instead, the more probable route to the generalization in question is likely to be more complex. Suppose, for example, that the first four items presented are SNAKE, SPIDER, GIRAFFE, and PIG, and that "animal" does not occur as an IAR until GIRAFFE is presented. At that point if the subject is rehearsing earlier items as well as the just-presented item, the common attribute may be extracted and the earlier items may be recoded as animals. Moreover, the subject may then generate an hypothesis to the effect that all list items are animal names. That hypothesis would have the effect of priming the encoding of future items similarly, e.g., of increasing the probability of "animal" occuring as an IAR to, say, BIRD.

The process just described would involve both cumulative rehearsal and hypothesis testing behavior, behavior not commonly observed in young school children. Moreover, the present case was additionally complicated by the presence of two such categories and by the random arrangement in the study list of words from those two categories. If the above analysis is roughly accurate, then it is not surprising that 10-year-olds did not use category information as a discriminative cue when not fully informed of the categorizable nature of the list.

The precise nature and use of the category information that was extracted by the CU and PC children cannot be specified from the above findings. Frequently the term "organization" is applied under such circumstances. The exact meaning of that term is difficult to pin down, but often it seems to refer to a mental rearrangement of items into categories during the encoding (study) stage (see, e.g., Hagen, etal., 1975). Such could have been the case in the present experiment, but, as in many such experiments, there is nothing in the data that demands such a conclusion. In fact, given the age levels involved, it appears more likely that simpler processes were involved. All that would be required during encoding to lead to the observed performance would be the occurrence of the appropriate category labels as IARs to a number of the study items. Then, during testing, the occurrence of those same labels to New Category items may lead to the false recognition of those items due to the similarity between codes. The above is not intended as an account of what occurred, but rather as an indication of the various alternatives that can only be sorted out by a series of more analytical experiments.

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Table 1

Test Words and Their Functions

Word	Function	Word	Function
COW	NC (NC/F)	BAKER	NC (F/NC)
STRIPE	NA (NA/F)	TRUNK	NA (NA/F)
CHURCH	NA (F/NA)	FARMER	NC (F/NC)
FOX	O (O/F)	SCHOOL	NA (F/NA)
DOCTOR	O (F/O)	GIRAFFE	O (O/F)
COWBOY	O (F/O)	GAMBLER	NC (F/NC)
TARGET	NU (O/O)	BED	NU (O/O)
CARPENTER	O (F/O)	WINDOW	NU (NU/NU)
BOTTLE	NU (O/O)	RACCOON	NC (NC/F)
NUMBER	NU (NU/NU)	MOVIE	NA (F/NA)
WEB	NA (NA/F)	KITCHEN	NU (O/O)
WOOL	NA (NA/F)	LAWYER	O (F/O)
NUT	NA (NA/F)	DOG	NC (NC/F)
PIG	O (O/F)	MOON	NU (O/O)
BIRD	NC (NC/F)	EGG	NA (NA/F)
DAY	NU (NU/NU)	MAIL	NA (F/NA)
BANKER	O (F/O)	SNAKE	O (O/F)
SONG	NA (F/NA)	FIREMAN	O (F/O)
BEAR	NC (NC/F)	TURTLE	O (O/F)
PAINTER	NC (F/NC)	PLUMBER	NC (F/NC)
GUN	NA (F/NA)	CUP	NU (NU/NU)
JUNK	NU (NU/NU)	CANDLE	NU (O/O)
SECRETARY	NC (F/NC)	MONKEY	NC (NC/F)
APPLE	NU (NU/NU)	GOAT	O (O/F)

Note: O = Old word, NC = New Category word, NA = New Associate, NU = New Unrelated word, and F = Filler word. See text for further explanation of test word functions.

Table 2

Mean Proportions of Old Judgements

Given to Each Type of Recognition Test Word

Condition	Grade	Old Categ. Words	New Categ. Words	New Associates	New Unrel. Words
Categorizable	1	.80	.28	.03	.01
Informed (CI)	4	.87	.40	.02	0
Categorizable	1	.83	.23	.08	.05
Uninformed (CU)	4	.86	.26	.11	.12
Partially	1	.74	.25	.06	.11
Categorizable (PC)	4	.82	.33	.12	.11

Footnotes

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Requests for reprints should be sent to James W. Hall, School of Education, Northwestern University, Evanston, Illinois, 60201.