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ABSTRACT

The effectiveness of two types of retrieval cues was assessed with second- and sixth-grade children. After a single presentation of a list of words, the children first recalled as many of the words as they could. Following free recall, children in each grade were given either conceptual (category names for words on the input lists) or acoustic (words which rhymed with words on the list) retrieval cues for the words missed in free recall. For all students conceptual cues were more effective than acoustic cues. For sixth-grade students both types of cues were more effective than could be expected on the basis of guessing. Second graders performed less well than sixth graders with both types of cues. While conceptual cues produced above-chance performance at the second-grade level, acoustic cues did not. Results are discussed in terms of developmental changes in memory attributes. (Author)

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Technical Report No. 220

EFFECTIVENESS OF ACOUSTIC AND CONCEPTUAL RETRIEVAL CUES IN MEMORY FOR WORDS AT TWO GRADE LEVELS

by

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Statement of Focus

The Wisconsin Research and Development Center for Cognitive Learning focuses on contributing to a better understanding of cognitive learning by children and youth and to the improvement of related educational practices. The strategy for research and development is comprehensive. It includes basic research to generate new knowledge about the conditions and processes of learning and about the processes of instruction, and the subsequent development of research-based instructional materials, many of which are designed for use by teachers and others for use by students. These materials are tested and refined in school settings. Throughout these operations behavioral scientists, curriculum experts, academic scholars, and school people interact, insuring th at the results of Center activities are based soundly on knowledge of subject matter and cognitive learning and that they are applied to the improvement of educational practice.

This Technical Report is from the Project on the Structure of Concept Attainment Abilities in Program 1. The general objectives of this project are to identify basic concepts in language arts, mathematics, science, and social studies appropriate at a given grade level; to develop tests to measure achievement of these concepts; and to develop and identify reference tests for cognitive abilities. These will be used to study the relationships among learned concepts in various subject matter areas, cognitive abilities, and possibly, certain cognitive styles. The results of these will be a formulation of a model of structure of abilities in concept attainment.

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Abstract

The effectiveness of two types of retrieval cues was assessed with second- and sixth-grade children. After a single presentation of a list of words, the children first recalled as many of the words as they could. Following free recall, children in each grade were given either conceptual (category names for words on the input list) or acoustic (words which rhymed with words on the list) retrieval cues for the words missed in free recall. For all Ss conceptual cues were more effective than acoustic cues. For sixth-grade Ss both types of cues were more effective than could be expected on the basis of guessing. Second graders performed less well than sixth graders with both types of cues. While conceptual cues produced above-chance performance at the second-grade level, acoustic cues did not. Results are discussed in terms of developmental changes in memory attributes.

I
Introduction

The purpose of this experiment was to determine the relative effectiveness of different types of cues in aiding memory in children of different ages. In addition to providing educationally relevant knowledge concerning the functioning of retrieval cues in children's memory, the present study represents a further attempt to explore developmental changes in memory attributes.

Underwood (1969) has conceptualized memory for a word as consisting of a collection of attributes. These attributes represent different types of encoded information and they serve to discriminate one memory from another as well as to serve as retrieval cues.

Recent evidence (Bach & Underwood, 1970; Ghatala, 1970) suggests that developmental changes occur in the dominance of various attributes in recognition memory. Bach and Underwood (1970) used a recognition task in which Ss were required to select a previously presented word from among a set of distractors which included an acoustically similar word, an associate of the target word, and a word unrelated to the target word. They found that second-grade Ss made more acoustic errors than associative errors, while sixth graders made more associative errors than acoustic errors. Both types of errors were more frequent than neutral errors. In a similar experiment, Ghatala (1970) found a decrease in acoustic errors with age and an increase in associative errors. Conceptual errors (i.e., choosing a distractor which is the name of the concept to which the target word belongs) also increased with increasing age.

The logic of both experiments was that types of errors made on the recognition test reflected the predominant type of information Ss encoded about the words when they were first presented for learning. The results suggest that the acoustic attribute of the memory for a word (i.e., its sound patterning when pronounced) is a dominant attribute for young children. With increasing age and concomitant experience in the verbal domain, the verbal-associative attribute, which consists of one or more words elicited by a word, and the conceptual attribute, which consists of the name of the concept to which the word belongs, become dominant over the acoustic attribute in word memory.

The present study explores the implications of the above findings concerning developmental differences in encoding for facilitating children's memory through the use of retrieval cues.

In studies using free recall tasks with adults, it has been found that providing cue words at the time of recall which are weakly associated with the to-be-remembered words facilitates recall only if the cues were also present on the input trial (Tulving & Osler, 1968). Other studies have found that cue words strongly associated with the to-be-recalled words facilitate recall even when they are presented only at recall (Bilodeau & Blick, 1965; Thomson & Tulving, 1970; Wood, 1967). Thomson and Tulving (1970) suggest that the effectiveness of cuing at recall is strongly determined by specific encoding of the to-be-remembered word at input. When adult Ss are free to encode words subjectively (i.e., no cue words are present at the time of input), strong verbal associates or strongly associated concept names serve as effective cues at output because S initially encodes the input words in terms of these attributes. On the other hand, for weak associates of the to-be-remembered words to be effective cues at output, the S's encoding of the words at input must be manipulated so as to include weak associates as memory attributes. Thus, it is argued, a cue will be effective at recall if it is part of the memory for the word regardless of whether S was induced to encode an

input item in terms of the cue or whether the cue was "naturally" part of the S's coding response to the item at input.

Little research has been done on the effectiveness of retrieval cues with children. However, the previously mentioned research showing changes with age in the dominance of "naturally" encoded attributes suggests that the effectiveness of different types of cues may be related to the age of the subject. If the conceptual attribute becomes a more dominant part of the memory for a word with increasing maturity, then retrieval cues which are conceptually related to the to-be-remembered words should become more effective with age. Cues which are acoustically related to the to-be-remembered words should be more effective or at least as effective as conceptual cues with younger children. Older children may also use acoustic cues effectively, but conceptual cues should be more facilitative than acoustic cues for older children.

In order to explore the above hypotheses, second- and sixth-grade children were presented with words which they then tried to recall. Following free recall, the children were given either conceptual or acoustic cues to help them remember the words missed in free recall. Performance on cued recall was expected to vary with type of cue and age-grade of subject as outlined above.

II
Method

Subjects

Second- and sixth-grade children enrolled in the elementary and middle schools of a suburban Wisconsin community participated in the experiment. Eighty children within each grade were assigned to conditions by means of a randomized-block scheduling procedure. The mean ages of the second and sixth graders were 7.7 years and 11.6 years, respectively.

Materials

Two lists of 16 words were constructed for use in the free recall portion of the experiment. The words in each list were responses to 16 of the category names contained in the Battig and Montague (1969) category norms for college students. Thus, the 16 words in a list represented 16 different categories. The category names were selected on the basis of their high familiarity to second-grade children as determined in a previous study (Ghatala, 1970). The words representing the categories were selected according to three criteria: (a) they were among the four most frequent responses to the category names, (b) they were of medium to high frequency (Thorndike & Lorge, 1944), and (c) rhyming words could be generated for them.

The conceptual cues used in the cued recall stage of the experiment consisted of the 16 category names already described. The acoustic cues were words which rhymed with the words on the input list and resulted from Es' judgments. An example will illustrate the nature of the to-be-recalled words and their cues. The word bee appeared on the input list, and on cued recall Ss were given either the acoustic cue for the word (sea) or the conceptual one (insect). Two lists were used to increase generality of results. The lists were equivalent in average Thorndike-Lorge frequency and on the mean frequency of occurrence of the words to the category names. A random half of the Ss in each grade were assigned to List 1, the other half to List 2.

Procedure

Subjects were run individually in a private room in the school building. The Ss in the experimental groups were first given the list of 16 words with instructions that they would be asked to recall the words in any order. The words were read by E at a 4-second rate. The Ss were required to repeat each word after E to insure that the words were heard correctly. Almost no words were mispronounced by any of the Ss. A 1-minute interval occurred between the single presentation trial and recall. During the interval, Ss were given the task of constructing patterns with colored blocks. This puzzle game, adjusted in difficulty for the two grade levels, was an intriguing task for the children and effectively prevented rehearsal. Following the interval, the Ss were told to say aloud in any order all the words they could remember from the list. Essentially unlimited recall time was allowed; however, Ss usually indicated after 2 to 3 minutes that they were finished. The E prompted Ss to think 1 minute longer and then terminated the task.

Immediately following free recall, Ss were given the cued recall task with either acoustic or conceptual cues. In cued recall, Ss were told that they would be given hint words that they could use to help them remember the words which they missed on the recall trial. The Ss were told the nature of the cues; that is, Ss receiving acoustic cues were told that the hint words in each case sounded like the word they missed. The Ss receiving the con-

ceptual cues were told that the missed word was an example of the hint word. For practice in using the cues, the E pointed out the relationship between the first three words actually recalled and their appropriate cues. This procedure required that one sixth-grade S in the conceptual cue condition and two second-grade Ss (one from each of the two cue conditions) be dropped from the experiment because they failed to recall at least three words in free recall. Following the practice trial, Ss were given the cue for each word they failed to recall earlier. The Ss were required to pronounce the cue word after E and then were given 40 seconds to respond. The children were cautioned not to guess at first but to try to think of a word which was on the list. If after 30 seconds S had not responded, E told him to guess any word.

In order to establish chance baselines against which to measure the effectiveness of each type of cue, a yoked-control procedure was employed. Each experimental S was randomly paired with a control S who did not receive the input list. Instead, the control S was given the words recalled by the experimental S during free recall and the appropriate set of cue words. The control Ss were instructed as to the relationship between the cue words and the recalled words and were told that even though they had never seen the input list, they were to use the cue words to try to guess the words the experimental S had forgotten. After this initial explanation of the task, the procedure employed in cued "recall" with the control Ss paralleled that for the experimental Ss.

Design

The experimental groups (those groups which received the input list) formed a 2 x 2 x 2 factorial design with Grade (second or sixth), Cue Type (acoustic or conceptual), and List (List 1 or List 2) as the factors. Ten Ss were assigned to each of the eight groups. Associated with each of the experimental groups was a control group which differed only in the absence of the input list. The ten Ss in each control group were yoked with the Ss in the corresponding experimental group as described earlier.

III
Results

Free Recall

An analysis of variance of the number correct in free recall for the experimental Ss showed only the Grade effect to be significant ($F = 19.04$; $df = 1,72$; $p < .001$). The mean words recalled by sixth-grade Ss was 6.32, and that for second-grade Ss was 4.80. Recall did not differ for the two lists nor for the different cue conditions. In this and all subsequent analyses the probability of Type I error was set at .05.

Cued Recall

Words given to the appropriate cue and not previously produced in free recall were counted as correct. It should be noted that there were almost no instances of a word from the input list being given to an inappropriate cue.

In order to control for differences in free recall scores which in turn reflect differing numbers of opportunities for correct responding during cued recall, a proportion was computed for each S by taking the ratio of number correct in cued recall to the number of possible responses (i.e., the number of unrecalled items in free recall). For each yoked-control S, the denominator of this ratio was determined by the free recall score of the corresponding experimental S.[1]

The left-hand side of Table 1 contains the mean proportion of correct responses in cued recall for experimental and control Ss as a function of grade and cue type. The scores are summed over lists since this was not a significant source of variation in any of the analyses to be reported. As can be seen in Table 1, for experimental Ss (those receiving the input list) the proportion of correct responses in cued recall was higher for conceptual cues than for acoustic cues at both grade levels, and performance of sixth-grade Ss was better than second-grade Ss with both types of cues. An analysis of variance performed on the ratio scores of the experimental Ss revealed significant effects of Grade ($F = 19.61$; $df = 1,72$; $p < .001$) and Cue Type ($F = 5.38$; $df = 1,72$; $p < .02$). The predicted interaction of Grade and Cue Type was not significant ($F < 1$).

The mean absolute numbers of correct responses during cued recall for the four experimental conditions were: 3.85 for second-grade Ss with conceptual cues, 3.10 for second-grade Ss with acoustic cues, 5.20 for sixth-grade Ss with conceptual cues, and 4.10 for sixth-grade Ss with acoustic cues. Thus, cuing at the time of recall resulted in retrieval of substantial numbers of words previously unavailable in free recall.

A separate analysis of variance of the ratio scores for the control groups produced no significant effects, indicating that the chances of generating correct responses by guessing during cued recall did not vary with grade or cue type. The mean absolute numbers of correct responses for the control groups corresponding to the four experimental conditions were: 1.85 for second-grade Ss with conceptual cues, 2.85 for second-grade Ss with acoustic cues, 1.85 for sixth-grade Ss with conceptual cues, and 1.90 for sixth-grade Ss with acoustic cues. These means represent the

[1] Inspection of results showed that the same results were obtained by analysis of the ratio of cued responses to number possible as by analysis of cued responses after covariance of number possible and/or log cued responses with covariance of log possible. The ratio variate was reported since it is meaningful and straightforward.

Table 1
Mean Proportion of Correct Responses in Cued Recall as a Function of Grade and Cue Type for Experimental and Control Groups

	Cue Type	Group Experimental	Control	Difference (E-C)
Grade 2	Conceptual	.357	.177	.180
Grade 2	Acoustic	.270	.206	.064
Grade 6	Conceptual	.516	.187	.329
Grade 6	Acoustic	.434	.199	.235

number of correct responses which might be expected from experimental Ss if they were simply generating words based on their knowledge of the relationship between the cues and the to-be-remembered words.

In every condition the proportion of correct responses in cued recall was lower for the control than for the experimental groups. In order to test for significant differences between experimental and control groups the following procedure was carried out. Difference scores were computed by subtracting the proportion of correct responses attained by each control S from that attained by the appropriate experimental S. Averaging across Ss and lists produced the mean difference scores shown in the right-hand column of Table 1. An analysis of variance of the difference scores showed that the overall mean difference between experimental and control groups was significantly different from zero ($F = 90.58$; $df = 1,72$; $p < .001$), reflecting the higher proportion of correct responses for the experimental Ss than for the control Ss. Also, the extent of the difference depended upon Grade ($F = 14.17$; $df = 1,72$; $p < .004$) and Cue Type ($F = 6.11$; $df = 1,72$; $p < .02$).

A multiple studentized maximum modulus test (Miller, 1966) was performed following the analysis of variance of the difference scores. This test involves a stepwise approach similar to Newman-Keuls except it does not compare means to each other, but determines which, if any, of a set of means can be considered to be non-zero. The number of means in this case is four, and the mean difference scores in the four Cue by Grade conditions are as shown in Table 1. The analysis indicated that three of the four mean difference scores were significantly different from zero; only the mean difference score for the second-grade, acoustic-cue condition could not be declared non-zero. That is to say, sixth-grade Ss performed significantly better than chance with both conceptual and acoustic cues. On the other hand, while second-grade Ss performed significantly better than chance with conceptual cues, acoustic cues at this grade level produced no better performance than that produced by mere guessing.

IV
Discussion

The prediction of an interaction between Cue Type and Grade was not supported in the present experiment. As predicted, sixth-grade Ss performed better with conceptual than with acoustic cues. However, conceptual cues were equally better than acoustic cues for second-grade Ss. In fact, at the second-grade level acoustic cues at recall produced little better than chance performance.

Considering first the results for the sixth graders, it may be argued that both conceptual and acoustic attributes (as well as other attributes) of the words may be encoded at the time of learning and hence both attributes can serve as effective cues at the time of recall. On the basis of research cited earlier, it may be further argued that conceptual cues are more effective than acoustic cues because conceptual or semantic encoding is the preferred or dominant mode of encoding at this age level. That is, the encoding pattern of the words should be more likely to include a conceptual component (i.e., the concept name) than an acoustic component, or at least the conceptual attribute is in some sense stronger than the acoustic attribute for older Ss. Thus, presentation of a conceptual cue would be more likely to produce the target word than presentation of an acoustic cue.

As compared to older Ss, both the conceptual and acoustic cues are less effective with second-grade Ss: In the case of conceptual cues, this is in accordance with the prediction based on the notion that conceptual and other semantic encoding responses are relatively weaker and more unstable in younger than in older children (Bach & Underwood, 1970; Underwood, 1969). Yet the concept name was part of the memory for a sufficient number of to-be-recalled words to produce a significant effect of conceptual cues at the second-grade level.

It was expected that acoustic cues would be better than or at least comparable to the conceptual cues for the second graders because for younger Ss the encoding patterns of many of the words should lack a conceptual component, or at least this attribute should be weaker and less stable than other attributes such as the acoustic. This appeared to be a reasonable hypothesis in view of conclusions drawn from recent recognition memory experiments (Bach & Underwood, 1970; Ghatala, 1970).

At least one hypothesis may be offered at this point for the failure of acoustic cues to be effective aids in recall for second-grade children. Even though the nature of the cued recall task and the relationship of the cues to the to-be-remembered words were carefully explained to Ss in all conditions, the second-grade Ss with acoustic cues did not appear to really understand the task. Often these Ss would respond immediately upon hearing the cue word and would produce nonwords which rhymed with the cues. Two Ss in this condition had to be dropped from the experiment because they consistently produced nonword responses in spite of E's instructions that they were to try to remember the words from the input list.[2] While other Ss in this condition did not produce nonword rhyming responses, they had to be constantly reminded by E not to guess immediately and wildly, but to try to use the cue word to help them remember a word on the input list. In contrast, second-

[2]The mean recall score of the Ss who were dropped for not understanding the acoustic cue instructions was 4.0, which is comparable to the overall mean free recall (4.8) of second-grade Ss retained in the experiment. It is doubtful that replacement of these two Ss biased the results for the acoustic cue condition.

grade Ss with conceptual cues and sixth graders with either type of cue did not engage in this indiscriminate guessing behavior. It may be that the acoustic cuing task simply confused the younger Ss. The suggestion here is that if one is interested in exploring the encoding habits of children as a function of age, the cued recall task is probably not the best tool, at least at the lower grade levels.

On the other hand, it has been demonstrated that retrieval cues at least of the type utilized in the present experiment, can be effective aids to memory with school-aged children, and this is an interesting result in its own right. The average number of new words added in the second grade (excluding the acoustic-cue condition) was 3.85 which is roughly 35% of the material not recalled in free recall. In the sixth grade (averaging across both cue types) 4.65 new words were added, which is roughly 50% of the material not previously recalled. Providing cues which are conceptually related to the material works better with older children but also aids recall of younger children.

The interest in this study was in the effectiveness of different types of retrieval cues given the natural encoding habits of children. It may be the case that greater effects of cuing would be obtained if Ss were induced to encode words in terms of the cues during learning by introducing the cues on the learning trial.

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