DOCUMENT RESUME

ED 049 001 RE 003 395

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TITLE	Some Experiments on Visual and Aural Word Recognition.
PUB DATE	Dec 70
NOTE	11p.; Paper presented at the National Reading Conference, St. Petersburg, Fla., Dec. 3-5, 1970
AVAILABLE FROM	Twentieth Yearbook of the National Reading Conference, Inc., Marquette University, 1217 W. Wisconsin Ave., Milwaukee, Wis. (In press)
EDRS PRICE	EDRS Price MF-$0.65 HC Not Available from EDRS.
DESCRIPTORS	*Auditory Discrimination, *Beginning Reading, Kindergarten Children, Letters (Alphabet), Phonemes, Primary Grades, *Reading Research, Syllables, *Visual Discrimination, *Word Recognition

ABSTRACT

Strategies children use when they recognize words were explored. To measure the effectiveness of two different methods of training children to attend to the critical features of letters, 40 first-grade urban children were presented two pairs of letters (similar and dissimilar) simultaneously or successively. Unexpectedly, it was found that with highly similar stimuli (b and d, the successive problem was less difficult than the simultaneous problem; while with dissimilar stimuli (s and b) the successive presentation was more difficult. Due to this finding, a more complex experiment which combined highly similar letters into trigrams was carried out with 48 first-grade children. Similar results were obtained as in the first experiment. From two additional studies it was found that children with some reading training used the initial and then the final letter of a word as the most important cues in word recognition. A study of the cues used by young children in identifying a word aurally revealed that the final and the initial consonant syllables were chosen more frequently than any of the given five cues. It was also shown by this study that visual word recognition experimental techniques are feasible in studying the aural modality. References are included. (DH)

Some Experiments on Visual and Aural Word Recognition*

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How is a word recognized? This question has probably been asked ever since people began to worry about reading instruction. Some of the most famous early experiments on reading were concerned with processes of word recognition; Cattell's studies, and those of Erdmann and Dodge, for example, were done before 1900. With all the interest and research on the topic, however, we still cannot delineate the strategies a reader actually uses when he identifies a word. Does he respond to the overall configuration of the word? Or does he notice individual letters? Do correspondences between spelling patterns and phonemes, once they have been learned, provide the primary cues? We are not sure.

Most of the work to date--including my own--has focussed on the recognition of words when they are presented visually. I should like to describe a couple of studies of this sort. Recently, my students and I have become interested in the aural mode, and I'd like also to tell you about some data on aural word recognition.

The studies that I shall describe are, in effect, laboratory studies, and they must be evaluated as such. People have often been too quick to over-generalize about date collected under carefully specified, artificial and arbitrary laboratory conditions. It is important to keep in mind the dangers of doing this, although naturally the temptations are great for the experimenter. I believe that one excellent way

*Paper presented at the meetings of the National Reading Conference, St. Petersburg, Florida, December, 1970.

to develop hypotheses about the nature and sequencing of instructional materials is to make comparisons in the laboratory, where crucial variables can be isolated and manipulated. But this type of work, of course, is only an initial stage in the development of materials and techniques to be used in the classroom.

Before a child can recognize a word, he must have learned to some degree how to differentiate the written symbols that he finds on the printed page. Gibson et al. (1962) has suggested that improvement of visual discrimination depends on learning the distinctive features of the forms to be discriminated, i.e., three dimensions of difference that distinguish the stimuli. Presumably, these distinctive features include such things as size, orientation, and symmetry. Some progress toward precise specification of the critical features of the letters of the alphabet has been made, but it is a most difficult task.

It is obvious in any case that the graphemic characteristics of the word provide an important cateogry of cues in visual word recognition. One of my students, Margaret Ackerman, and I did an experiment concerned not with the nature of the critical features themselves, but rather with the effectiveness of different training methods in ensuring that attention is focussed on the features, whatever they may be.

In this experiment (in press) we compared simultaneous and successive discrimination tasks involving highly similar letters (b and d) and dissimilar letters (s and b). Forty first-grade urban children were used as subjects. In simultaneous training, the two letters were presented at the same time, and on every trial, the subject was reinforced for responding to the same one of these stimuli, regardless of its spatial position. In the successive discrimination problem, only one letter

was presented on each trial. The subject learned to press the left of two response buttons when b was presented, and the right button when s was presented. Theoretically, successive discrimination should have been more difficult. However, we found that with highly similar stimuli (b and d), the successive problem was less difficult than the simultaneous problem; while with dissimilar stimuli (s and b) the successive problem was more difficult. Analysis of variance on the mean number of correct responses during training showed that while neither main effect was significant, the interaction was. These findings were unexpected, so we replicated the study and got the same results. Our notion is that for the s-b comparison, distinctive cues (such as size) are easily identified, and so, in simultaneous training, the subject has from the start some basis for comparison and differentiation. However, b and d are notoriously confusing to a first-grader, and the cues that are to be used in the solution of this discrimination problem must be developed during the training. It is possible that simultaneous training in this case presents the subject with so much information at one time that the identification of some critical feature which can be used in comparison will be hindered.

Because the results of this experiment were so different from what was expected, we decided to see if the same result would occur in a more complex task. In a second experiment, highly similar letters (b and d) were combined into trigrams which were presented in a paired-associates paradigm. This task was chosen because it simulated the early reading task, in which the child must learn to associate phonemes with their graphic values.

Two combinations were possible. First, the stimuli could be presented simultaneously in a single trigram--bad (or dab). This approximates the simultaneous training studied in the first experiment, in which both b and d appeared on every trial. On the other hand, the stimuli could be presented successively, that is, with only one of the two letters appearing in a given trigram--bab or dad. This approximates the successive training of Experiment 1. In light of the results of Experiment 1, we predicted that performance would be superior when the highly similar stimuli were presented successively, that is, when the trigrams were bab or dad.

Forty-eight first-grade children served as subjects. There were four trigrams in the list: bad and dab (or dad and bab) were the critical trigrams. Two additional trigrams were added as "non-criticals" to fill out the list. These--for example, ban and sab--were chosen so that the subject could not differentiate on the basis of either initial or final letter. A paired-associates paradigm (anticipation method) was used, in which the trigrams were stimuli and color words were responses. Subjects were run until they had performed correctly on two trials.

The most important comparison was of the critical trigrams--whether or not they were learned more easily in successive training, as we had predicted. They were. There were no such differences for the non-critical trigrams. (Parenthetically, we noted that the critical trigrams that started with d were harder than initial b trigrams. It may be that children develop effective discrimination of the letter b earlier than they do for d.)

An analysis of errors, which I shall not report now, confirmed our findings. The results of this second experiment led us to the same

conclusion; that is, in successive training, the child has a chance to identify a distinctive feature and learn the discrimination on the basis of that feature. These results suggest to us that readiness programs that include letter-discrimination and letter-naming training can be most effective if different methods are utilized for different letters. Letters which are distinctive can be introduced simultaneously, and they will probably require less training than will letters that are highly similar; these should be introduced successively.

Now let us turn from comparisons of training methods to more descriptive data. In 1965, Marchbanks and Levin did a study that assessed the relative importance of several graphemic cues in children's matching responses. They asked middle-class children in kindergarten and first grade to compare the similarity of three-letter and five-letter "pseudowords." They found that the specific letters are much more important in determining recognition than is the overall shape of the word. I shall describe the task, because I want to report some data that we have collected using this method.

The task consisted of a delayed matching-to-sample procedure. The stimuli were three-letter and five-letter nonsense words (trigrams and quingrams). A slide containing a single pseudoword was projected for three seconds. Then this word was removed from sight and an array of several randomly arranged words appeared, from which the subject was to choose one that most resembled the stimulus word. The words on the response slide were so structured that each choice represented one of a systematic series of errors that might be made. For example, it was possible to match the stimulus cug on the basis of the first letter (che), the second (tuk), the third letter (ilg), or on the basis of

overall shape (arp). For the quingrams, it was possible to evaluate six cues--each letter plus overall shape. Shape was defined by whether the letters were above, below or on the line. On some trials, in order to find out what happens when the subject does not have the choice of recalling all of the cues but only some of them, certain cues were held constant in the response items. The subject had an equal opportunity to respond on the basis of any one of the individual letter cues.

Ellen Blumberg, David Williams, and I did our study (1970) with disadvantaged urban children, to see what true non-readers would do. Our kindergarten sample had had no formal reading training and had little or no knowledge of the alphabet. We found that these children showed no preference for any of the cues; they matched on a random basis. Our first grade sample had had some reading training. They behaved exactly as did Marchbanks and Levin's middle-class children. That is, individual letters, especially the initial letter and then the last letter, provided the important cues.

What implications are there here for instruction? In view of these and other findings, there really seems to be no justification for developing instructional methods or primer materials based on the use of overall shape as the primary cue. Shape seems a poor choice after reading training is begun, for when children know the alphabet, individual letters become quite salient. Moreover, if one's instructional strategy were to attempt to capitalize on tendencies seen before any instruction is given, shape would be a poor choice, for there was no tendency at all on the part of our non-readers to utilize this cue.

We also tested some adults on this task. The data were quite different from those of the children; the adults' choices were much more

complex. Surprisingly, although the task as presented seemed wholly visual, half of the subjects reported some use of an "aural" strategy--rhyme, for the most part. The other half reported that they used a purely visual strategy, and again surprisingly, half of these described their strategy as one in which they tried to match on the basis of overall shape. This had been the least salient cue for the children.

These results remind us once more that it should not be assumed that adults and children behave in the same manner on this type of visual matching task. Indeed, it is interesting to note the fact that while many widely-used reading methods over the past thirty years have stressed identification of words on the basis of overall shape and configuration, it is adults and not children who sometimes show this strategy in word recognition.

After having completed this experiment, I feel that this experimental technique is a promising one for studying word recognition. In fact, one of my graduate students, Janet Kuenne, has used it quite successfully in her doctoral dissertation. Kuenne (1970) was interested in what cues might be used in identifying a word aurally. She argued that any successful instructional program for beginning reading must stress the establishment of associations between elements of the spoken language and elements of the written code. Such methods, of course, depend on, first, the child's ability to discriminate, both aurally and visually; and secondly, on the ability to integrate these two sensory modes. We have very little evidence concerning how young children make discriminations in the aural mode; we do know, from the work of Liberman and others, that there are fundamental differences between aural processing and visual processing. In her experiment, Kuenne asked children

in kindergarten, first grade and second grade to match tape-recorded nonsense syllables. Let me give you an example of her materials and her procedure. Suppose that KUG /kəg/ were the word used as a standard. The child would hear this word, and then would hear three variations--for example, KUZ /kəz/, GUK /gək/, and KIF /kɪf/. He would then choose one of the three as the best match for the standard. As in our earlier work, the task was structured so that each choice represented one of a systematic series of errors that might be made. In all, Kuenne evaluated five cues: the initial consonant phoneme, the initial consonant syllable, the final consonant phoneme, the final consonant syllable, and a complete reversal of the stimulus standard. For example, take the standard KUG /kəg/: if KIF /kɪf/ were chosen as a match, the child would be matching on the basis of initial consonant phoneme; KUZ /kəz/ would represent a match on the basis of initial consonant syllable. Similarly, DAG /dag/ would be a match on the final consonant phoneme, and SUG /səg/ on the final consonant syllable. GUK /gək/ is the reversal of KUG /kəg/. Clearly, a young child could never store and evaluate five stimuli as possible matches for a standard. That is why each item was designed so that only three comparison words appeared; of course, over all items and over all subjects, there was an equal number of opportunities to respond to each cue.

Kuenne found that two of the five cues were chosen significantly more frequently than any of the others. These two cues were the final consonant syllable and the initial consonant syllable. There was no significant difference between these two, although there did seem to be a tendency for the final consonant syllable to be more frequently chosen. The other three cues were chosen equally often. There were interesting developmental differences. As in the earlier visual study, it was the

older children--the second graders--who showed the effect most clearly. The same trends were evident in the data from the kindergarten children, but there were no significant differences. In addition, the girls in the first grade were more similar to the second grade subjects, while the boys in the first grade looked like the kindergarten sample. This, of course, reflects the typical finding that girls are more advanced in verbal tasks and show more differentiated behaviors at an earlier age.

Kuenne's study is useful in that it demonstrates that the experimental technique used in studies of visual word recognition are also feasible in studying the aural modality. Moreover, the superiority of the syllable over the single phoneme cue focusses on the general question of the nature of perceptual unit. What is the relevant unit to consider when evaluating cues in aural word identification? How does it relate to the unit in visual word recognition?

In addition, another question arises. The superiority of the initial letter in visual word recognition is well established. Is position a relevant cue in aural recognition? Kuenne's data suggest that if it is, the final position may well be most salient. The implications of this sort of difference between the two modalities might lead to a better understanding of some of the beginning reader's difficulties.

In this paper I have been considering intra-word cues only. Clearly, the context in which the word appears is at least as important. That is, a reader makes use of the information contained in the rest of the sentence in his efforts to recognize a word. More research emphasis is being placed on context, or, to state it another way, the search for cues when units larger than a single word are considered. Some comparisons

between the two modalities, aural and visual, have been made (see Hubbard-Jones '1968), for example).

In summary, I have described several studies on visual and aural word recognition. I have discussed them in terms of how they may contribute to the understanding of the nature of visual and aural processing. I have also attempted to outline certain implications of these findings that might suggest some feasible hypotheses for various aspects of instruction.

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