DOCUMENT RESUME

ED 104 052 EC 071 652

AUTHOR	Archwamety, Teara; Samuels, S. Jay
TITLE	A Mastery Based Experimental Program for Teaching Mentally Retarded Children Word Recognition and Reading Comprehension Skills Through Use of Hypothesis/Test Procedures. Research Report No. 50.
INSTITUTION	Minnesota Univ., Minneapolis. Research, Development, and Demonstration Center in Education of Handicapped Children.
SPONS AGENCY	Bureau of Education for the Handicapped (DHEW/OE), Washington, D.C.
PUB DATE	May 73
GRANT	OEG-0-9-332189-4533(032)
NOTE	72p.
EDRS PRICE	MF-$0.76 HC-$3.32 PLUS POSTAGE
DESCRIPTORS	Childhood; Conceptual Schemes; *Educable Mentally Handicapped; Exceptional Child Research; Mentally Handicapped; Models; Program Effectiveness; *Reading Skills; Teaching Methods; *Training Techniques; Transfer of Training; *Word Recognition

ABSTRACT

The effectiveness of a model for training word recognition was tested with 60 eeucable mentally retarded children (mean age 10 years). Thirty Ss, randomly assigned to the experimental group, were given 14 weeks of training on the model's seven component skills (such as the ability to construct a word given an initial sound), while the 30 control Ss were given reading tasks not related to the model. Posttest scores revealed the experimental group was significantly superior on five of the seven components of the model when a reaction time measure was used, and on six of the seven components when a number of correct responses measure was used. The experimental group was also superior on latencies for recognition of known words, on recognition of unknown words in context, and on a cloze test. Results indicated that components of word recognition can be trained in mentally retarded children and that this training transfers to better word recognition performance on a number of indices. (Experimental data and the test of component skills are appended.) (LS)

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RESEARCH REPORT #50

Project No. 332189
Grant No. OE-09-332189-4533 (032)

A MASTERY BASED EXPERIMENTAL PROGRAM FOR TEACHING MENTALLY RETARDED CHILDREN WORD RECOGNITION AND READING COMPREHENSION SKILLS THROUGH USE OF HYPOTHESIS/TEST PROCEDURES

Teara Archwamety and S. Jay Samuels
University of Minnesota

Research, Development and Demonstration
Center in Education of Handicapped Children
Minneapolis, Minnesota

May 1973

Department of Health, Education and Welfare
U. S. Office of Education
Bureau of Education for the Handicapped

TECHNICAL REPORTS

University of Minnesota Research, Development and Demonstration Center in Education of Handicapped Children

(Place of publication shown in parentheses where applicable)

1. N. Buium & J. Rynders. The early maternal linguistic environment of normal and Down's Syndrome (Mongoloid) language learning children. Research Report #51. May 1973.

2. T. Archwamety & S. Samuels. A mastery based experimental program for teaching mentally retarded children word recognition and reading comprehension skills through use of hypothesis/test procedures. Research Report #50. May 1973.

3. W. Bart. The process of cognitive structure complexification. Research Report #49. April 1973.

4. B. Best. Classroom story development in deaf children: Research on language and cognitive development. [illegible]

5. R. Riegel, A. Taylor, & F. Danner. The effects of training in the use of a grouping strategy on the learning and memory capabilities of young EMR children. Research Report #48. April 1973.

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The research reported herein was performed pursuant to a grant from the Bureau of Education for the Handicapped, U.S. Office of Education, Department of Health, Education and Welfare to the Center for Research, Development and Demonstration in Education of Handicapped Children, Department of Special Education, University of Minnesota. Contractors undertaking such projects under government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official position of the Bureau of Education for the Handicapped.

Department of Health, Education and Welfare

U. S. Office of Education

Bureau of Education for the Handicapped

RESEARCH AND DEVELOPMENT CENTER
IN EDUCATION OF HANDICAPPED CHILDREN
Department of Special Education
Pattee Hall, University of Minnesota, Minneapolis, Minnesota 55455

The University of Minnesota Research, Development and Demonstration Center in Education of Handicapped Children has been established to concentrate on intervention strategies and materials which develop and improve language and communication skills in young handicapped children.

The long term objective of the Center is to improve the language and communication abilities of handicapped children by means of identification of linguistically and potentially linguistically handicapped children, development and evaluation of intervention strategies with young handicapped children and dissemination of findings and products of benefit to young handicapped children.

Acknowledgments

The investigators would like to express their deep gratitude to the Minneapolis Public Schools personnel, especially, Dr. Richard Faunce - Director of research, Dr. Jerry Gross - Assistant Director of Special Education, Mrs. Mae Peterson - Assistant Coordinator for EMR children, Mr. Merle Griffith - Principal of Putnam School, Mrs. Mary Mullen and Miss Lynn Finberg - Staff Members of Putnam School, Mrs. Barbara Fellows - Principal of Kenny School, Mrs. JoAnne Bakken and Mrs. Marilyn Dahl - Staff Members of Kenny Schools, Mr. Donald Ravell - Principal of Loring School, Mrs. Dorothy Hegdal and Mrs. M. Kertzman - Staff Members of Loring School, for their excellent cooperation without which the present study could not have been made. The investigators would also like to express their appreciation to the participating children whose patience and cooperation made the present study possible.

ABSTRACT

Objective: The purpose of this study was to take the hypothesis/test model of word recognition and to derive an instructional strategy from the model. This model is complex and requires mastery of a number of skills. In essence, what the model suggests is that the reader must use context to predict words which might reasonably follow and use minimal visual cues to verify the words predicted. Experimental subjects trained to use the components of the model should be able to recognize words faster and more accurately than those not receiving the training.

Method: Sixty educable mentally retarded children participated in the study. They were randomly assigned to an experimental and control group, with thirty in each group. Research assistants worked with both groups of subjects. The experimental subjects were trained on components of the model but control subjects were given reading tasks not related to the model. Training lasted for fourteen weeks, approximately four hours a week. All subjects were pretested and posttested.

Identical pretest and posttest were used on mastery of components of the model. Additional dependent variables were: (a) tachistoscopic recognition of known words, (b) recognition of unknown words in context, (c) cloze test.

Results: Pretest - No significant differences were found between the two groups on mastery of components of the model. Posttest - The experimental group was significantly superior on five of the

seven components when the reaction time measure was used and on six of the seven components when the number of correct responses measure was used (t's from 1.68 to 4.15). Latencies for recognition of known words showed the experimenta oup was superior ($p < .05$). When shown unknown words in context, the experimental group was superior ($p < .01$). On the cloze test the experimental group was superior ($p < .01$).

Implications: Results show that components of word recognition can be trained in mentally retarded children and that this training transfers to better word recognition performance on a number of indices. Presently, these instructional strategies are not deliberately given in school as part of the curriculum. We have specified what these strategies are and how they can be taught.

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Teara Archwamety
S. Jay Samuels

Review of Literature

How words are recognized has been a controversial issue in psychology for nearly 100 years. One point of view holds that word recognition occurs by serially processing the letters in the word, one letter at a time. Another view holds that the word is processed as a whole. A third point of view suggests that recognition is a constructive process and only part of the word is used in recognition.

What makes the question so difficult to answer as to the way in which a word is recognized is that the process of recognition may differ with the degree of reading skill of the experimental subjects. Beginning and fluent readers are probably using different strategies of recognition. In addition, the characteristics of the experiment will influence the recognition strategy. Whether the words presented for recognition are in isolation or are in context, whether they are high or low frequency words, whether they are easily legible or not, will greatly affect how the words get processed. Rather than argue that there is one way to recognize a word, it is probably more correct to argue that the mode of recognition is determined by degree of reading skill and by the demand characteristics of the reading task.

Evidence for serial processing of letters in a word.

Sperling (1963) found that if a random matrix of letters was followed immediately by a patterned mask, the number of letters reported increased linearly with the duration of the matrix (one letter every 10 msec approximately up to a limit imposed by memory). It is fair then to say that unrelated letters can be recovered from the icon at rates of roughly 10-20 msec per letter.

Scharf, Zamansky et.al.(1966) found the masked recognition threshold for familiar five-letter words to be roughly 90 msec. Sperling's results above suggest that with this threshold four or five letters can be read out from the icon easily.

Sperling's results together with those of the Scharf experiment provided indirect evidence for serial processing of letters in a word, at least, at the icon level.

Evidence for parallel processing of letters in a word.

Cattell, in 1885, published an experimental study showing that a word could be recognized as fast as a letter. He, therefore, concluded that we read in word wholes, not by letters (Huey, 1908). Because of methodological inadequacies in Cattell's experiment, the conclusion that recognition occurs at the whole word level is open to question. However, this experiment has often been cited as evidential support for parallel processing of letters in a word. A number of more recent experiments with improved methodology have showed support for parallel processing of letters in a word. One such experiment was conducted by Ericksen and Spencer (1969).

The controversy over the nature of letter processing (serial vs. parallel) in a word has been a long one. The problem is still unsettled. This is clearly depicted in the article debate between Gough (1972) who is in favor of serial processing and Brewer (1972) who opposes Gough.

Haber (1970) has obtained evidence for serial processing in word perception with naive subjects, but not with practiced subjects, who show parallel processing in the same task.

Evidence for constructive processing in word perception.

There has been a large body of evidence in the history of research in the psychology of reading that word recognition is a constructive process and only part of the word is used in recognition. Pillsbury (1897) tachistoscopically presented words containing misprinted letters. Although his subjects were able to recognize the words, many of them did not realize that there were misprinted letters. Failure to recognize the spelling errors suggests that they were not processing all the letters in a word.

If only part of a word is sufficient for its recognition, what parts or aspects of a word helped the subjects to recognize the word? What were the cues? There was some indication in Pillsbury's (1897) study that the subjects saw the first few letters of a word more clearly than the others. In Pillsbury's experiment (1897), he found that misprints introduced in words exposed in a tachistoscope were most often detected at the beginning of the words.

Recent work by Broerse and Zwann (1966) indicates that the beginning letters in a word contain the most information as to its identity.

Anderson and Dearborn (1952) referred to a study done by Zeitler, a German psychologist who, in 1900, found from tachistoscopic experiments that capital letters and letters extending above and below the line were reported more correctly than the others. Zeitler called these letters "dominant letters."

There was also evidence showing that word shape was an important cue to word recognition. Anderson and Dearborn (1952) referred to an experiment conducted by Erdmann and Dodge who, in 1898, found that a word could be read at a distance at which its letters could not be seen.

To sum up, it is clear that a word did not have to be seen in totality in order to be identified and certain aspects of a word served as cues to its identification. Some of these cues were: the first few letters, "dominant letters" and word shape.

Variables influencing the recognition of words.

Subject variable. There is evidence indicating that the process of word recognition differs with the degree of reading skill of the experimental subjects. Samuels and Chen (1971) found that adults recognized tachistoscopically presented words faster than children. They also found adults had: (1) more and faster partial perceptions of word in the absence of total recognition, (2) better ability to utilize clues such as first and last letters and word length, and (3) greater willingness to alter incorrect hypotheses as to the identity of a word. Samuels and Chen suggested that these three superior skills in adult readers should account, in part, for the adults' faster word recognition in general.

Smith (1971) argues that fluent readers use different strategies from beginning readers in recognizing a word or in reading a passage. In recognizing a word in a passage, a fluent reader first uses syntax to predict a word. Then he needs only a minimum of visual cues from the printed word to confirm the prediction. In other words, he crosses the bridge from meaning of the word (deep structure) to the visual representation of the word (surface structure). A beginning reader, however, crosses the bridge in the opposite manner.

Experimental Variable. There is evidence indicating that the verbal context in which a word is embedded influences the speed of the recognition of that word. Tulving and Gold (1963) first showed the subjects some words (called the preexposure context) then immediately flashed a target word. They varied the length of the preexposure context, holding the stimulus word constant. The preexposure context was of two types - one relevant to the stimulus word, the other irrelevant to the stimulus word. Visual Duration Threshold of the stimulus word was recorded. Tulving and Gold found that when the preexposure context was relevant, the longer the preexposure context the shorter the Visual Duration Threshold of the stimulus word, and that when the preexposure context was nil, i.e., the target word was shown in isolation, the visual duration threshold was the longest. However, when the preexposure context was irrelevant, the longer the preexposure context the longer the Visual Duration Threshold of the stimulus word. Tulving explained his findings in terms of information theory which was originally developed for communication engineering but has gained popularity in psychological theories since the early 1950's (Norman, 1969). According to Tulving, a stimulus word (target word) contains a certain amount of information. The subject has to abstract this amount of information before the word can be identified. Some of this information or, in some cases, all of this information can be supplied by the relevant preexposure context. The subject, therefore, needs little or, in some cases, none of the information from the target word in order to identify the target word itself. Consequently, when a target word is shown in context, a very brief exposure of the target word is enough for the subject to identify the target word. When the preexposure context is irrelevant, however, not only is none of the information in the target word supplied by the context, but also the contextual information interferes with the information in the target word. This probably explains why the length of irrelevant preexposure context varies directly with the Visual Duration Threshold of the target word.

Rouse and Vernis (1963) and Samuels (1969, 1970) conducted experiments similar to Tulving's. The only difference was that the preexposure context was composed of only one word. This word could be an associate of (or relevant to) the target word, or a nonassociate of (or irrelevant to) the target word. Recognition time of the target word was faster after the associate word was shown than after the nonassociate word was shown.

Stimulus variable. The characteristics of the stimulus words may determine how fast they can be recognized. It is evident that high frequency words are recognized faster than low frequency words. The tabulation of word frequency by Thorndike and Lorge (1944) stimulated psychological research in word frequency. Solomon and Howes (1951), in their tachistoscopic experiments, found that words with high frequencies were recognized faster than words with low frequencies. Solomon and Postman (1952) found the same thing. In the years that followed, a number of theories have been proposed to explain this phenomenon of word frequency effect. Broadbent (1967) had summarized a number of such theories. Of these theories, the "sophisticated guessing theory," as termed by Broadbent, probably provides the best account for the word frequency effect. Neisser (1967) termed this theory differently - as "fragment theory." The essence of the theory remains the same whatever name we call it. The leading proponent of this theory is Newbigging (1961). According to Newbigging, when a word is presented at a short duration, only a few letters or a fragment of the word is seen by the subject. This fragment may be common to a number of words. The subject guesses the word with bias towards the word of greatest frequency of occurrence which incorporates the seen fragment. If the stimulus is a low frequency word, however, the guess will be wrong, and the experimenter has to increase the duration of the stimulus shown. "Word frequency effect" is obtained in this way.

Models in reading and word recognition.

A large number of models in reading have grown out of research and analysis in the area of reading proper as well as psychology and linguistics. Williams (1971) grouped these reading models into five categories.

1. Taxonomic models. The main characteristic of reading models in this category is that the reading behavior is intuitively broken down into several skills. Gray's model (1960) is an example. He classified reading behavior into four skills: word perception; comprehension; reaction to and evaluation of ideas of the author; and, assimilation of what is read.

2. Psychometric models. The main characteristic of reading models in this category is that the reading behavior is analyzed into several independent skills (called factors) through the use of the technique of factor analysis. Each skill or factor can be further analyzed into more subskills or subfactors. Holmes' model of reading (1953) is an example.

3. Psychological models. This category can be divided into three subcategories: behavioral, cognitive, information processing.

3.1 Behavioral models. Essentially, models in this subcategory regard reading as a process in which an appropriate verbal response is associated with a verbal stimulus through reinforcement. Proponents of this type of reading models are, for example, Skinner (1957) and Staats (1962).

3.2 Cognitive models. Gibson's model (1970) is one example. According to Gibson, learning to read passes through several "phases": from acquiring speech to scribbling, from differentiating scribbles to differentiating letters of the alphabet by noticing their distinctive features, and from letter differentiation to learning "rules" of unit formation which will enable the child, as he becomes more skilled, to use the "structural principles" to read in larger, more efficient units.

3.3 Information processing models. These models are essentially computer models. Reading models under this subcategory are exemplified by that of Venezky and Calfee (1970) and that of Smith (1971).

Briefly, in Venezky and Calfee's reading model, the reader's scanning of the reading material is directed by his general knowledge and his immediate knowledge of the material. There are two (simultaneously-operating) forms of processing: integration of stimuli already scanned, and forward scanning. The forward scanning locates the largest manageable unit and goes on to the next while the information in the unit is integrated. A word is identified via search of the high-frequency word storage and low frequency word storage.

Smith's model contends that letter identification, word identification, and identification of meaning are all based on feature analysis. According to this model, fewer visual features are required to discriminate a letter in a word than to discriminate a letter in isolation. Also, identification of meaning requires less information than does word identification.

4. Linguistic models. Reading models in this category grow out of studies and research in linguistics. One such model is that of Goodman (1970). According to Goodman, the reader decodes from the graphic stimulus not to speech, but directly into deep structure. In oral reading, he then encodes the meaning into speech. The proficient reader may recode what he reads into speech containing transformations in vocabulary and syntax with no modification in meaning.

5. Transactional models. Rosenblatt's reading model (1970) is an example. According to her, the quality of the experience that the reader is living through, under the stimulus of the text, is the goal of the reading. There is an active, two-way relationship between reader and text. She distinguishes between "aesthetic" mode of reading and "instrumental" reading.

Of these five categories, only the category of Psychological Models deals explicitly with the problem of how a word is recognized in reading.

One criticism Williams (1971) had concerning the models in all five categories is that most of them are too comprehensive. In her own words:

> ...Rather, I would like to see us turn our attention to certain limited areas and attempt to refine certain notions that at this point need sharpening. We need "partial" models that are specific, rigorous, and testable. Samuels' (1971) three-stage model of the recognition

> of flashed words provides an example. The output of the model is well specified, the processes are carefully described, and data in support of the model are presented.
> (p. 7-158)

Samuels' (1971) three-stage model of the recognition of flashed words referred to above is, in fact, called the hypothesis/test model of word recognition. The model was recently revised (Samuels & Chen, in press) and now has four stages.

Stage 1 (information use) Information from the reading material already read (or, in Tulving's experiment, the preexposure context) is utilized, e.g., Father cut the green _____.

Stage 2 (hypothesis making) Information from the reading materials (or preexposure context) as well as knowledge of the structure of English is used to formulate hypothesis, i.e., make predictions of what the next word (or target word) will be, e.g., Father cut the green _____ (next word could be emerald, grass, money, plant, etc.).

Stage 3 (test) The hypothesis is tested using new information gathered from partial perception of the next word. Information used to test the hypothesis may be a letter, group of letters, or word shape, e.g., Reader sees letters "gr" which match the word "grass".

Stage 4 (accept/reject) If the new information matches one of the predicted words, the hypothesis is accepted and recognition is rapid. If the new information does not match any of the predicted words, the reader must engage in careful time-consuming visual analysis to recognize the word.

It is worth noting that the process of word recognition described in the hypothesis/test model of word recognition is very similar to the process of speech perception first advanced by Halle and Stevens (1959, 1964). They called this process of speech perception the analysis by synthesis. The essence of the process is that the listener generates guesses as to what a speaker will say and then compares the hypothetical signal with the real one, i.e., the one produced by the speaker. The perception of speech is achieved even though the listener does not receive the speech signal clearly or in totality. This is supported by the work of Miller, Heise, and Lichten (1951). They found that words auditorily presented in context and with noisy background were more correctly identified than words auditorily presented in isolation with noisy background.

Statements of the Problems

The present study is designed to investigate if the hypothesis/test model of word recognition can be broken down into behaviors that can be taught to children and to see if children so taught would be able to recognize words faster and more accurately and, accordingly, have better reading comprehension than children who are not so taught.

The so called EMR (educationally mentally retarded) children were chosen as subjects for the present study because the investigators were convinced that if these children could be taught the behaviors involved in the hypothesis/test model of word recognition, so could normal children. If normal children were the first subjects, however, doubt would exist regarding generalizability to the retarded.

To teach an EMR child the behaviors involved in the hypothesis/test model of word recognition first requires the analysis of the model into its component skills and then the training of the EMR child on these component skills. The following seven component skills are believed by the investigators to enable the EMR child, if he is trained on them, to recognize words in the manner explicated by the hypothesis/test model.

1. The ability to construct a word given an initial sound. (CW/S) e.g.,

   The experimenter (E) says the sound "f."
   The subject(S) gives a word starting with the sound "f."

2. The ability to tell what the starting letter of a word just heard is. (TL/W) e.g.,

   E asks: What letter starts the word "man?"
   S gives the initial letter name of the word "man."

3. The ability to visually recognize the initial letter of a word heard. (RL/W) e.g.,

   E says "pen," then E shows p l k n.
   S points to the letter p.

4. The ability to use auditory context to predict word(s) that could logically follow in a sentence without hearing the initial sound hint as to what the word(s) to follow the context may be. ($AP\bar{W}A$) e.g.,

   E says: Mother cleaned the _____.
   S predicts word(s) in the blank.

5. The ability to use auditory context to predict word(s) that could logically follow in a sentence hearing just the initial

sound hint as to what the word(s) to follow the context may be. (APWA) e.g.,

E says: Mother boiled the w____.
S predicts the word starting with w.

6. The ability to use visual context to predict word(s) that could logically follow in a sentence without seeing the initial letter hint as to what the word(s) to follow the context may be. (VPWA) e.g.,

E shows: The pen is on the ____.
S predicts the word to follow.

7. The ability to use visual context to predict word(s) that could logically follow in a sentence seeing the initial letter hint as to what the word(s) to follow the context may be. (VPWA) e.g.,

E shows: We ate bread and b______.
S predicts the word starting with b.

If the training on the component skills is effective the score on the component skills in the final test of an EMR child who has received training should be higher than that of an EMR child who has not received training.

Suppose an EMR child were to recognize a target word under the following five conditions in a tachistoscope (T-scope) experiment:

Condition 1 The target word is shown in isolation and the target word is of low frequency occurrence in the language, e.g., rabbi.

Condition 2 The target word is shown in isolation but the target word is of high frequency occurrence in the language, e.g., camp.

Condition 3 The target word is shown following a relevant, one word preexposure context and the associative value between the preexposure word and the target word is high, e.g., green grass.

<u>Condition 5</u> The target word (e.g., noise) is shown following a relevant, longer context - a sentence context (e.g., We heard a loud).

Would a trained EMR child be able to recognize the target words faster than an untrained EMR child in all the above five conditions?

Considering the theoretical model, it can be predicted that the trained EMR child would have faster target word recognition in Conditions 3, 4, and 5 since he is trained to use context and only a small part of the target word (i.e., the initial letter) to help determine what the target word is. The untrained EMR child is not so trained and probably needs to examine the target word more closely and therefore needs more time to recognize it. Under conditions 1, and 2 the trained EMR child might recognize the target word faster than the untrained EMR child although there is no preexposure context, since the trained EMR child is trained to use the initial letter to guess the word while the untrained EMR child is not.

What about the performance of the trained EMR child within himself across the 5 conditions? Would he recognize the target word under some conditions faster than other conditions? From Tulving and Gold's experiment mentioned earlier, it can be predicted that the trained EMR child would recognize the target word faster under condition 5 than conditions 3 and 4, and faster under conditions 3 and 4 than conditions 1 and 2. From Rouse and Vernis' experiment mentioned earlier, it can be predicted that the untrained EMR child would recognize the target word faster under condition 3 than under condition 4. The word frequency effect leads to the prediction that the trained EMR child would recognize the target word faster under condition 2 than under condition 1.

As for the untrained EMR child, since he is not trained to take advantage of the preexposure context and the first letter of the target word, the tentative prediction is that his speed of target word recognition would not be different across the five conditions.

Of course, an EMR child does not know too many words. When such a child is confronted with an unknown word, no recognition of the word is possible. There can only be a guess. Supposing such a word appears in a preexposure sentence context, can a trained EMR child, when asked to guess, guess more accurately than an untrained EMR child?

Situation 1. The preexposure sentence context is so compelling as to what word must follow (e.g., When it's dark, we turn on the ______) that it is almost certain that the word to follow is "light."

Situation 2. The preexposure sentence context is more ambiguous as to what word might follow - e.g., the fierce animal over there is a ______. Here, the word to follow could be a "lion," "tiger," "bear," etc.

The prediction is that, under Situation 1, when shown the unknown target word (e.g., "light"), after a sentence context (e.g., When it's dark, we turn on the _____), the EMR child should be able to guess that the target word is "light" whether he is trained or not, since the context is so compelling. On the other hand, under Situation

2, when shown an unknown target word (e.g., tiger) after an ambiguous sentence context (e.g., The fierce animal over there is a _____), the trained EMR child should be able to guess better than the untrained EMR child since the trained EMR child has been taught to use the first letter to help guess what the target word is.

Finally, given a modified cloze test in which some of the words in a passage are deleted except for their initial letters, can a trained EMR child guess the deleted words better than an untrained child? Here, the investigators would like to consider a word correct if and only if it 1) starts with the initial letter provided, 2) is grammatically correct, and 3) makes sense in the passage. Any filled-in word which does not meet all of these requirements is considered not correct. Considering that a trained EMR child is taught to utilize information from context and to use the initial letter of a target word to guess the target word (corresponding to the deleted word in the cloze test), it can be predicted that he would be able to fill in the deleted words better.

To summarize, the following tentative hypotheses are stated:

1. Trained EMR children recognize target words faster than untrained EMR children in all the 5 conditions stated previously.

2. Trained EMR children recognize target words faster under condition 5 than conditions 4+3, faster under conditions 4+3 than conditions 1+2.

    2.1 recognition under condition 3 is faster than under condition 4.

2.2 recognition under condition 2 is faster than under condition 1.

3. Untrained EMR children's speed of word recognition is not affected by variation in the five conditions.

4. Trained EMR children identify unknown target words in context more accurately than untrained EMR children but do so only under ambiguous context. Under compelling context, there is no difference in accuracy of identification.

5. On modified cloze tests in which, except for their initial letters, some words are deleted, trained EMR children perform better than untrained EMR children.

Methods

Sixty EMR children participated in the study. Their mean I.Q. was 72 and the I.Q. ranged from 53 to 85. Their mean age was 10.6 yrs. and the age range was from 7.67 yrs. to 13.5 yrs. They were randomly assigned to an experimental group and a control group, with thirty children in each group. The experimental subjects were trained on the seven component skills derived from the hypothesis/test model of word recognition as mentioned in the previous section. The control subjects were given reading tasks and other tasks not related to the hypothesis/test model of word recognition.

Tasks for Experimental Subjects

The essence of training on the seven component skills derived from the model was as follows:

1. <u>Trained on CW/S</u>. (Given a sound, S can construct or say a word starting with that sound.) S was given drills of the following nature:

Stimulus situation: E says, "Tell me a word starting with the sound /p/."

Response situation: S gives a word starting with that sound.

The following sounds were selected as stimuli:

/b/
/d/
/g/
/h/
/dz/
/l/
/m/
/n/
/p/
/r/
/v/
/w/
/z/
/tf/
/θ/

2. <u>Training on TL/W</u>. (Given a spoken word, S can state the initial letter.)

S was given drills of the following nature:

Stimulus situation: E asks, "What is the first letter in the word 'girl'?"

Response situation: S gives the name of the initial letter in "girl."

A large set of stimuli of the above nature was designed for intensive drill.

3. <u>Training on RL/W</u>. (Given a spoken word and 4 visually

presented letters, S can point to the letter which is the initial letter of the spoken word.)

S was given drill of the following nature:

Stimulus situation: E says, "What is the first letter in the word 'boy'?" Then, E shows a card with the letters b c t r printed on it.

Response situation: S points to the letter b.

A large set of stimuli of the above nature was designed for intensive drill.

4. Training on APWA. (Given a spoken sentence with one word deleted completely, S can insert [orally] an appropriate word.)

S was given a drill of the following nature:

Stimulus situation: E says, "My mother sleeps on her _____."

Response situation: S predicts the missing word.

A large set of stimuli of the above nature was designed for intensive drill.

5. Training on APWA. (Given a spoken sentence with one word deleted except for the word's initial letter sound, S can insert [orally] an appropriate word.)

S was given drill of the following nature:

Stimulus situation: E says, "The cat ran after the m______."

Response situation: S predicts what the missing word might be.

A large set of such stimuli was designed for intensive drill.

6. Training on VPWA. (Given a visually-presented sentence with one word deleted completely, S can insert [orally] an appropriate word.)

S was given drill of the following nature:

Stimulus situation: E shows the following in printed form:

The children open the _____.

Response situation: S is asked to read and predict the word in the blank.

E tells S whatever word S cannot read.

A large set or such stimuli, in both sentence and paragraph form, was designed for intensive drill.

7. Training on VPWA (Given a visually presented sentence with one word deleted except for the word's initial letter, S can insert [orally] an apprpriate word.)

S was given drill of the following nature:

Stimulus situation: E show the following in printed form:

The girl ate the b______.

Response situation: S is asked to read this and predict the word in the blank.

A large set of such stimuli, in both sentence and paragraph form, was designed for intensive drill.

Since the knowledge of letter name - letter sound correspondence is important in the development of component skills TL/W RL/W and VPWA, S was taught the following letter name - letter sound correspondence:

Letter name	Letter Sound
b	/b/
c	/k/
d	/d/

Letter name (continued)	Letter Sound (continued)
f	/f/
g	/g/
h	/h/
j	/dz/
k	/k/
l	/l/
m	/m/
n	/n/
p	/p/
r	/r/
s	/s/
t	/t/
v	/v/
w	/w/
z	/z/
ch	/ʧ/
th	/ə/

This does not include all letters and digraphs, but it was enough for the investigators' purpose. Also, the one to one correspondence between the letter (or digraph) and its sound was adopted for convenience.

Tasks for Control Subjects

The reading tasks and other tasks not related to the model of word recognition which the control Ss were engaged in were, essentially, the following:

1. Ss listen to the stories told by E and then answer E's questions concerning the stories.

2. Ss read story books at the control Ss' own level of reading ability with the aid of E.

3. Ss read words from word cards with E's help.

Three research assistants, all of whom had some experience teaching children, served as Es. Each was assigned to approximately one third of the experimental Ss and one third of the control Ss. Each research assistant worked with her own Ss for fourteen weeks approximately four hours a week. She tried to spend one half of her time working with the experimental Ss and the other half with the control Ss. Each assistant worked with about 5 Ss (either experimental or control, exclusively) at a time.

When working with the experimental Ss, E drilled Ss on the seven component skills outlined above. Of course, E could arrange the drill into gamelike forms to make the drill more interesting to Ss. When working with the control Ss, E and Ss were engaged in the three activities not related to the model of word recognition as described above.

To determine whether the experimental Ss, after being trained in the seven component skills, improved in these more than the control Ss, a series of seven tests, each representing one component skill, was constructed. Both the experimental Ss and the control Ss were tested on this test series <u>before</u> and <u>after</u> the 14-week training. The details of this series of tests appear in Appendix B (note that the stimuli used in training were not used in the tests). Two indices were used to indicate the performance on each of the seven component skills: mean reaction time (MRT) and number of correct responses (CR). A decrease in MRT from pretest to posttest indicates the improvement of a skill whereas an increase in CR indicates an improvement.

Immediately after the 14-week training, all Ss, both experimental and control, participated in three experiments designed to test the stated hypotheses of this paper.

Experiment 1

Tachistoscopic Recognition of High and Low Frequency Words Presented with and without Context

This experiment was designed to test hypothesis 1, 2 and 3 (see Statement of the Problems, pp. 17-18). The apparatus used was a two-channel tachistoscope (Scientific Prototype, Model 800F). Each S was tested under five conditions. Each condition had two trials. Each trial consisted of the exposure of a preexposure context (S_1) and a target word (S_2). S was asked to read S_1, then look at the red line following S_1. (If S could not read S_1, E told S_1 to S.) As soon as S read S_1, S_1 was terminated and then for 20 ms. S_2 was flashed at the place where the red line had been. S then was to identify S_2. If he could not do this, the sequence S_1 - S_2 was applied again and again with the exposure duration of S_2 increasing 10 ms. each time. A trial was completed as soon as S could identify S_2.

The five conditions were as follows:

Condition	S_1	S_2
1	-	pard
	-	rabbi
2	-	camp
	-	fifty
3	cold	snow
	green	grass
4	blue	ocean
	beautiful	song
5	Lemon has a salty	taste
	We heard a loud	noise

S_2's in Condition 1 were low frequency words. Both occur less than six times in one million words (Thorndike & Lorge, 1944). The S_2's in other conditions were higher frequency words but their frequency values were controlled to be approximately equal to one another, about 400-600 occurrences per million words. These frequency values are averages of the Thorndike-Lorge count.

S_1's and S_2's in condition 3 and condition 4 were selected such that the associative values between S_1's and S_2's in condition 3 were high (47 between 'cold' and 'snow,' 113 between 'green' and 'grass') and those between S_1's and S_2's in condition 4 were low (0 between 'blue' and 'ocean,' 0 between 'beautiful' and 'song'). These associative values were taken from Jenkins and Palermo's Word Association Norms (1960).

This control on word frequency and word association was done to permit the evaluation of word frequency effect on the visual duration threshold of a target word and word association effect on the visual duration threshold of a target word.

For an S to recognize a target word (S_2), he has to know what that word is, i.e., he has to be able to read that word. Since Ss in the present study were just beginning readers, many of them could not read all the ten selected target words. Therefore, during the 14-week training, all Ss - experimental and control - were taught to read these ten S_2's as well as four other words (girl, school, man, boy) which would be used for warm up purposes. Only those Ss who knew how to read all S_2's could participate in Experiment 1.

Before the experiment started, S was given some warm up. The following instruction was used:

> We are going to play many games today. In each game, you look into that thing (T-scope). First you read what you see then look at the red line. If you see only a red line say 'just a red line.' While your eyes are looking at the red line, I will flash a word, very fast, at the red line and you tell me what that word is. If you can tell me what that word is you win the game. If you can't we'll have to start the game all over again, OK? Do you have any questions? .... Let's try.

Four practice trials were given during the warm up. They were administered in the following order:

Warm-Up

Trial	S1	S2
1	big	man
2	some	boy
3	(blank)	girl
4	I go to	school

Warm-up trials were continued until E was satisfied that S was familiar with the procedure for recognizing words tachistoscopically presented. Then S rested for three minutes and was ready for the actual experiment.

In the actual experiment, the five conditions were randomly administered. Only the conditions were randomly administered. The order of the two trials in each condition was as appeared previously in this section. Criterion consisted of a correct recognition of the target word (S_2). The exposure time at which recognition occurred was recorded and taken to be the visual duration threshold of that trial. The two visual duration thresholds for the words in a condition were averaged and taken to be the visual duration threshold of that condition. Thus, a VDT score was obtained for each S under each condition. The analysis of these scores was by way of a 2 x 5 analysis of variance with repeated measure on conditions.

Experiment 2

Word Identification in Context

This experiment was designed to test hypothesis 4 (see Statement of the Problems, p. 18). The materials used were two sets of ten 5 x 8 index cards each. On each card was typewritten (with an Underwood Primary Typewriter) a sentence. The last word of the sentence was underlined in red and called the target word. The words before the target word were called the context. Sentences in the first set were intuitively designed such that the context seemed so compelling that the target word could hardly be any other word. These ten sentences were:

1. The Apollo astronauts went to the moon.
2. It is dark at night.
3. When it is dark, we turn on the light.
4. Mother sewed her clothes with a needle.
5. Father pounded the nail with a hammer.
6. I saw the smoke coming out of the chimney.
7. That sick man was sent to the hospital.
8. I put the ring on my finger.
9. Mr. Smith has two sons and three daughters.
10. The loud noise the sky makes when it rains is called thunder.

Sentences in the second set were designed such that the context might suggest some other word than the target word. In other words, the context in the second set was not as compelling as that of the first. The ten sentences in this second set were:

1. That fierce animal is a tiger.
2. There are fish in the lake.
3. The car is making a funny sound.
4. At the hospital, there are nurses.
5. The teacher told us a joke.
6. At Christmas, Alex received a lot of gifts.
7. Father keeps his tools in the garage.
8. We get the news from the newspaper.
9. Mother likes to drink coffee.
10. We drink milk.

In the experiment E sat opposite S at a table. E covered the context of a sentence with a blank index card. Only the target word was exposed.

E: Can you read this word?

S: (responds)

If S read the target word correctly, he was ready for the next trial. If S could not read it, E said, "Let's try it this way." E then exposed the context and said, "Read from here," pointing to the first word of the context. E helped S read any word S could not read until S came to the target word. If S could then read the target word by himself, he got 1 point. If he could not, E asked, "Can you make a guess?" If S guessed correctly, he got 1 point. If he guessed incorrectly or refused to guess, he got 0 points. Then, S was ready for the next trial. The experimenter gave no help on the target word. S was given one point only if the same word as appeared in the sentence was given.

The procedure was the same as above for every sentence - or trial. Sentences were administered in the order appearing above in both sets. However, some S's got set 1 first and some got set 2 first in a random manner. The points in each set were added. Thus, each S had two scores corresponding to the two sets. The analysis of these scores was by way of a 2 x 2 analysis of variance with repeated measure.

Experiment 3

Modified Cloze Test

This experiment was designed to test hypothesis 5 (see Statement of the Problem, p. 18). The material used was an 8" x 11" piece of paper on which a passage was printed. Twenty words in this passage were deleted except for their initial letters. This passage was as follows:

> Bobby and Johnny went to the z____. They saw k____, ch____, t____, l____, birds, m____ and many other animals. Bobby liked b____ animals but Johnny liked s____ animals. Bobby bought some f____ to feed the sea lion. Johnny gave c____ to squirrels to eat. When it was getting d____, the boys r____ their bicycles back h____. They put their bicycles in the g____. Then, they drank some w____. Their sister, Patsy, was sewing some clothes. She had with her some th____ and a n____. After supper, everyone was in the living room, singing. Mother was playing in the p____, and Father was playing the v____. It was a j____ day.

In the experiment, E sat opposite S at a table with the experimental material in front of S. The following instructions were used:

> Today we are going to play some guessing games. You and I are going to read this (point to the experimental material). When we come to a blank such as this (point to the first blank) you have to guess what the word in the blank should be. The word you guess must start with the letter you see in the blank. Any questions? Let's start.

S then started reading the passage. E helped S on whatever word S could not read. When S came to a blank, if the blank was at the end of the sentence E asked, "Can you guess what the word in the blank is?" No help was given on the target word. If the blank was not at the end of the sentence S was asked to read on to the end of the sentence. Then E asked, "Can you guess what the word in the blank is?"

If S guessed a word which

1. started with the letter appearing in the blank,
2. was grammatically correct,
3. made sense,

he got one point for that blank. If he failed in any of these three requirements he got zero points for that blank.

Each S's points were then added. Thus, an S could get a maximum score of twenty on the cloze test. The experimental Ss' scores for the cloze test were then compared with those of the control Ss by the use of the _t_ statistic.

Results

Comparisons between the experimental group and control group concerning the performance of the seven component skills both before and after the training is shown in Table 1, Table 2, Table 3, and Table 4. Table 1 compares the experimental group and control group on the basis of the S's mean reaction time in seconds between the stimulus and the response for each component skill _before_ training. Table 2 compares the experimental group and the control group on the basis of the S's mean reaction time in seconds between the stimulus and response for each component skill _after_ training.

Table 3 compares the experimental group and control group on the basis of the number of correct or acceptable responses given by S _before_ training for each component skill. Table 4 compares the

TABLE 1

MEAN REACTION TIME BEFORE TRAINING

Component skill	Experimental group			Control group			t
	$\bar{X}$	SD	N	$\bar{X}$	SD	N	
CW/S	3.36	2.54	30	4.38	5.40	30	-0.92 ns
TL/W	3.19	2.28	30	3.75	3.57	30	-0.72 ns
RL/W	2.21	1.29	30	2.61	2.20	30	-0.86 ns
APW$\bar{A}$	2.47	1.81	30	2.48	1.45	30	-0.01 ns
APWA	2.33	2.12	30	2.05	2.49	30	0.47 ns
VPW$\bar{A}$	2.19	2.00	30	1.89	1.27	30	0.67 ns
VPWA	2.98	3.91	30	3.18	2.67	30	-0.23 ns

Note: ns $p < .05$

See meanings of component skill abbreviations on the next page.

COMPONENT SKILL ABBREVIATIONS

CW/S: Given a sound S can construct (say) a word starting with that sound.

TL/W: Given a spoken word, S can state the initial letter.

RL/W: Given a spoken word and 4 visually presented letters, S can point to the letter which is the initial letter of the spoken word.

$\mathrm{APW}\overline{\mathrm{A}}$: Given a spoken sentence with one word deleted completely, S can insert (orally) an appropriate word.

APWA: Given a spoken sentence with one word deleted except for the word's initial letter sound, S can insert (orally) an appropriate word.

$\mathrm{VPW}\overline{\mathrm{A}}$: Given a visually presented sentence with one word deleted completely, S can insert (orally) an appropriate word.

VPWA: Given a visually presented sentence with one word deleted except for the word's initial letter. S can insert (orally) an appropriate word.

TABLE 2

MEAN REACTION TIME AFTER TRAINING

Component skill	Experimental group			Control group			t
	$\bar{X}$	SD	N	$\bar{X}$	SD	N	
CW/S	2.27	1.77	30	3.30	3.45	30	-1.44 ns
TL/W	1.77	1.54	30	3.11	2.79	30	-2.27 *
RL/W	1.01	0.53	30	1.68	1.43	30	-2.35 *
APW$\bar{A}$	1.36	1.00	30	2.16	2.37	30	-1.68 *
APWA	1.36	1.41	30	1.81	1.90	30	-1.03 ns
VPW$\bar{A}$	0.79	0.71	30	1.20	0.75	30	-2.11 *
VPWA	0.67	0.23	30	3.61	3.81	30	-4.15 **

Note: ns $p > .05$
* $p < .05$
** $p < .01$

TABLE 3

NUMBER OF CORRECT RESPONSES BEFORE TRAINING

Component skill	Experimental group			Control group			t
	$\bar{X}$	SD	N	$\bar{X}$	SD	N	
CW/S	4.27	0.63	30	3.93	0.99	30	1.52 ns
TL/W	6.00	1.91	30	5.43	2.72	30	0.92 ns
RL/W	3.63	0.84	30	3.30	1.19	30	1.24 ns
APW$\overline{A}$	3.63	0.71	30	2.57	0.62	30	0.38 ns
APWA	3.63	0.60	30	3.67	0.54	30	-0.22 ns
VPW$\overline{A}$	3.80	0.40	30	3.77	0.42	30	0.31 ns
VPWA	3.13	1.12	30	2.97	1.05	30	0.59 ns

Note: ns $p > .05$

TABLE 4

NUMBER OF CORRECT RESPONSES AFTER TRAINING

Component skill	Experimental group			Control group			t
	$\bar{X}$	SD	N	$\bar{X}$	SD	N	
CW/S	4.57	0.50	30	4.17	0.64	30	2.67 **
TL/W	7.30	1.13	30	5.80	2.65	30	2.81 **
RL/W	3.93	0.25	30	3.43	0.96	30	2.73 **
APW$\overline{A}$	3.93	0.25	30	3.87	0.34	30	0.85 ns
APWA	3.80	0.48	30	3.47	0.76	30	2.00 *
VPW$\overline{A}$	3.97	0.18	30	3.80	0.48	30	1.77 *
VPWA	3.93	0.25	30	3.13	1.02	30	4.09 **

Note: ns $p > .05$
* $p < .05$
** $p < .01$

experimental group and the control group on the basis of the number of correct or acceptable responses given by S after training for each component skill.

Figure 1, Figure 2, Figure 3, and Figure 4 in Appendix A depict means presented in Table 1, Table 2, Table 3, and Table 4 respectively.

It can be seen that before training, there is no significant difference in performance on any of the seven component skills between the experimental group and the control group, whether the performance was measured by reaction time (as shown in Table 1) or by number of correct responses (as shown in Table 3). However, after the training, significant differences between the two groups were shown in five out of seven component skills when the performance was measured by reaction time (Table 2) and six out of seven component skills when the performance was measured by number of correct responses (Table 40). Figures 1 through 4 in Appendix A are presented to help visualize this situation.

Results of Experiment 1

The summary results of Experiment 1 are shown in Table 5. It should be noted here that only 20 Ss from the experimental group and 20 Ss from the control group participated in this experiment. This is because these Ss were the only Ss who could read all the ten target words used in this experiment. The other Ss could not read one or more of those ten words.

TABLE 5

SUMMARY SCORES ON SPEED OF TACHISTOSCOPIC WORD RECOGNITION OF HIGH AND LOW FREQUENCY WORDS PRESENTED WITH AND WITHOUT CONTEXT

Condition	Experimental group $\bar{X}$	Experimental group SD	Control group $\bar{X}$	Control group SD
I	34.25	11.54	66.00	64.74
II	33.50	15.50	78.25	99.20
III	47.50	73.70	118.50	123.65
IV	81.50	89.92	117.25	163.99
V	45.50	56.61	105.25	187.82
Combined	48.45	43.08	97.05	84.03

Note: In condition I, the target word is of low frequency and shown in isolation. In condition II, the target word is of high frequency and shown in isolation. In condition III, the target word follows a word highly associated with it. In condition IV, the target word follows a word not highly associated with it. In condition V, the target word follows a sentential context.

The analysis of variance (see Table 1 in Appendix A) shows no significant difference among the five treatments. The interaction between the condition factor and the group factor is not shown to be significant, either.

However, the analysis shows that, overall, the experimental group was significantly faster in recognition of target words than the controls, $F(1,38) = 5.03$, $p < .05$.

Results of Experiment 2

The summary results of Experiment 2 are shown in Table 6.

The analysis of variance (see Table 2 in Appendix A) shows that, overall (i.e., conditions I and II combined), the experimental group identified target words in context more accurately than did the controls, $F\ (1,58) = 4.92$, $p < .05$. The analysis also shows that word identification was more accurate under Condition I (compelling context) than under Condition II (ambiguous context), $F\ (1,58) = 46.79$, $p < .01$. Since the analysis shows significant interaction effect between the condition factor and group factor ($F\ (1,58) = 13.76$, $p < .01$), a test of simple effect was performed. This is shown in Table 2.1 in Appendix A. The analysis of variance on simple effect shows that, under Condition I (compelling context), there is no significant difference in the number of words identified correctly between the experimental group and the controls. However, under Condition II (ambiguous context), the experimental group identified the target words significantly better than the controls, $F\ (1,116) = 14.30$, $p < .01$. Figure 5 in Appendix A shows this interaction effect more clearly.

TABLE 6

SUMMARY SCORES ON WORD IDENTIFICATION IN CONTEXT

Condition	Experimental group $\bar{X}$	Experimental group SD	Control group $\bar{X}$	Control group SD
I. Compelling context	5.47	2.57	5.43	2.03
II. Ambiguous context	4.57	2.30	2.40	1.74

Results of Experiment 3

Results of Experiment 3 are shown in Table 7.

Table 7 shows that the experimental group filled in significantly more "acceptable" words in the modified cloze test than the control group, t (58) = 4.74, $p < .01$.

Discussion

The purpose of this study was twofold: (a) to derive an instructional strategy from a hypothesis/test model of word recognition, (b) to test the instructional strategy with a sample of mentally retarded children. If the instructional strategy was successful, the children in the experimental group should have been superior to the controls on the dependent variables.

Pretests.

Tables 1 and 3 indicate that there was not a statistically significant difference in the seven component skills derived from the hypothesis/test model between the experimental group and the control group to start with - whether the measure was in mean reaction time or in number of correct responses.

Post-tests

However, after fourteen weeks, the experimental group scored significantly better than the control group in five out of the seven component skills when the reaction time measure was considered as indicated in Table 2, p. 34. The experimental group scored significantly higher than the control group in six out of the

TABLE 7

NUMBER OF ACCEPTABLE WORDS IN BLANKS

FOR THE MODIFIED CLOZE TEST

Test	Experimental group			Control group			t
	$\overline{X}$	SD	N	$\overline{X}$	SD	N	
Modified cloze test	15.10	2.60	30	10.67	4.31	30	4.74**

Note: ** $p < .01$

seven component skills when the number of correct responses measure was considered as indicated in Table 4. It can be said that the experimental group had acquired a better set of component skills comprising the hypothesis/test word recognition process than the control group.

Experiment 1. (Tachistoscopic Recognition of High and Low Frequency Words Presented with and Without Context

The results from Experiment 1 (Table 5, p. 38 together with ANOVA Table 1 in Appendix B) indicated a significant group effect with $\overline{X}$ = 48.45 msec. for the experimental group and $\overline{X}$ = 97.05 for the control group, but no significant main condition effect and no significant interaction effect. These imply that:

1. Trained Ss (experimental group) recognized target words faster than untrained Ss (control group) under each of the five conditions.

2. Within each group, there was no differential condition effect.

These suggested that the following hypotheses were confirmed:

(A) Trained EMR children recognize target words faster than untrained EMR children in all the 5 conditions. (Hypothesis 1, p. 17)

(B) Untrained EMR children's speed of word recognition is not affected by variation in the five conditons (Hypothesis 3, p.18).

However, the results suggested that the following hypotheses had to be rejected.

(C) Trained EMR children recognize target words faster when the words are shown in longer context than in short context (Hypothesis 2, p. 17).

(D) For trained EMR children, recognition of words in high associative context is faster than in low associative context (Hypothesis 2.1, p. 17).

(E) For trained EMR children, recognition of high frequency words is faster than low frequency words (Hypothesis 2.2, p. 18).

Tulving and Gold's experiment, as mentioned earlier, suggested that recognition of target words should be faster when the words are shown in longer context than in shorter context. The present experiment did not show this effect.

Why did the present experiment produce a result different from that suggested by Tulving and Gold's experiment? The investigators suspect that the answer lies in the difference between Tulving and Gold's Ss and the present study's Ss. Tulving and Gold's Ss were college students who could read all the preexposure contexts and the target words fluently. The present study's Ss were EMR children who did not know how to read some of the words in the preexposure contexts (and thus had to be told). Difficulty in recognizing the context word(s) and accessing their meaning prevents Ss from using the contextual information for effective prediction. If this suspicion is correct, the Tulving and Gold effect should vary directly with reading skill. An experiment designed to test this hypothesis is worthwhile.

The Rouse and Vernis experiment (1963), discussed earlier, suggested that a target word preceded by a high strength associate should be recognized faster than one preceded by a low strength associate. The present experiment did not support this hypothesis. This result was not surprising in view of the previous argument that the subjects in the present study had difficulty with the context words and therefore were prevented from using the contextual information for effective prediction. Since the subjects could not use context for prediction it made no difference whether the context had high or low associative strength with the target word.

The well-known word frequency effect suggested that Hypothesis 2.2 should be confirmed. Recognition of high frequency words should be faster than low frequency words. The present experiment did not show this effect.

Why was there no difference in speed of recognition for high and low frequency words? The answer is that low frequency words in the present experiment were no longer low frequency words because they were taught to the subjects as much as the high frequency word during training.

Experiment 2. (Word Identification in Context)

The hypothesis (Hypothesis 4, p.18) that trained EMR children identify unknown target words in context more accurately than untrained EMR children but do so only under ambiguous context (e.g., The fierce animal over there is a _____. Here, the target word to follow could be "lion," "tiger," "bear," etc.) was supported by the results from Experiment 2. A number of sentences, each of which was printed on an index card, were selected for the experiment. First, only the final words (target words) in the sentences were shown to each subject.

He could read some but not the others. Overall, there was no significant difference between the experimental and control group in the number of target words that they could not read ($p > .05$). However, when the sentences were shown in wholes, together with the target words, and the subjects were asked to guess the target words that they could not read before, the experimental group did significantly better than the control group in identifying those target words correctly ($p < .05$). This is evident in Table 2, Appendix A. Upon further analysis, the experimental group did better only on those target words which appeared in ambiguous contexts ($p < .01$). For target words appearing in compelling contexts (e.g., When it's dark, we turn on the ____. Here the target word is quite certain to be "light."), no difference between the two groups was found ($p > .05$). This is evident in Table 2.1, Appendix A.

Experiment 3. (Modified Cloze Test)

Finally, the hypothesis that on a modified cloze test, where, except for their initial letters, some words are deleted, trained EMR children perform better than untrained EMR children (Hypothesis 5, p. 18) was supported by results from experiment 3. Table 7 indicates that the experimental group performed significantly better than the control group in the cloze test.

The present study posed a problem in training children to the point where they can use the context to predict the target word automatically. There is no question about the children's ability to use the context to predict the target word. This ability was evident in the course of the fourteen-week training. The fact that fourteen-week training failed to enable the children to recognize target words in context faster than those in isolation in the T-scope experiment indicated that the children's ability to use context in prediction was not developed to the automatic level yet. Additional training time and better equipment might be needed for the development of automaticity in using context for prediction. The study of automaticity is currently being carried out at Laberge-Samuels laboratory and at the RD&D Center, University of Minnesota.

Although the present study posed some problem as discussed in the previous paragraph, it sheds some light on a variety of things.

First, the study shows that the hypothesis/test model of word recognition can be broken down into component skills and these component skills can be taught to children.

Second, children who are taught these component behaviors, compared with children who are not taught those behaviors, do better on

1. recognition speed of known words,
2. recognition of unknown words,
3. filling in appropriate and/or sensible words in a cloze test.

This suggests that training on the word recognition strategies would at least enable a beginning reader to read faster, attack words more efficiently and use minimal cues in word recognition, which is a fluent reading skill. These faster word recognition skills and ability to make good predictions are important factors in comprehension. Smith (1970) stated that when a beginning reader has to spend too much time decoding each individual word in a sentence, some of these words will be forgotten by the time the reader comes to the end of the sentence. Consequently, the meaning of the sentence is lost. Slow reading often overloads the memory.

The present study suggests that an instructional reading program can be constructed to help EMR and, perhaps, normal children to recognize words faster, and to predict unknown words more efficiently as aids to comprehension. The present study has provided a foundation for such an instructional program. The approach to teaching reading suggested by the present study is to encourage children to make good predictions on target words, using information from context and partial visual cues from the target words. Although this might result in reading a word incorrectly from time to time, it results in faster reading and better comprehension.

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APPENDIX A

ANOVA TABLES AND FIGURES

TABLE 1

ANALYSIS OF VARIANCE

SPEED OF TACHISTOSCOPIC WORD RECOGNITION OF HIGH AND LOW FREQUENCY WORDS PRESENTED WITH AND WITHOUT CONTEXT

Source	df	MS	F
Between subjects			
Group (Ex vs. C)	1	118,098.00	5.03 *
Subjects within group	38	23,464.46	
Within subject			
Condition (T)	4	16,175.00	1.92 ns
Group x T	4	2,724.87	0.32 ns
Error	152	8,421.64	

Note: ns $p > .05$

* $p < .05$

TABLE 2

ANALYSIS OF VARIANCE OF WORD IDENTIFICATION IN CONTEXT

Source	df	MS	F
Between subject			
Group (Ex vs. C)	1	36.30	4.92 *
Subjects within group	58	7.37	
Within subject			
Condition(T)	1	116.03	46.79 **
Group x T	1	34.13	13.76 **
Error	58	2.48	

Note: * $p < .05$

** $p < .01$

TABLE 2.1

ANALYSIS OF VARIANCE: SIMPLE EFFECT-
WORD IDENTIFICATION IN CONTEXT

Source	df	MS	F
Ex vs. C under Condition I (compelling context)	1	0.02	0.003 ns
Ex vs. C under Condition II (ambiguous context)	1	70.42	14.30 **
Error within cell	116	4.93	

Note: ns $p > .05$

** $p < .01$

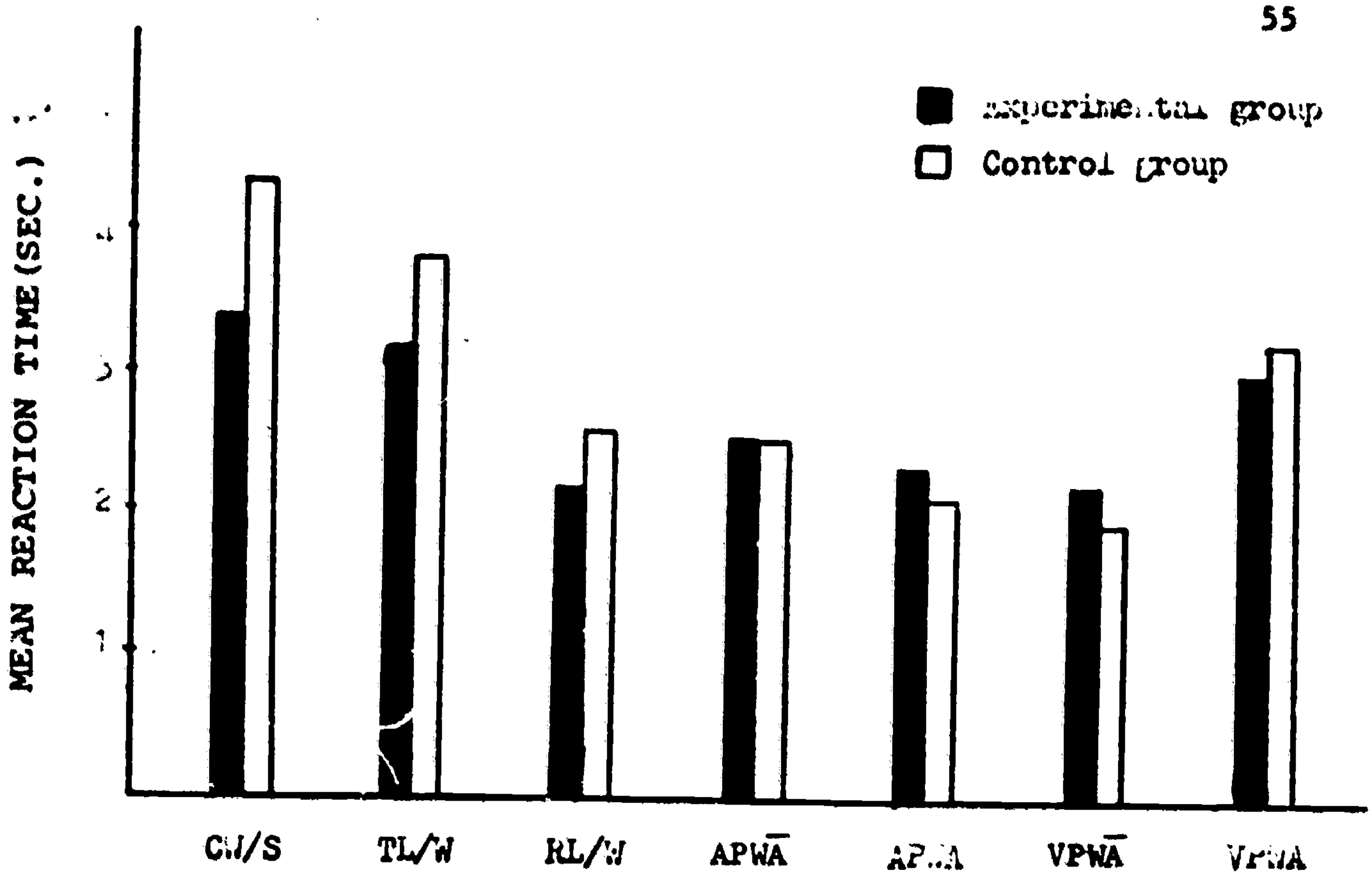

Fig. 1 Comparison of reaction time on the seven component skills between the experimental group and the control group before training

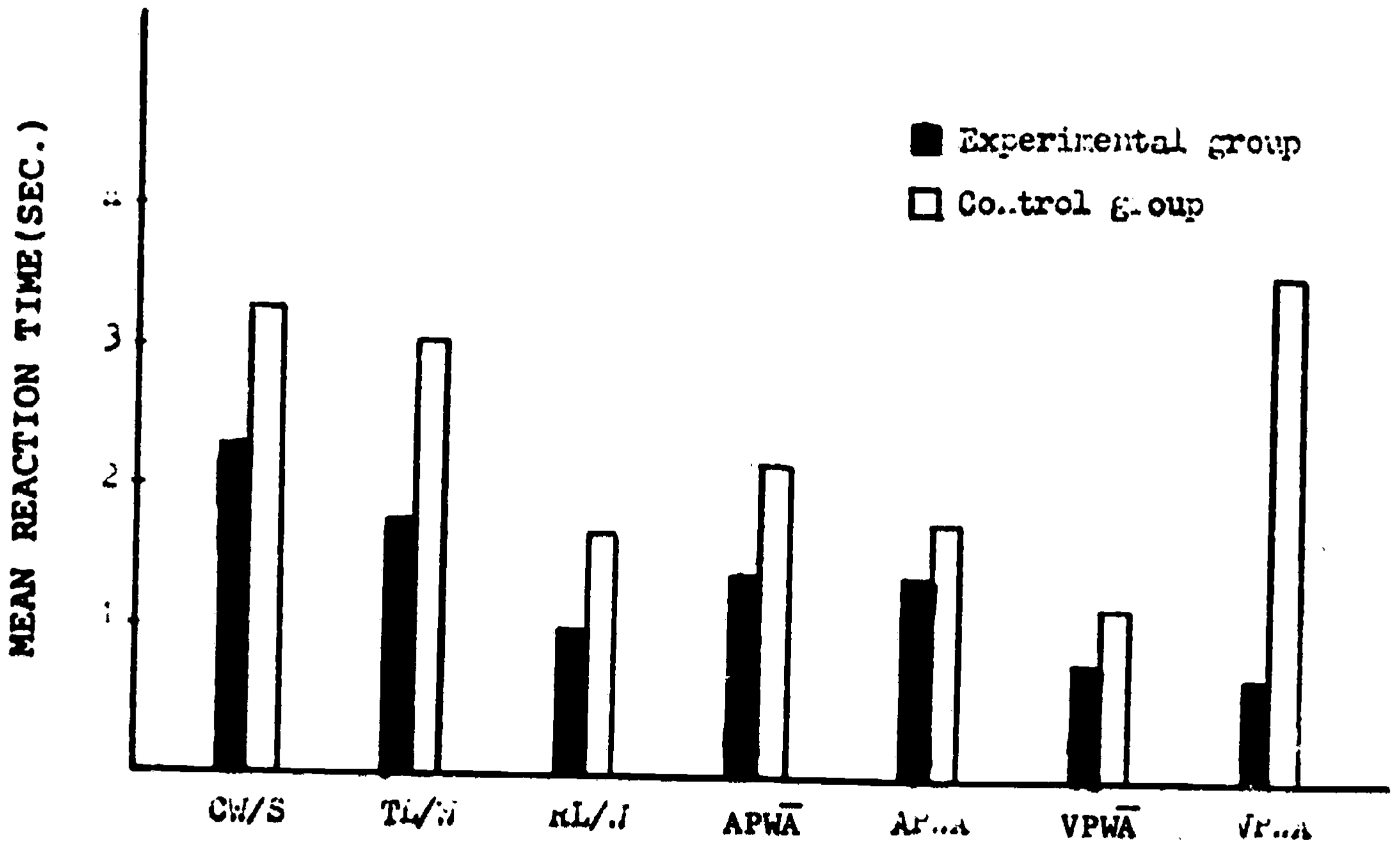

Fig. 2 Comparison of reaction time on the seven component skills between the experimental group and the control group after training

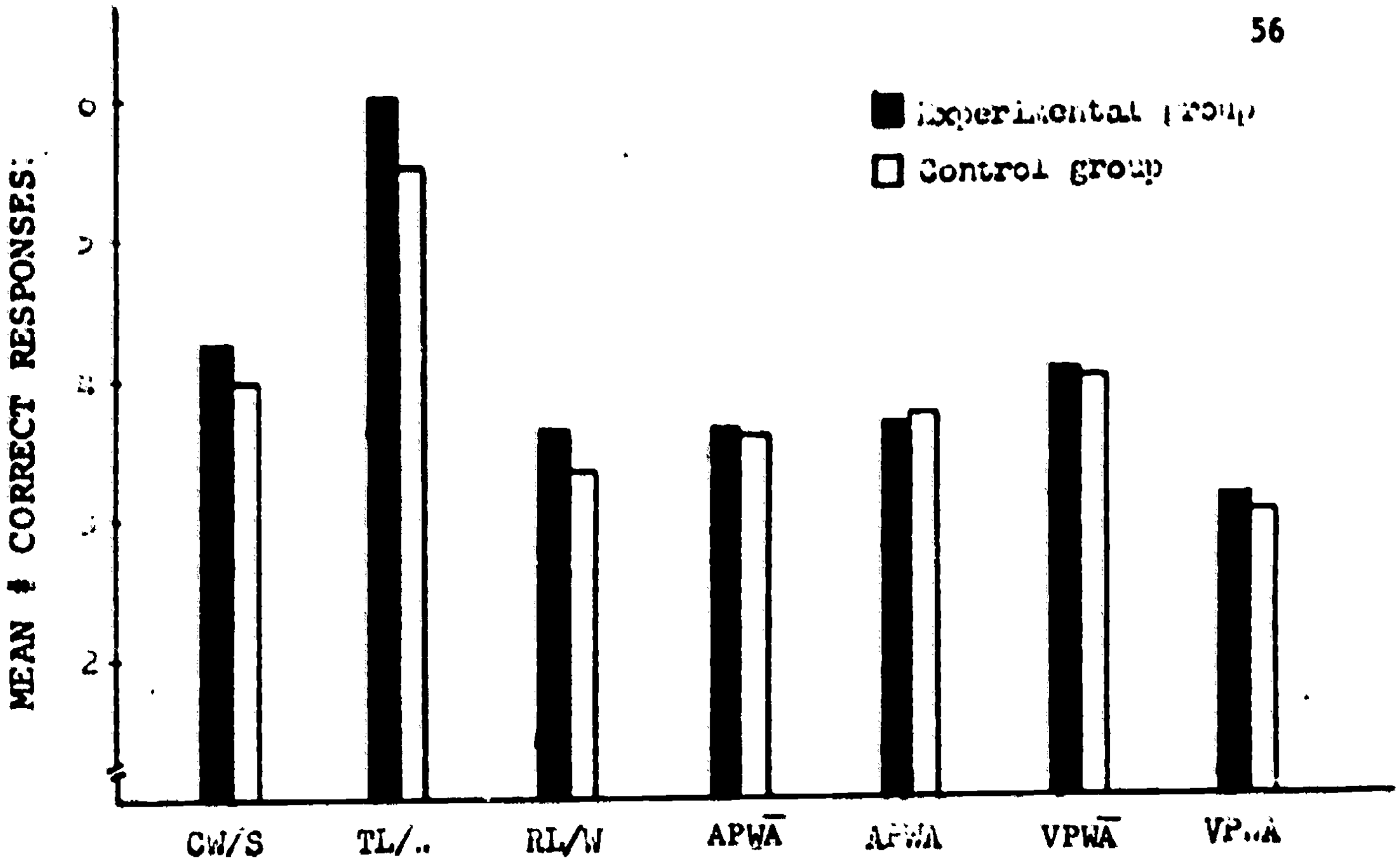

Fig. 3 Comparision of number of correct responses on the 7 component skills between the experimental group and the control group <u>before</u> training

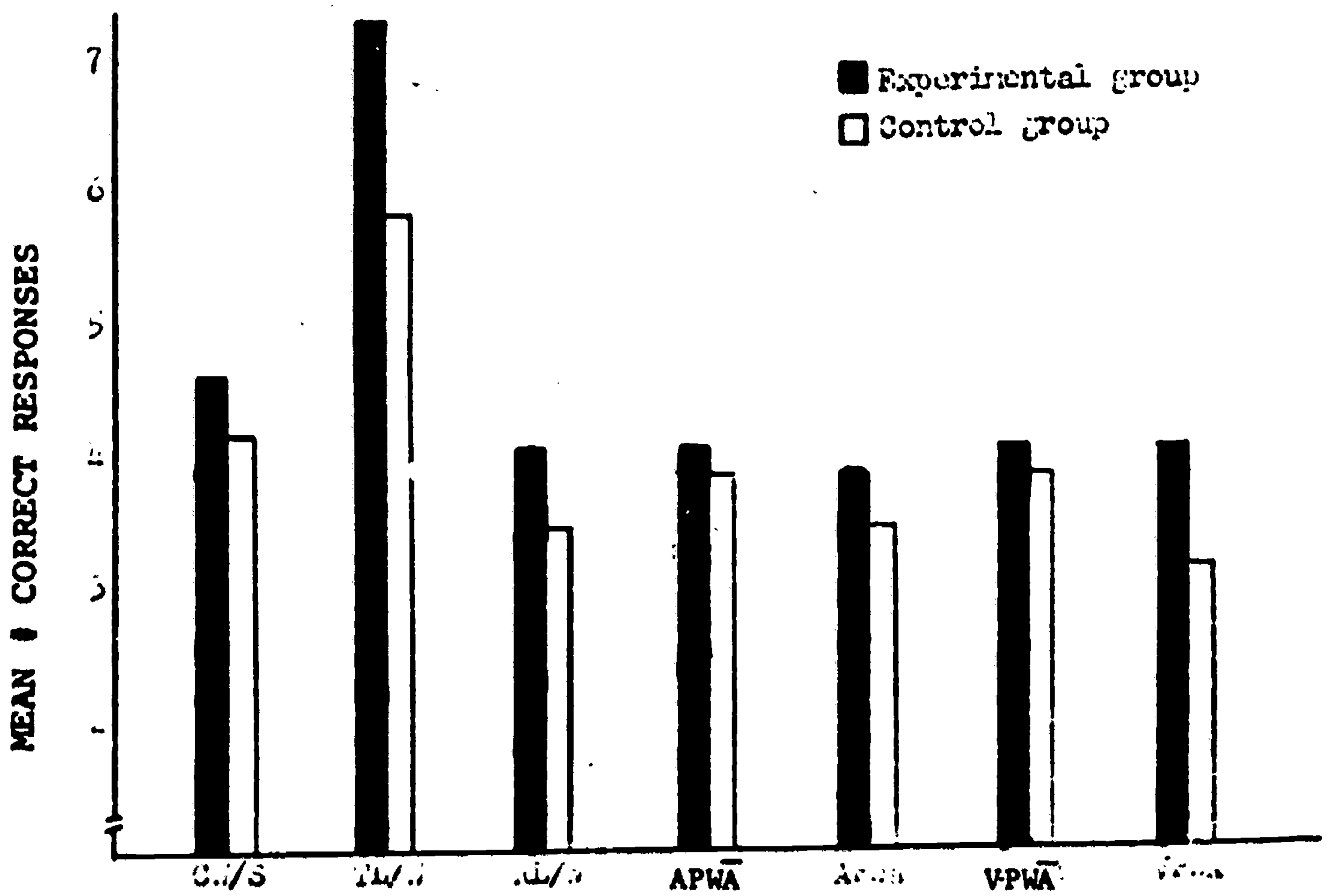

Fig.4 Comparision of number of correct responses on the 7 component skills between the experimental group and the control group <u>after</u> training

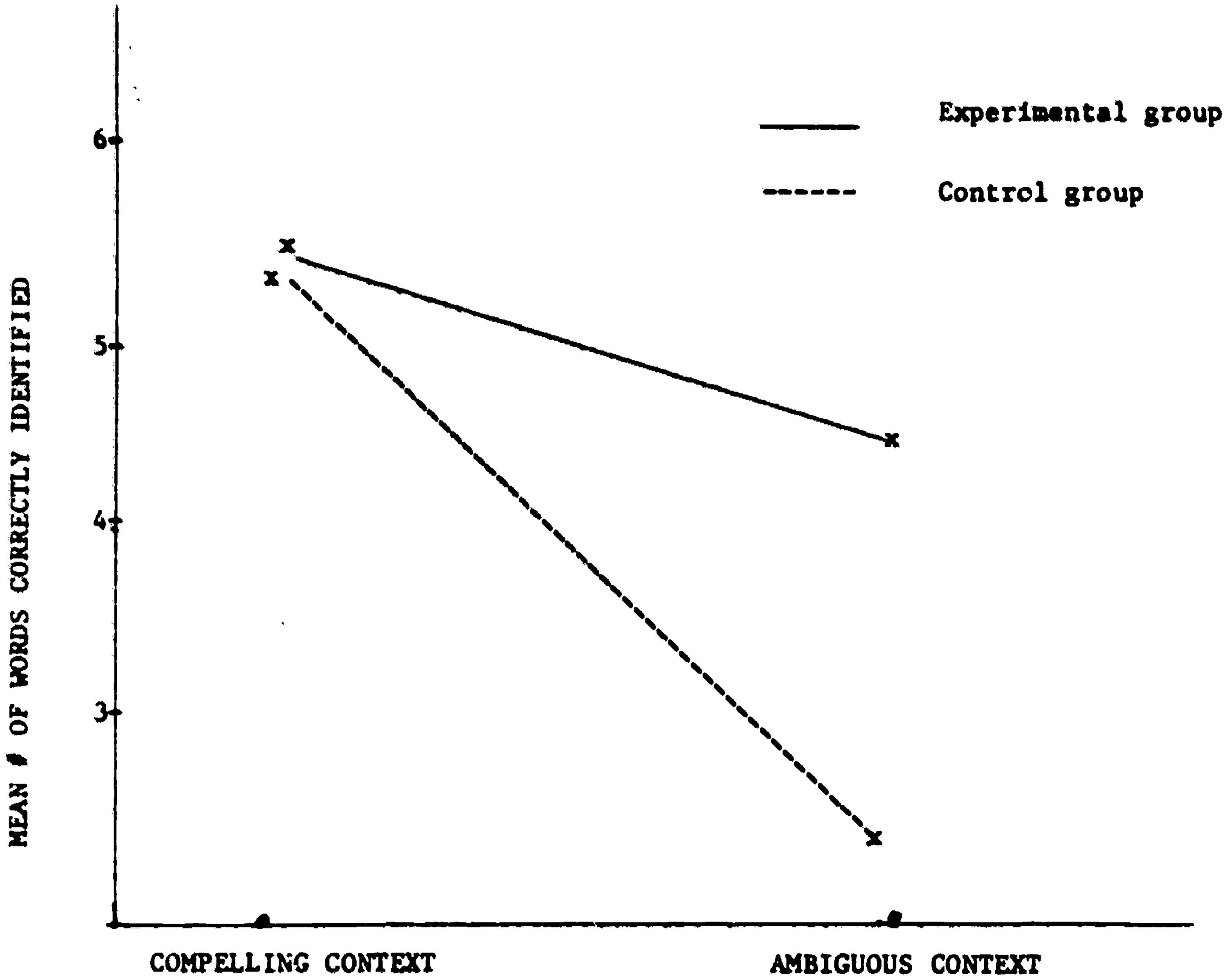

Fig. 5 Comparison of mean number of words identified under compelling vs. ambiguous context between the experimental group and the control group

APPENDIX B

TEST OF COMPONENT SKILLS

1. Testing the construction of a word starting with the given sound (CW/S).

<u>Instruction and warm up</u>

> We are going to play a game. I'll say a sound. You'll tell me a word starting with that sound. "p______". Can you tell me a word starting with that sound?
>
> "g_____"
>
> "sh____"

<u>Real test</u>

> "f_____"
>
> "bl____"
>
> "t_____"
>
> "k_____"
>
> "s_____"

2. Testing the ability to catch the initial sound of a word (TL/W).

<u>Instruction and warm up</u>

> We are going to play another game. I'll tell you a word. You'll tell me what letter of the alphabet it starts with. "boy" (flash card). What letter does it start with?

"girl"

"man"

Now you'll have to do it without flash card. "dog." What letter does it start with?

"cat"

"bird"

Real test

"lamp"

"pin"

"say"

"table"

"man"

"chair"

"school"

"this"

3. Testing the ability to recognize the initial letter given a word auditorily (RL/W).

Instruction and warm up

Listen to the word "boy." What letter does it start with? (show m b x i)

Listen to the word "girl." What letter does it start with? (show c f g z)

Listen to the word "cat." What letter does it start with? (show c m g b)

Real test

Listen to the word : What letter does it start with?

pen	p l k n
table	b c t r
me	a m t g
short	w i s d

4. Testing the use of context to predict word(s) that could logically follow in a sentence (APWA).

Instruction and warm up

We are going to play a game. I'll say something and you'll guess what I am going to say next. "On Sundays, we go to the ____" What word do you think comes next?

"I put on my ice ____"

"Johnny drinks a cup of ____"

Real test

"Father called to ______."

"We write on the ______."

"Mother cleaned the ____."

"The dog bit the ______."

5. Testing the use of context+partial perception to predict word(s) that could logically follow in a sentence (APWA).

Instruction and warm up

We are going to play another game. I'll say something and you'll guess what word comes next. I'll help you guess. "Tommy sat on the ch____" What word do you think comes next?

"Father took me to the picture show. We saw a good m____."

"He is my fr____."

Real test

"Father hit the b____."

"In the classroom, we listen to the t_____."

"Mother boiled the w____."

"In the classroom, we sometimes play g_____."

6. Testing the use of context to predict a word that could logically follow in a sentence (VPWA).

Instruction and warm up

Read the sentence and tell me what word should be in the blank. (each sentence is shown in flash card)

I like to eat ______.

She has a ______.

Mother called to the _____.

Real test

There are boys and ______.

I open the ______.

The pen is on the ______.

Do you know my ________.

7. Testing the use of context+partial perception to predict word that could logically follow in a sentence (VPWA).

Instruction and warm up

Read the sentence and tell me what word should be in the blank. (each sentence is shown in flash card)

We hit the b______.

The dog chased the c_____.

There are a chair and a t_____.

Real test

Some children are boys and some children are g____.

After school, I go h_____.

We ate bread and b_______.

The mouse ate the ch_____.

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