STRATEGY TRAINING AND REMEDIAL TECHNIQUES: INFORMATION PROCESSING APPROACH

by

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ABSTRACT

Presently, a substantial number of children who are labelled "learning disabled", lack motivation and self-confidence as a result of school failure (Das, 1979). Frequently, the mass of methods, materials, and programs which are available to the educator, fail to fulfill the expectations of those involved. The central theme of the present study is that training in the area of cognitive strategies has the potential to overcome some of the problems these children have.

Rather than focus on teaching skills or reviewing content, as has been done in the past, training cognitive strategies focuses on learning and learning how to process information. The purpose of the present study was to investigate strategy training and remedial techniques and academic performance within an information processing frameword for a group of learning disabled children. A simultaneous-successive theoretical paradigm based on the research finding of Jarman and his associates was chosen for the study. Research programs used can improve learning strategies (Krywaniuk, 1974).

Subject's involved in the strategy training program were the 7 boys and 4 girls in a special class for learning disabled students located in a central B.C. school district elementary school. Students were randomly divided into two equal groups: one group received additional reading instruction, a second group participated in the remedial program aimed at improving learning strategies. The subjects involved in the strategy training program performed a series of tasks for 20 - 30

minutes once a day on a daily basis for the 21 weeks of the study. The remaining students received additional reading instruction from the regular reading program for the same amount of time each day.

The research design was a time-series design, made up of four phases. The first phase involved the collection of baseline data, during the second phase the treatment program was introduced, for the third phase the treatment program was withdrawn and during the final phase the treatment program was again reinstated. In this way the effects of the treatment program was compared twice to a no-treatment period. Data was collected once a week on each students word analysis skills during the study.

Data collected for each individual student was graphed for visual inspection and statistical analysis performed on the results. Apparent differences were found between the group which received the additional reading instruction and the group which received the treatment program. For the group receiving the treatment program there was a plateau between the treatment phases and a greater overall improvement in word analysis skills from the initial baseline phase to the final treatment phase.

Results were discussed in terms of the following limitations and simultaneous-successive model of information processing. The results were subject to certain limitation in that there was no latitude for for selection of subjects. Some of the subjects did not represent true learning disabled children because their performance was influenced by other factors.

Implications of these findings for future research in the area of reading disabilities were drawn.

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CHAPTER 1

INTRODUCTION

In the area of learning disabilities different labels and definitions based on various theoretical viewpoints are used to describe children who demonstrate difficulties with learning in the regular classroom setting. This has led to confusion in understanding the problems which these children have. Unfortunately, the definitions and the level may have no bearing on the actual problem a child has, but can influence the course of remediation. As a result of the lack of any central focus, researchers question the meaning and usefulness of even using the term "learning disabilities" (e.g. Leong, 1982; Das, Kirby & Jarman, 1979). Leong concludes from a review of work in the area that "for research and scholarly purposes it behooves the researcher to define exactly the group under investigation and to state clearly the factors considered in the selection of experimental subjects", (p.6).

Leong suggests that it is more appropriate to explicate the concept of learning disabilities in the different academic areas. Therefore, this present study will focus on one academic area, reading, in order to offer insight into the specific problems of learning disabled children and to demonstrate the effectiveness of a remedial program aimed at improving the specific learning problems these children have.

One aspect of past remedial programs which limits their usefulness is their focus on abilities. This approach views the child's difficulty with learning as being a result of a lack of ability in one or more areas

of intellectual functioning. Within this framework, testing procedures assess the level of ability the child can obtain on a test so that treatment focuses on the measured abilities. For example, a treatment program may be implemented to improve a child's ability to memorize, perceive or use language. These programs have had limited success. At times, classifying children in schools in terms of ability has obstructed rather than helped their cognitive development (Das, 1979). The abilities approach is limiting because the difficulties the child has may be the result of the way in which he learns. He is unable to choose an appropriate plan of action based on the available information, in other words select the appropriate learning strategy.

A second factor of previous research is that it was limited in its ability to suggest remedial measures. Much of the research in the past has been conducted either without any basic theoretical rationale or with a strict adherence to an outdated one. This has affected both assessment of learning problems and remedial programs. There is a need for a theoretical model to guide the selection, validation and interpretation of measurement instruments used for assessment purposes. Adopting a basic theoretical rationale provides a frame upon which the results of assessment can be interpreted and may suggest necessary modifications for existing remedial programs.

Clearly then, the adoption of a specific theoretical position is necessary for the establishment of effective remedial programs. For the theoretical model to be of value it must present a clear-cut method

of measuring cognitive processes, with emperical support for the factors measured.

An information processing approach to learning disabilities can be derived from a general cognitive model. The advantage of such an approach is that cognitive processes can be related to observed behaviors. This allows the researcher to make inferences about the strategies which the individual employs to perform a task. Research in the area of information processing can suggest modifications of whatever basic information-processing model is adopted and these changes can add to our understanding of learning disabilities and hence the appropriate remedial measures.

The present study adopts a specific theoretical position in relation to cognitive processes. As a result of the research finding of Das, Kirby and Jarman (1979), Luria's (1966a, 1966b) formulations of simultaneous and successive processes have been extended and made operational. This provides a framework by which to view, evaluate and suggest ways to encourage the use of simultaneous and successive strategies of learning. Rather than focus on abilities, training within the simultaneous and successive model of information processing focuses on learning and specifically how to appropriately use strategies of information processing. The simultaneous-successive model of information processes is based on a clear-cut way of measuring these processes with emperical support for the factors measured. Research using task analysis confirms the distinctions among processes as presented by the model.

To clarify, Kirby and Das (1978) summarize the distinction between

the two processes of simultaneous and successive synthesis:

> Simultaneous processing can be characterised as involving the synthesis of separate elements into groups that generally have spatial overtones, with all portions of the synthesis being surveyable or accessible without dependence on their position within the synthesis. This type of processing is required for instance, in the formation of any holistic gestalt, or in the discovery of the relationships among two or more objects. Successive processing, on the other hand, involves the integration of separate elements into groups whose essential nature is temporal. Portions of this synthesis are accessible only in the temporal order of the series-each element is dependent on the preceding elements. Successive processing is necessary for the formation or production of any ordered series of events. (p. 59)

Simultaneous synthesis is the processing of information for which the parts are mutually surveyable and accessible. On the other hand, successive synthesis refers to processing information with only limited acquisition to individual elements.

Basically simultaneous processing is required in tasks involving the multiple coordination of information which takes place during direct perception, retention of traces of previous experiences and the performance of complex intellectual operations. Whereas, successive processing is found in tasks that incorporate the sequencing of separate events into a series. Successive synthesis is associated with the motor and auditory sphere. Simultaneous synthesis involves more of the visual and kinetic sphere, which is responsible for the orientation of the body in space. The model assumes that the simultaneous and successive modes of processing information are both accessible to the individual. The individual selects a method of processing depending on the demands of the task and the individual's planning ability.

The simultaneous-successive synthesis model of cognitive abilities provides a valuable alternative view to the study of abilities conducted in the past.

Underlying assumptions of the abilities approach limit its usefulness. One of the assumptions is that intelligence is a measure of capacity when, in fact, the scores of individual on an intelligence test merely give a sample of his current level of functioning; the second assumption is that intellectual ability is fixed or unchangeable; the third is the prediction of aptitude when predictor test results correlate with criterion tests, only an indication that an individual has maintained a relative position to a population over time. An abilities approach treats abilities as fixed and immutable properties of the mind.

The theory of simultaneous and successive synthesis emphasizes the form of cognitive representation used in task performance. The type of information processed and the amount of information transformation vary with each form of synthesis. Differences in performance can be attributed to a variety of processes. Therefore, the theory which can suggest the processes underlying cognitive abilities has more strength and validity than an abilities approach.

A quote from Das, Kirby and Jarman (1975) clarifies:

> We may liken ability to the basic structure responsible for integration; it admits of a variety of processes which depend on this structure. The end product, final performance on a task, cannot be understood by analyzing the ability. (p. 101)

There is a place for "abilities" within the model. We can still have a variety of processes within the confines of the ability.

Finally, conventional research strategies of using large populations has resulted in limited school-based research. It is necessary to conduct research in particular settings to establish the credibility of applied interventions (Kratochwill, 1977). Single subject research strategies deserve increased emphasis, especially in the area of learning disabilities where each child is unique in his background, functional level and capabilities. For these reasons the method selected was the single-case research design. This design was considered appropriate for testing the effects of the remedial program aimed at improving learning strategies for a group of children with learning disabilities.

Using elementary school children, described as being learning disabled by a central B.C. School District, the present study focuses on the efficiency of a training program that encouraged the use of nonacademic strategies of information processing. The potential of this approach has already been demonstrated in studies conducted by Kaufman (1978) and Krywaniuk (1974). To make the task more manageable, the focus of the present study is one particular aspect of school learning: that is the area of reading and, more specifically, word analysis skills.

Proficient readers may use the various word identification techniques in combinations complementary and supplementary to each other. However, children with reading disabilities must rely more on the analysis of individual words into their component sub-units. For this reason the study of word analysis skills is critical to understanding the problems of reading disabled children.

CHAPTER 2

REVIEW OF THE LITERATURE

A Perspective

The importance of learning to read is obvious. Learning to read is a complex task that has been the topic of research for many disciplines ranging from philosophy, psycholinguistics to information systems analysis. However, there is little consensus among scholars with respect to a complete description of the reading process. Chall (1967) in a review of the literature on reading, recommends greatly improved research and states that too much has been undertaken in the area of reading to prove that one ill-defined method is better than another ill-defined method.

Efforts directed towards describing the reading process can be divided into two classes: information processing models and models that emphasize analysis by synthesis (Gibson & Levin, 1975). The analysis by synthesis approach to reading views reading as a process of hypothesis formation, that is, directed data sampling followed by confirmation or disconfirmation of the "guess". A contrasting theory of reading is information processing analysis. Generally, an information processing approach to reading assumes that any cognitive task can be analyzed into stages that proceed in a fixed order from sensory input to output or response.

An extensive account of the reading process as "analysis by synthesis" is proposed by Kenneth Goodman (1967) and other theorists

who view reading as a "guessing game". Briefly, Goodman views reading as a guess and check process and, using this theory, he has directed a research program on reading errors, or "miscues" as he refers to them. Criticism of Goodman's guessing game theory is it's inability to answer questions related to the basis, nature and checking of predictions made by the reader and what alternative action the reader takes if the guesses are wrong. This criticism applies in most cases, to all other analysis-by-synthesis theories. This approach to reading can be considered too imprecise to account for all kinds of reading disabilities.

Recently, alternative directions to reading research have followed an information-processing approach in an effort to present a more complete theory of reading which would account for the many factors related to the reading process. The information processing approach allows for a greater representation of the complex behaviors that are typical of reading (Hansen, 1974). Because this approach specifies the mental processes that determine specific input-output relationships the flow of information through this system can be identified by a series of steps. There is an emphasis on the transformation of incoming information and on the transformations necessary for the successful retrieval of these events by the individual.

Research in the area of information processing confirms the usefulness of this approach to provide an understanding of reading, and suggest appropriate remedial measures for the child with reading disabilities, (Arnett and DiLoelo, 1979).

An example of an information processing approach is proposed by Luria (1966a, 1966b) based on his observations of different types of cortical lesions and their effect on behavior. He divides the brain into three main blocks. The three main blocks correspond to functional systems: the first block to the functional system arousal, the second block to the functional system coding and the third to the functional system planning. The second block is the most relevant here for it contains a group of analyzers which work together to synthesize input into two different forms, simultaneous and successive.

Based on the assumptions of Luria's work, Das, Kirby and Jarman (1975) have investigated the usefulness of the simultaneous-successive information processing approach. They have demonstrated the potential of this approach to provide a framework for understanding and ultimately remediating reading difficulties (Cummins and Das, 1977). Henceforth, this work will focus on the literature relating to the relationship between simultaneous and successive processing, language and reading, and the potential of the model to provide a basis for a remedial program aimed at improving an individual's learning strategies.

Language and The Reading Process

There is some research in the area of language which is significant to the understanding of the reading process. To the extent that reading is a verbal process, understanding reading and reading difficulties must come from studying the role of verbal processing as a key component of reading and a source of reading difficulties (Leong, 1982).

Cognitive linguistic strategy deficits in the learning disabled are presently being studied by Wiig (1983). Wiig's language theories are based on Bruner's (1973) types of hypothesis testing. The main premise of Wiig's language remediation strategies is language experience. Wiig (1976) emphasizes the assigning of meaning to heard phonemic, morphemic and linguistic synthesis of phonemes at all levels of processing. However, no account of the actual underlying processes involved are presented.

In another study Leong and Haines (1978) studied beginning readers ability to analyse words and sentences. Children in grades 1, 2 and 3 were examined for their ability to segment syllables into phonemes and words into syllables, and use concepts of phonological representation and understand sentence structure. Results indicated that awareness of phonological representation of sounds in words contributes significantly to reading performance.

The relevance of studying language to provide an understanding of the process of reading is supported by research. Vogel (1975) studied oral language deficits accompanying dyslexia. The major finding was that dyslexic children are significantly inferior to good readers in syntactic abilities. Additional studies in the area of linguistic analysis of verbal and written output of good and poor readers provided evidence of high correlations between syntactical competence and reading ability (eg. Dawkins, 1975; Allington & Strange, 1977; Bryan, 1978; Gibson & Levin, 1975; Weaver & Henry, 1978).

Deficits in verbal functioning have also been studied by Johnson

and Myklebust (1967). Their results indicated that, out of a group of dyslexic children, less than half were experiencing reading problems resulting from visual processing difficulties. For the majority of children reading difficulties were related to verbal processing deficits. Language disorders recognized by Johnson and Myklebust as affecting reading comprehension were based on syntactic problems. A basic principle of Johnson-Myklebust remedial work is that input takes precedence over output; that is, the child must learn to comprehend before he reads.

These recent developments in the information-processing literature demonstrate the importance of understanding all aspects of verbel language in order to provide a framework for investigating the process of reading. Two studies demonstrated the relationship between reading, language and successive-simultaneous processing. Leong and Sheh (1982) concluded that cognitive processing affects reading through its relationship to language awareness. In this study, language awareness was defined as the understanding of language rules, ambiguities and incongruities. Reading was defined as word recognition. The results were further validated in a follow up study. The researchers concluded that language awareness is a mental activity which interacts with and depends upon other cognitive activities. It in turn can modify these same cognitive activities.

On the basis of Luria's clinical research Das, Kirby and Jarman (1979) predict that a relationship exists between successive processing on linguistic tasks which require either analysis of the sequential

linear structure of the input or syntactically mature expressive speech. Simultaneous processing is involved in linguistic tasks which require the grasping of quasi-spatial conceptual relationships, (p. 177). Research based on the simultaneous and successive processing model suggests how linguistic functioning varies between different racial groups and between children at different developmental levels (Cummins and Das, 1977). Reading competence for the low-achiever may be related to initial deficits in successive processing which retard the development of the basic understanding of the conceptual-linguistic operations.

Reading Disabilities

"Reading disability", "reading retardation", "dyslexia" and "specific reading disability" are all terms frequently used to describe the child who is having difficulty with the acquisition of reading skills despite normal or above normal intelligence. The difference among the terms lies in the underlying conceptual framework. For the purpose of this study, "reading disability" will refer to a serious discrepancy (two years below grade level) between reading ability and reading potential.

Inferior performance of a reading deficit group has been demonstrated to be related not to poorer intelligence but rather, the difficulty lies in the strategies that need to be chosen when a child is faced with an unfamiliar task (Das, Leong and Williams, 1978)

Kirby and Das (1977) have given evidence for usefulness of the simultaneous-successive model by providing a framework for studying reading

disabilities. In a study comparing the scores of 99 grade 4 children on subtests of the Gates McGinitie Reading Test and simultaneous and successive factor scores, the children who scored higher on tasks involving simultaneous and successive processing had a higher level of reading competence than children who had lower scores on tasks involving both modes of processing. These results can be considered indications of the importance of both simultaneous and successive synthesis in the reading process.

These studies suggest that successive processing is implicated in the reading competence of poor readers; whereas simultaneous processing is related to a greater extent in the reading performance of normal and above average readers. Of course, reading difficulties can be the result of one or a combination of problems. It has been demonstrated that problems in language functioning are associated to reading difficulties. Within the framework of the simultaneous-successive model language problems may be the result of a deficit in successive processing. To the extent that reading is a verbal process, the understanding reading and reading difficulties must come from studying the role of verbal processing as a key component of reading and a source of reading difficulties (Leong, 1982). Therefore, research concerning reading performance, cognitive processing and semantic or conceptual-linguistic processing has the potential to provide an understanding of reading disabilities and to suggest remedial techniques.

Word Analysis Skills

Among reading theories there is a general agreement that reading involves two basic processes, word analysis and comprehension. Word analysis skills involves the ability to derive the pronounciation and/or meaning of a word through phonics, structural analysis or contextual clues (Ekwall, 1976). Word analysis skills depend on grapheme-phoneme correspondence rules. Comprehension can be considered to occur when we comprehend the intention of the writer and succeed in relating his message to the larger context of our own system of knowledge (Gibson & Levin, 1975). Word analysis skills are a prerequisite for reading comprehension. The educational measures have been researched. Spache (1976) describes two approaches to teaching word analysis: analytic, in which letter sounds are taught as integral parts of words, and synthetic, in which the isolated letter sounds are stressed and taught.

A critical prerequisite for successfully learning to use grapheme-phoneme correspondence rules is an awareness on the part of the learner of the segmentation of language into words, syllables, the phonemes and an ability to handle these language units in dealing with their graphemic representations.

The retrieval of word analysis skills must become automatic. Additional word recognition studies (eg. Mar & Kamil, 1978) suggest that the difference between good and poor readers is the ability to decode quickly and automatically. However, the problem with much of the research conducted in the past is that it has not provided information

on how word analysis skills and comprehension skills are acquired, that is, how the reader develops the underlying processes responsible for the acquisition of these skills. Another problem with linguistic models of reading, is that competence with printed language is not taken into account.

Linguistic models of reading do not take into account competence with printed language. Print is a system for representing language, one which is related to but not dependent upon search for its structure, therefore a model must suggest factors to account for the ability to deal with printed language (Ehri, Barron and Feldman, 1978). Obviously, all reading involves written surface structure. Therefore, a model of reading must suggest factors to account for the ability to deal with printed language (Ehri, Barron and Feldman, 1978).

A study by Leong and Sheh (1982) uses multivariate techniques to describe the relationship between simultaneous-successive processing, language awareness (defined as understanding of language rules, ambiguities and incongruities) and reading (defined as word recognition). Elementary school children were tested on measures of simultaneous-successive processing, language awareness and a word recognition test. Results supported the hypothesis that those children who are high on both the simultaneous and successive dimensions also perform better on language awareness tasks and on reading. This study indicates the potential of the simultaneous-successive model to provide insights in the area of language and word recognition.

In the reading process, successive processing may be important for the mastery of word attack skills, whereas simultaneous processing may be related to the mastery of comprehension skills. Several studies support this hypothesis (Das, Cummins, Kirby & Jarman, 1979; Cummins & Mulcahy, 1979; Cummins & Das, 1977; Kirby & Das, 1977; Das, Kirby & Jarman, 1975). The research in this area has also suggested remedial strategies for educational application.

Studies Involving Remediation

The importance of focusing on differences in information-processing as opposed to observed weaknesses in abilities in the auditory and/or visual perceptual areas (Ekwall, 1976) has been the topic of recent literature. For example, Keeney, Cannizzo and Flavell (1967) conducted a brief training program aimed at inducing nonrehearsers to rehearse. Subgroups of "rehearser" and "nonrehearsers" were identified by means of direct observation of subjects spontaneous semi-overt verbalizations. The researchers concluded that the child's mediated behavior was due to his failure to produce the appropriate mediator rather than an inability to utilize it effectively. Maki and Schuler (1980) found that recall for words increased with what they consider deeper levels of processing and with longer rehearsal intervals. Rehearsal strategies have been further researched by Barclay (1979), Brodie & Prytulak (1975), Denny (1975). Although the research in this area is impressive, its significance is limited because rehearsal is merely a production strategy Das, Kirby & Jarman (1979).

Research in the area of memory and recall appears to have more direct relevance to learning and remedial measures. In a study designed to examine the retention of an item over time Norman (1966), concluded that rate of presentation, length of a list, type of item and modality of presentation primarily affect the initial acquisition of items for recall. Deese and Kaufman (1957) studied the serial effects in recall of unorganized and sequential organized verbal material. The main conclusion of this study was that subjects reorganize their patterns of verbal behavior to conform to the structure of ordinary language.

Application of the Simultaneous-Successive Model

Das, Kirby & Jarman (1979) discussed three possible approaches to remediation, within the information processing framework.

The first approach is to design a remedial program which would encourage the development of improved processing abilities. Success of the remedial program depends on the generalization of processing skills. Training should involve school-related materials. The difficulties with this approach to remediation is the lack of measure of the mutability of the processes and no specific guidelines for educators abilities.

Another approach to remediation is to design educational programs which encourage the use of the individual's intact processing strengths. At the same time, the program provides tools to help the individual cope with his less efficient mode of processing. These tools could be in the form of books, teacher prepared materials and teacher guidance in the use of more efficient forms of processing. There are no programs

based on this approach available to teachers at this time.

A third remedial technique involves the teaching of strategies. Strategies can be defined as ways of selecting, storing, manipulating, managing, and producing information which occur at all levels of behavior (Das, Kirby & Jarman 1979). Research (eg. Estes, 1975; Flavell, 1979) has suggested that young children do relatively little monitoring of their own memory, comprehension and other cognitive enterprises. Within this remedial approach it is assumed that what effects a child's performance is not a processing difficulty, but a problem in selecting the appropriate strategies. Strategy training is aimed at encouraging the use of optimal processes in a particular situation.

The present study adopts the third remedial technique to investigate the effects of strategy training and remedial techniques on academic performance.

Evidence for Simultaneous and Successive Strategies

Educational research involving strategy training and remedial techniques, as an application of the simultaneous-successive model, is limited to two studies; Krywaniuk (1974) and Kaufman (1978). These studies confirmed the effectiveness of a treatment program emphasizing the use of appropriate strategies. However, the educational implication of this type of program is hindered by the particular population used in one of the studies, the type of research design, the lack of assessment to confirm changes in academic performance corresponding to the remedial program and the assessment measures used.

The studies are similiar in their emphasis on verbalization although Krywaniuk uses verbalization to a lesser extent than Kaufman. Training tasks in both aim at improving the use of successive strategies. Verbalization took the following form in each of the studies. As the child performed tasks, he was encouraged to verbalize the strategies he used. At the end of the session the child summarized his strategies. Each training session began with the experimenter questioning the child to recall specific strategies used in the previous sessions.

Krywaniuk's Study:

The subjects were Canadian native Cree children in grades 3 and 4 in a Reserve school. The children selected for the study were in the lowest third of the class according to teacher rating. The children were randomly divided into two groups, 20 students in each: one received 14 to 15 hours of training, the other received minimal training. There were comparable means (84.55 and 83.95) on intelligence measures. Both groups received three test measures from the simultaneous-successive battery Das (1973) and the Schonell's Word Recognition Test.

The selected tasks encouraged successive processing strategies. They did not reflect competence in any academic area and were easy to use. The intervention program was made up of the following tasks: Sequence Story Board, Parquetry Designs, Serial Recall, Coding Matrix and Serialization.

Following intervention and postesting complete records were available for 15 children in the experimental group and 20 in the control

group. The groups were adjusted for initial differences by a covariance technique. The statistical analysis showed significant gains on the Schonell, Serial Learning and Visual Short Term Memory tests for the group receiving maximum amount of instruction. Improvement in these tasks may be taken as an index of success for the training of successive strategies. The main conclusion drawn from the study is that the intervention program was successful in helping the subject to apply either successive or simultaneous strategies appropriately.

The first shortcoming of the study conducted by Krywaniuk was the particular population from which the subjects were selected. The subjects were native Cree children. More recently Das studied Cree Indians living on a reserve near Edmonton found that not only is the general level of reading low, but nearly one-third of the children in grade 3 were reading at grade 1 levels. These children were found to be of average ability in "nonverbal" intelligence tests but were clearly backward in English. The reason for the variation between white Canadian children and these Canadian native children was that language was not being used to the same extent as in white Canadian cultures. It was argued that Canadian native children do not use successive processes as much as white children do in their ordinary environment, and that it is therefore, not their preferred mode of coding. The study suggests that cultural differences influence preference for cognitive processes. The limitation of the study is that the results connot be generalized beyond the population used. For the purpose of generalizability, a random

selection of cultural groups would have been more appropriate.

The research design could be considered another shortcoming of Krywaniuk's study. The 40 students selected for the study were considered by teachers to be in the lowest third of the class based on academic achievement. These students were obviously experiencing difficulty with learning. A more appropriate research design would be one that looks at each child as an individual. Single subject research design offers the opportunity to collect data on each child individually. Single-case research follows a time series design which results in a precise assessment of behavior changes and the factors related to these changes.

A third shortcoming of the Krywaniuk study was that the applicability of the model of simultaneous-successive processes to the classroom setting was not considered. This raises the question of whether or not remedial intervention stressing a processing strategy will help academic learning difficulties and facilitate academic achievement. To clarify this problem, Kaufman conducted a study following a similar remedial program to the one Krywaniuk based on the simultaneous-successive model of cognitive processes.

Kaufman's Study:

The subjects in Kaufman's study (1979) were 68 grade 4 children. The children were divided into three groups on the basis of their performance on the Metropolitan Achievement Test (MAT). The above average group was excluded from the intervention program. The remaining 68 children were rank ordered and categorized into 34 average and 34 below

average children. Each of these groups were again divided so that seventeen children were randomly assigned to either an intervention or no-intervention group. The intervention group received 10 hours of individual training for a 17 week period on the following tasks: People Puzzles, Picture Story Arrangement, Matrix Numbers, Matrix Letters, Matrix Pictures, Picture (Number) Arrangement, Serial Recall of Pictures, Free Recall of Pictures, Follow-the-Arrows and Film Strips. None of the training tasks was purely successive. Verbalization was encouraged.

All groups were administered five tests from the simultaneous-successive battery and the Schonell Reading tests before and after the intervention program. Results were compared in a three-way analysis of variance. The intervention program appeared to effect performance on all the successive and all but one of the simultaneous tasks. We can assume that the experimental group learned where and when to use successive strategies and at the same time when a simultaneous processing strategy may be more appropriate. It is interesting that Kaufman found that intervention which stressed the use of successive strategies did not improve scores on the MAT "Word Knowledge" and "Reading" subtests. This can be explained by examining the content of these tests. Word Knowledge is essentially a measure of a child's comprehension of word meaning, perhaps more related to simultaneous processing. Scores on the Schonell Graded Word List, MAT "Reading Composite", "Mathematics Composite", "Math Computation" and "Math Concepts" subtests correlated significantly with successive factor scores. These results led the researcher to conclude

that reading skills, as measured by the Schonell Graded Word List, improved as a result of the intervention program. Tasks used in the intervention program appeared primarily to have trained successive strategies.

Despite significant conclusions, there are limitations in Kaufman's study, as well. First, the test of reading performance used was a graded word list. Educators know that there are other abilities involved in reading in addition to word recognition. For example, study and comprehension skills are important reading tools. A graded word list measures only a very limited area of reading performance, thus making it difficult to generalize from the results of this one test to the overall reading performance for any child. A more appropriate method of measuring the effects of training learning strategies on reading performance would be to break the task up into different aspects of reading performance. In additions, validity of the results would have increased had the researcher compared teaching in an academic area with strategy training.

In the time-series design used in the present study each student was assessed at periodic intervals on a weekly basis. The experimental treatment was administered during two of the four phases of the study. Of the remaining two phases one phase involved the collection of baseline data; the other involved the collection of data when the experimental program was not in progress. The time-series design is particulary appropriate for field research where the experimental treatment is a naturally occurring event, such as a teaching method (Borg & Gall 1979).

For these reasons it was regarded as an appropriate research strategy for the present study.

Another difference between the present study and the previous two studies by Kaufman and Krywaniuk is the assessment procedures. Only one area of academic functioning (eg. word-analysis skills) is assessed appropriately. In this way the educational implications of a strategy training program can be confirmed by analyzing differences between tests results during the four phases of the study. Word analysis assessment followed a combination of the most reliable measures of word analysis skills available to the researcher. That these measures provided an accurate assessment of word analysis skills is confirmed in Chapter 4.

Summary

Educational research has long been concerned with remedial programs for children who are experiencing problems with learning. However, despite the prodigous amount of research, educators are left without any clear-cut remedial programs because research in the area has suffered from methodological and theoretical shortcomings.

A common approach to dealing with cognitive incompetence is to assess the child's "abilities". A child is then assigned a score which is considered to represent his level as a potential learner. This procedure has hindered rather than encouraged the cognitive development of many students. Educators often realize the problem but do not have any alternatives available to them. These problems can almost always be related to a central need for a theoretical model to guide the selection,

validation and interpretation of assessment devices used in research. Educators are left without a theory by which to interpret research results and to make program modifications based on those results. This lack of a basic theoretical rationale has led to the random selection of tasks for special programs and unfortunately, has resulted in remedial measures which are not successful in helping the child with learning problems.

A simultaneous-successive model of information processing has been adopted for this present study. This approach offers an effective and theoretical method of selecting and validating aspects of cognitive functioning.

Recent literature on reading disabilities has suggested a relationship between successive processing and reading. Das (1979) summarizes the rationale as follows:

> Successive processing is critical for the acquisition of reading; especially for children who have difficulty as beginners in reading. Successive processing is coding of disparate stimuli in a temporal array, imposing an order or sequence. There is evidence to believe that successive processing is basic to language acquisition, and through the experience of language, successive processing develops further - the relationship is a dialectical one. (p.83)

In the reading process then, successive processing may be important for the mastery of initial decoding skills. Training in successive skills may be an appropriate remedial measure to improve word analysis skills.

CHAPTER 3

Statement of the Problem

Despite the amount of literature describing cognitive strategies and their development, we know little about whether or not these strategies can be taught (Gibson & Levin 1979). However, there are a few studies which indicate that cognitive strategies can be taught and used spontaneously in appropriate situations. The low-achieving child appears to have two major difficulties: he does not organize his material because he may not realize the necessity to so so, and he does not use whatever verbal-successive skills he possesses in solving a problem.

If a child with learning problems is to be trained in strategies for improving his academic performance, the two important aspects of remediation are the verbalization by the instructor to guide the child in solving a task and feedback, (Das, Kirby & Jarman 1979).

Research within the framework of the simultaneous-successive model of cognitive processes (Krywaniuk 1974; Kaufman 1978) has demonstrated the usefulness of this model in helping to develop effective techniques for structuring task information to increase successful performance.

The present study is similar to the two previous studies of Kaufman and Krywaniuk; however, in several respects there are important differences. The fundamental theoretical position of the present study is based on a model of cognitive processes, that is, the simultaneous-

successive model. The tasks selected for the treatment program in the present study are identical to the tasks developed by Krywaniuk and confirmed by him as having the ability to improve successive processing strategies. The present study emphasizes verbalization to encourage the appropriate selection of strategies in the same way as Kaufman did in his study.

The present study overcomes the limitation of both the Kaufman and Krywaniuk studies and previous research in the area of remediation. First, a time-series design was selected for the single-case research. In order to rule out alternate explanations of the shift in the time series data children were divided into two equal sized groups. One group received the strategy training program, the other received additional instruction in a variety of reading skills. The teaching of these skills followed the regular reading program format.

The purpose of the present study is to investigate the relationship between strategy training, within a simultaneous-successive processing model framework, and performance in reading for a group of learning disabled children. Research suggests that among groups which might be expected to experience difficulty in reading, successive processing is highly related to reading performance,(Cummins & Das 1977). Morever, gains in test scores measuring the use of successive processing strategies followed an intervention program (Krywaniuk, 1974; Kaufman, 1978). These results form the basis for the present study.

Hypothesis

For a class of learning disabled children, performance on tests of word analysis skills will show greater improvement for a group participating in an intervention program aimed at improving the appropriate use of successive processing strategies than for a group receiving additional reading instruction.

Rationale of the Hypothesis

Conclusions drawn from Krywaniuk's study suggest that performance on tests of successive processing shows greater improvement for a group of children who received a maximum of treatment in the use of strategies than for a minimum treatment group. Low achieving students were found to have poor successive processing skills which were also poorly differentiated from their simultaneous processing strategies. High achieving students were shown to have good successive strategies that were relatively independent of simultaneous strategies. These children could therefore use the strategies which they had more appropriately.

Results of the present study can be explained within the context of the simultaneous-successive approach to information processing.

Much of the information received is in a temporal (successive) order. Some of this information is later used in a simultaneous fashion. Reading requires successive scanning even though the material being read is of a simultaneous nature. If children with reading difficulties have initial deficits in successive processing that delay the differentiation of conceptual-linguistic operations from more elementary forms of

sequential linguistic processing, we can then expect that simultaneous and successive processing will relate differently to the reading performance of children with reading problems than to the performance of successful readers.

The child with reading difficulties cannot function effectively if his skills remain at a low level. Krywaniuk and Kaufman have shown that the appropriate use of successive skills which are deficient can be taught by the application of an appropriate remedial program. This study will attempt to confirm that successive processing is related to reading performance, (and further that a remedial program aimed at improving the appropriate use of successive strategies will improve reading performance) specifically decoding skills in children with reading problems.

CHAPTER 4

Experimental Procedures

Subjects

The sample selected for use in this study was the twelve members of a special class in a central B.C. school district. Within this district, special programs for children with learning disabilities are designed to provide a fairly short, intensive individualized educational program for children who have identified learning disabilities, and need more attention than can be provided for them in the Learning Assistance Program at the school. Enrolment in the classes is limited, and in addition the teacher is provided with a part-time aide. Assessment and program support is provided by a district counsellor when feasible. Students requiring extended individual support remain on the program for two to three years. Referrals to these programs are directed to the Special Services offices. The District Screening Committee reviews referrals and considers placement.

The Junior Special Attention class involved in the study follows a program designed for average or above average ability students, 9 years or over, who are at least two to three years behind in reading achievement. Mathematics and other curricular areas are also provided for. When feasible, the student is involved in an integration program in a regular class. A description of the criteria for entry as described in the Special Services Handbook follows:

Criteria for Entry-Generally speaking the following criteria will determine appropriate placements:

1. Chronological age 10 years or over.
2. At least two to three years behind in reading achievement.
3. Average or above average ability.
4. No extreme social - emotional behavior problems.

A district counsellor is responsible for the educational assessment of referrals before entry into the class. Extended assessment as required includes medical, vision, speech, hearing and social factors.

The average age of the learning disabled students involved in the study on January 1, 1983, was 9 years 11 months. The range was from 9 years 2 months to 12 years 3 months. The proportion of males to females was 7 to 5.

The school where the study was conducted is well-equipped. It provides education for 340 students from kindergarten through grades one to seven. In addition, an assessment centre and special class are situated in the school providing for the needs of students requiring short term intervention programs. Special class students either walk or are bused, (of the 12 students 5 are bused).

Selection of Tests

Reading is a complex behavior comprising of numerous skills. Reading subtests, for example, assess oral reading sheets, comprehension skills, word-attack skills, study skills and rate of reading.

For the purpose of this study a variety of subtests and reading

tests were used to assess word and analysis skills because different authors approach the task of assessing word analysis skills differently. Materials which assess skills in word analysis vary considerably, for example tests which assess skills in associating letters with sound are of the form that the child must identify the word. The words are not basic sight words, and the child must rely on word analysis skills to read the words. The Durell Analysis of Reading Difficulty and the Roswell-Chall illustrate this method. The Roswell-Chall also contains consonants, vowels, and consonant clusters which the child must identify. The word attack subtest of the Woodcock Reading Mastery Test assesses ability to use phonic and structural analysis skills in the identification of nonsense words. The Stanford Diagnostic Reading Test measures blending by presenting alternative beginning, middle and ending sounds from which the child is required to produce a word. The Stanford Diagnostic Reading Test also assesses syllabication ability and the use of prefixes, root words and blends.

In summary, using test items from four different tests of word analysis skills assessment of the following skills was possible:

Recognition of words in isolation;

Identification of root words;

Skill in separating words into syllables;

Skill in synthesizing or blending words;

Skill in distinguishing beginning sounds;

Skill in distinguishing ending sounds;

Skill in distinguishing vowel and consonant sounds.

These tests are widely used in this particular school district and scores from these measures are considered to represent as accurately as possible a childs' ability to apply word analysis skills.

The Measuring Instruments

The major testing instruments used in this study is a stratified sample of 80 items taken from a pool of items which make up four tests of word analysis skills. Each stratified sample contained one quarter of the total number of test items from each test or subtest selected for use in this study. By administering a different sample of questions for each testing session the effect of practice was eliminated.

A - Durrell Analysis of Reading Difficulty

The Durrell Analysis of Reading Difficulty provides an excellent opportunity for an experienced reading teacher to observe difficulties in word recognition and oral reading. The checklist of errors is the best available Robinson (1953). Check lists and test situations are provided for three levels of reading:

1. Non-reader;
2. Primary grade reading level;
3. Intermediate grade reading level.

The subtest "Word Recognition and Word Analysis" was used for this study. Materials provided are word cards and tachistoscope, a list for

grade one, and another for grades 2 to 6. Both word lists were used for the study to cover the wide range of students' ability. Separate norms and check lists are available for recognition and analysis. From the total of 40 items for grade 1, and 50 items for grades 2 - 6 available, a stratified sample of 23 words was gathered randomly for each test situation.

The subtest, Word Analysis, provides a raw score which can be converted to grade scores. There is no reported data on the nature of the population on which the Durrell Analysis of Reading Difficulty was standardized or evidence of validity or reliability in the test manual.

B - Roswell-Chall Diagnostic Reading Test of Word Analysis Skills

This is a test of word analysis skills. These skills are presented in the order in which they are usually taught: single consonants, consonant combinations, short vowels, rule of silent e, vowel combinations and syllabication. "The major value of this test is to point out children's instructional needs in word analysis irrespective of age, grade placement, or silent reading level" (Manual of Instructions, p.1). It was designed for children reading at approximately 2nd to 6th grade level. Two equivalent forms of the test are available.

Reliability and validity data are available. Correlation between the total scores of Forms 1 and 2 was found to be .98 for a sample of 52 children receiving remedial reading instruction, (average reading

level of 4.3). For the same subjects, subtest reliabilities were reported to range from .78 to .99. Reliability appears adequate (Chall 1958). Normative data are not given. The test is similar to informal inventories of word recognition skills used by many educators.

A stratified sample of 50 items from a total of 198 items from both forms I and II were administered at each testing sessions.

C - Stanford Diagnostic Reading Test

The Stanford Diagnostic Reading Test (SDRT) measures specific reading skills in four domains: decoding, vocabulary, comprehension and rate. There are four overlapping levels of the test, with two parallel forms (A and B) at each level.

The SDRT was standarized and is reliable enough to be used in pinpointing specific domains of reading in which pupils demonstrate skill development strengths and weaknesses, (Salvia & Ysseldyke 1981). Criterion-related validity data are available. Correlations range from .61 and .98 on the Red and Green levels which are appropriate levels for the pupils of this study. Two types of reliability information are available for SDRT: reliability of raw scores, (internal-consistency coefficients exceed .90, alternate form reliability coefficients range from .75 to .94) and reliability of Progress Indicators (tables provided in the Manual).

The skill domain "Decoding" contains two subtests: Phonetic Analysis and Structural Analysis. Phonetic analysis is concerned with the relationships between sounds and letter", (Manual for Administering and Interpreting, p.23). The Phonetic Analysis subtest assesses the students' ability to identify letter-sound relationships. The subtest is included in all four levels. The Structural Analysis subtest is included in the Green, Brown, and Blue levels. Items assess skill in the use of syllables, prefixes, root words and blends. Red level, Test 3: Part 1 and 2 yield two scores, a vowel score and a consonant score. A stratified sample of one quarter of the test items for each level was used for each testing date.

D - Woodcock Reading Mastery

The Woodcock Reading Mastery Tests are a battery of five individually administered tests used to assess skill development in reading with students in kindergarten through grade 12. Two forms of the test are available for interchangeable at any level.

The Word Attack subtest contains 50 items which measure ability to identify nonsense words through application of phonic and structural analysis skills. Items are arranged in order of difficulty. At the lower end of the test the nonsense words are simple consonant-vowel or consonant-vowel-consonant combinations: multisyllabic words are presented at the upper end of the test. Represented within the set of nonsense words are most consonant and vowel sounds, common prefixes and suffixes, and frequently appearing irregular spelling of vowels and consonants.

The five subtests are letter identification, word identifications, word attack, word comprehension, and passage comprehension. Three estimated grade scores are available. Reliability data are provided but it is limited; only split-half reliability coefficients for forms A and B for second-grade and seventh-grade populations are reported in the Woodcock manual but could be misleading since the pretests are not identical with the final forms. Test-retest reliabilities are adequate. Evidence for the validity of the test is sparce.

The Word Attack Test measures the subject's ability to identify nonsense words through the application of phonic and structural analysis skills, (Manual for Administration).

Testing Procedures

Approval for conducting the study was obtained from the school district and the principal of the school in which the special class was located. Shortly thereafter, parent consent forms and information sheets were sent to the parents of each child in the special class.

Testing was begun the first week of February, 1983 and was continued on a weekly basis for the duration of the study. During the 21 weeks of the study the group of test items was administered by the investigator or teacher aide to all students in the special class taking part in the study. These measures of word analysis skills not only ensured that the required data would be available on the students who were subjects for the study; but it also provided a measure which could be used to evaluate each student's word analysis ability. The testing was thus considered as part of the school program.

Individual testing sessions lasted approximately 10 minutes each and were conducted in a quiet corner of the classroom usually by the teacher aide. All scoring was double checked by the investigator or teacher aide after testing had been completed.

The children were tested in an essentially randomized order on an individual basis. There was no fixed time set aside in the school day for testing. The tester selected the students when they appeared to have completed assignments or were not attending to some seat work. Responses were always verbal and when required, the child would point to the correct response. Directions for administration of each of the tests were followed to ensure that tests were administered in the same way to each student.

It should be noted that for each testing session tests were given in a fixed order. Care was taken to ensure that the testing times were not too long.

Experimental Design

To test the hypothesis, a single case time-series experimental design was used. The number of children involved in the study could be considered smaller than is optimal for statistical purposes. However, factors support the sample size as being appropriate. The single case experimental design is appropriate for learning disabled children who are unique in their background, functional levels and capabilities. Also, the individual is of the greatest importance in studying behavior change, therefore the single-case methodology is appropriate, (Hersen &

Barlow, 1976).

An ABAB design was implemented to examine the effects of the treatment program. Simply, the A phase is the baseline condition when no treatment program is being conducted. In this phase direct measurement of word analysis skills was recorded once a week before treatment was implemented. In this way we had data on the present level of the student's ability to use word analysis skills and it was possible to predict what the future level of functioning would be if no treatment program was implemented. The B phase is the treatment program.

In the B phase the independent variable, successive processing was introduced. Continuous assessment provided the several observations over time needed to make a comparison of word analysis skills before and after treatment. Care was taken to change only one variable, the subjects' ability to use successive processing appropriately. The affects of the treatment program are manifest if performance improves during both of the B phases. The third and fourth phases of the design provided more certainty about the role of successive processing in affecting word attack skills.

The ABAB design provided a comparison of phases and an indication of performance altered by intervention. The premise was that if a child's word analysis skills change when a program aimed at improving the child's ability to use successive processing is introduced and stabilize after the intervention is withdrawn and again improve when the program is reinstated, the pattern of results would indicate that the intervention

is responsible for change.

The program was administered daily on an individual basis for 6 weeks for each of the B phases, to 6 members of the class of 12 learning disabled students. The 6 children represented each of the four ability groups within the classroom. Stratified sampling assured that each group is represented. Students from each of the ability groups were randomly selected to participate in the treatment program. Those students not involved in the treatment program received additional reading instruction from the regular reading program (Keytext Reading Program). In this way, all students received some additional instruction.

The Intervention Program

A series of tasks, the description of which follows, was used on an individual basis. In general, the children were guided in approaching the tasks at hand and encouraged to verbalize the use of successive processing. The method of training was considered more important than the actual content of the tasks used for training, (Kaufman & Kaufman 1979) because verbalization can indicate not only the strategy being used but can also regulate subsequent actions. During each session the child was encouraged to verbalize the strategies and give a verbal summary. At the beginning of each training session the child was asked through direct questioning to review the strategies introduced in previous sessions.

The tasks selected for the intervention program were selected according to their similarity to successive tasks. They are not complicated to produce or use and are easily adaptable for use in the classroom. Also, they do not relate directly to any academic area of school learning.

It is realized that it is nearly impossible to devise training tasks that are exclusively successive; however, the tasks involved successive processing as much as possible.

Sequence Story Boards

Instructors Activity Kit: Let's Learn Sequence contains separate stories, each having 6 removable pictures that could be arranged to tell a story.

Generally, the procedure was simply to place the pictures in a random order in front of the child and instruct him to arrange them so they would tell a "good" story. When this was completed, the child was to tell the story, picture by picture, paying attention to the details in each picture. As he told the story, the inconsistencies in his arrangement were pointed out, and he was given time to correct them.

If the child was having difficulty, the minimum amount of necessary help was given. For instance, he might be asked to point out the first picture in the story, and if he could not do so after a reasonable time, it was shown to him. If it was obvious the child was having considerable difficulty, the pictures were grouped into three piles, one for each row, with the correct pictures for that row in each pole, but in randon order.

The purpose of this procedure was to give the child practice in ordering data into sequential forms by paying attention to visual details. Included in this was the necessity for the child to attempt at least some verbalization. The task was expected to augment verbal mediation in serialization.

Serial Recall

This intervention task had two parts. In the first, 12 common objects were laid on the table and the child was instructed to name them. Any name the child gave was accepted. These were then placed in a box, and the child was asked to recall as many as he could. If he did not remember all 12, the omitted objects were all placed on the table, and the child studied them once more. He was again asked to recall them. This procedure was repeated until he could recall all 12 objects.

In the second part, 12 different pictures were used from a commercially available kit called Instructor Activity Kit: The Classification Game. As before, they were laid on the table for the child to name, but now he was asked to put them into piles that were "the same" in some way. If he did not understand, some guidance was given. Usually the objects were grouped according to color, material, shape or functional association. This was done to encourage the child to use grouping strategies in recall. The task then continued as in the first part.

Short-term memory is thought to be one of the primary abilities needed for intelligent thought and reasoning, (Jensen 1969) and for this reason received a considerable amount of attention in the remedial program. This task should improve scores on the WISC Digit Span and the other measures of short-term memory.

Coding

In this task the child first underwent a small training series of hand and knee "claps" in which he followed the administrator's movements.

This was done to familiarize the child with the task and introduce the two necessary movements: clapping the hands together and slapping both hands on the knees. The movements were done in a rhythmic fashion, using patterns similar to those in the CMC test. When the child was able to copy the instructor's movements, he was introduced to the cards on which these movements were coded by dots and squares: a dot for a hand clap and a square for a "knee clap". The series began with simple patterns and proceeded to more complicated ones. Some patterns are shown below:

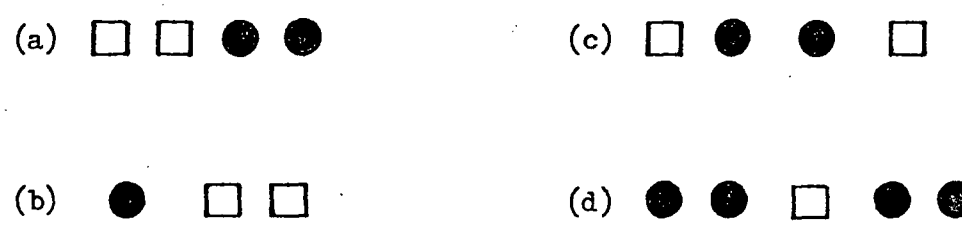

Fig. 1. Some typical "clapping" patterns.

If he did it incorrectly, he was asked to do it again, up to a maximum of three trials. He then proceeded to a new card. When the series was complete, the cards were inverted, having the effect of reversing each card.

The purpose of this task was two-fold. First, it provided practice in visual-auditory (kinesthetic) cross-modal coding. Second, it encouraged the use of symbolic mediation and rhythm which are thought to constitute processes necessary in reading. This intervention device was

aimed primarily at the CMC test but, as rhythm is important to many processes, it may have more general implications.

Matrix Serialization

This training series had two parts, differing mainly in difficulty, and presented on different occasions.

Task I. The initial six training series were constructed in a way that they would establish a consistent pattern. Initially, a simple matrix was devised (Figure 5).

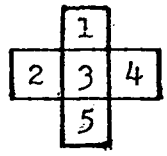

Fig. 2. A simple matrix

This matrix was broken down into its five component parts, each part being presented singly on a separate page as in Figure 6.

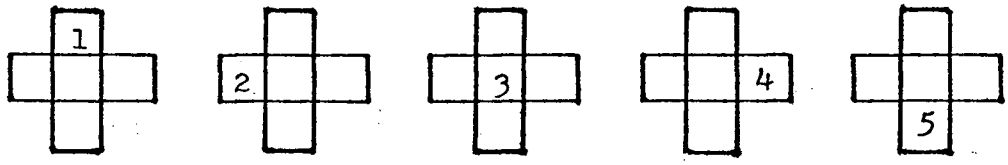

Fig. 3. Component matrices

Each matrix was presented separately in the order shown and the child was expected to read the numbers out loud as they appeared. When all five matrices were shown, he was expected to repeat the entire series of numbers. If he failed to do so, he was shown the complete matrix (Figure 5) and then asked to read it and then recall it. The latter part of the procedure was repeated a maximum of three times. When he could repeat it correctly, he was asked to write it down.

Task II. The second task was similar to the first except that it was more difficult and was presented during a different time in the remedial program. It consisted of 12 different matrices which were read, repeated and written down.

It was observed during initial testing that the children did not have consistent search/recall patterns. Consequently, they made many mistakes in serial position recall. It was felt that this was one of the reasons these children were having difficulty reading and comprehending visual material. Consistent visual strategies are required by many perceptual tasks.

Auditory Discrimination and Digit Span

The auditory discrimination task consisted of three parts administered consecutively in one day and contained all of the different words used in the Serial Learning test. The first task series used the words cow, pen, few, day, book, bar, wall, hot and key. The words were read one at a time and the requirement was a simple repetition. If a mistake was made, the word was repeated.

The second part was structured to encourage the use of associations in memory. The words big, long, great, tall, fat, wide, huge, high, large were read one at a time and the child was required to think of a word (or object) that could be described by the stimulus word. When the list was completed, it was read again one word at a time and the child was asked to repeat the word (or object) he originally associated with it. This was done a maximum of two times.

The third part consisted of the words from the acoustically similar section of the test: man, mad, mat, cat, cab, cap, can, pan, map, tap. These words were read one at a time and the child was asked to write the word down and then to draw a picture representing the word. If the child did not write the word correctly, it was repeated. If the error persisted, his mistake was corrected and he was given some help by example. The purpose of this task was to encourage the use of visual symbolism in auditory tasks. In general, the purpose of these tasks was to present alternative strategies for use in serial memory.

The digit span task consisted of series of random numbers from three to eight digits in length. The digits were read in such a way as to group them initially into groups of three. The child then repeated them, usually adopting the grouping strategy. As he progressed through each series, grouping was faded out in the stimulus presentation. The child generally retained his grouping strategy. If he did not, the notion of grouping was reintroduced. This proceeded from series of three numbers to as many

as the child could remember. The task was continued until the grouping strategy was firmly established. This grouping strategy was intended to improve auditory discrimination and short-term memory as measured by the WISC Digit Span and Serial Learning Test. The purpose of this task was to introduce a grouping strategy into memory.

These tasks were all done individually or with a small group of 2 or 3 children. In general, the children were encouraged to use verbal mediation and were encouraged to verbalize their thinking. At all times the researcher attempted to encourage the use of appropriate strategies and to lead the learning tasks in such a way as to point out how these strategies were used in the solution of the problem.

CHAPTER 5

Results

Analysis of Data

The evaluation of data was through visual inspection and statistical analysis. Visual inspection is critical in single-case experimental research. A major purpose of continuous measurement over time is to allow the investigator to see changes in the data as a function of stable patterns of performance within different conditions, (Kazdin, 1982).

Visual inspection of the data from measurements of word analysis skills is displayed graphically on a line graph. In this way the data can be easily evaluated. Basically, the data on the dependent measure, word analysis skills are plotted on the ordinate or vertical axis and the data are plotted over time, represented by the abscissa or horizontal axia. The line graph allows for the easy examination of changes in means, levels and trends across phases and the rapidity of changes in performance when experimental conditions change.

Results

Children were tested using measures of word analysis skills on a weekly basis during each of the four phases of the study.

Results of the word analysis testing for the group receiving extra reading instruction and the group receiving additional reading instruction follows:

Control Group

Subject 1, (Age: 10 yrs. 4 mos., male). Scores on the most recent aptitude test were, WISC-R: Verbal 84, Performance 108, Full scale 94. Statistical analysis revealed the following relationships.

Table 1

Correlation of Word Analysis Scores Between Phases

	B_1	B_2
A_1	1.20	1.78
A_2	.49	.51*

*$p < .05$

Data for subjects receiving extra reading instruction - Subject 1

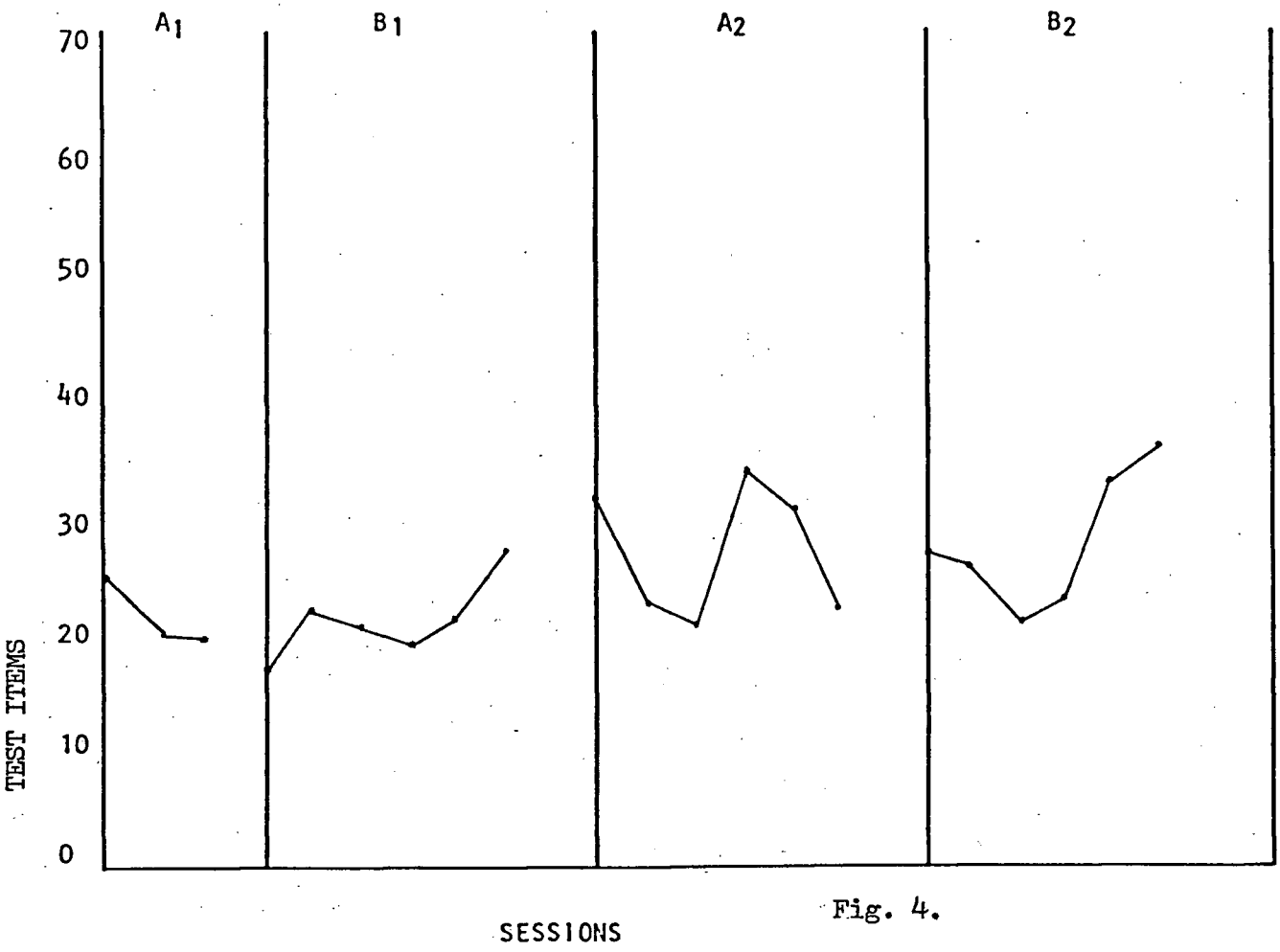

Fig. 4.

Extraneous factors which may have affected performance for this child was his being taken off medication during the A_2 phase. The anti-epileptic medication appeared to "slow down" this student generally. His work habits improved when the medication was withdrawn which happened during the course of the study.

Subject 2, (Age 11 yrs. 9 mos., female). Scores on the most recent aptitude tests were, WISC-R: Verbal 76, Performance 98, Full scale indicates Average and lower end of range. Statistical analysis revealed the following relationships:

Table II

Correlation of Word Analysis Scores Between Phases

	B_1	B_2
A_1	1.76	2.96*
A_2	.36	1.07

*$p < .05$

Data for subjects receiving extra reading instruction - Subject 2

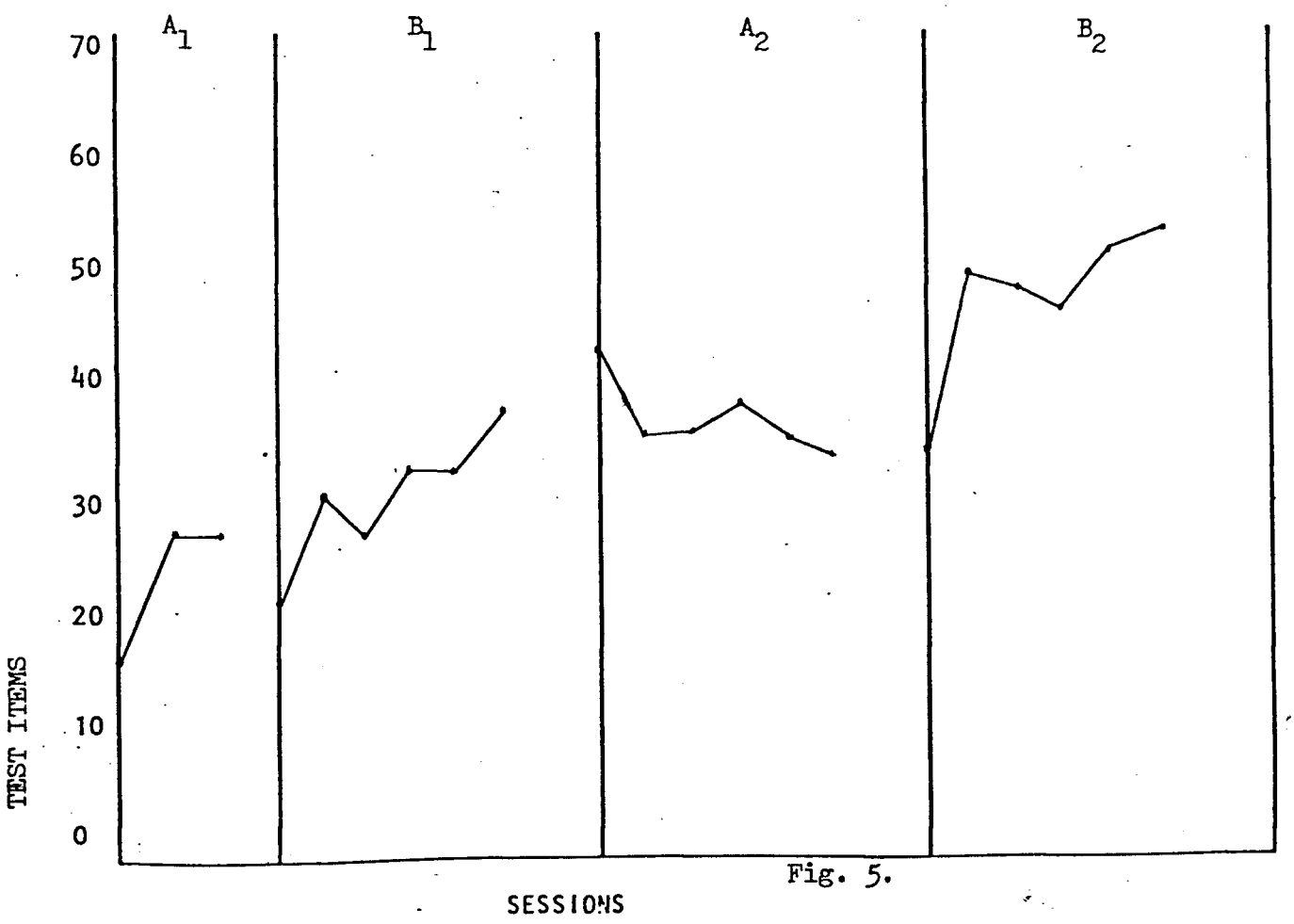

Fig. 5.

Extraneous factors which may have affected performance for this child in a positive way was that for the last two phases the family was receiving counselling and it was observed that within the classroom the student's performance improved.

Subject 3, (Age: 12 yrs. 9 mos., female). Scores on the most recent aptitude tests were, WISC-R: Verbal 74, Performance 88, Full Scale 80. Statistical analysis revealed the following relationships:

Table III

Correlation of Word Analysis Scores Between Phases

	B_1	B_2
A_1	-.20	2.45*
A_2	.58	2.02*

* $p < .05$

Data for subjects receiving extra reading instruction - Subject 3

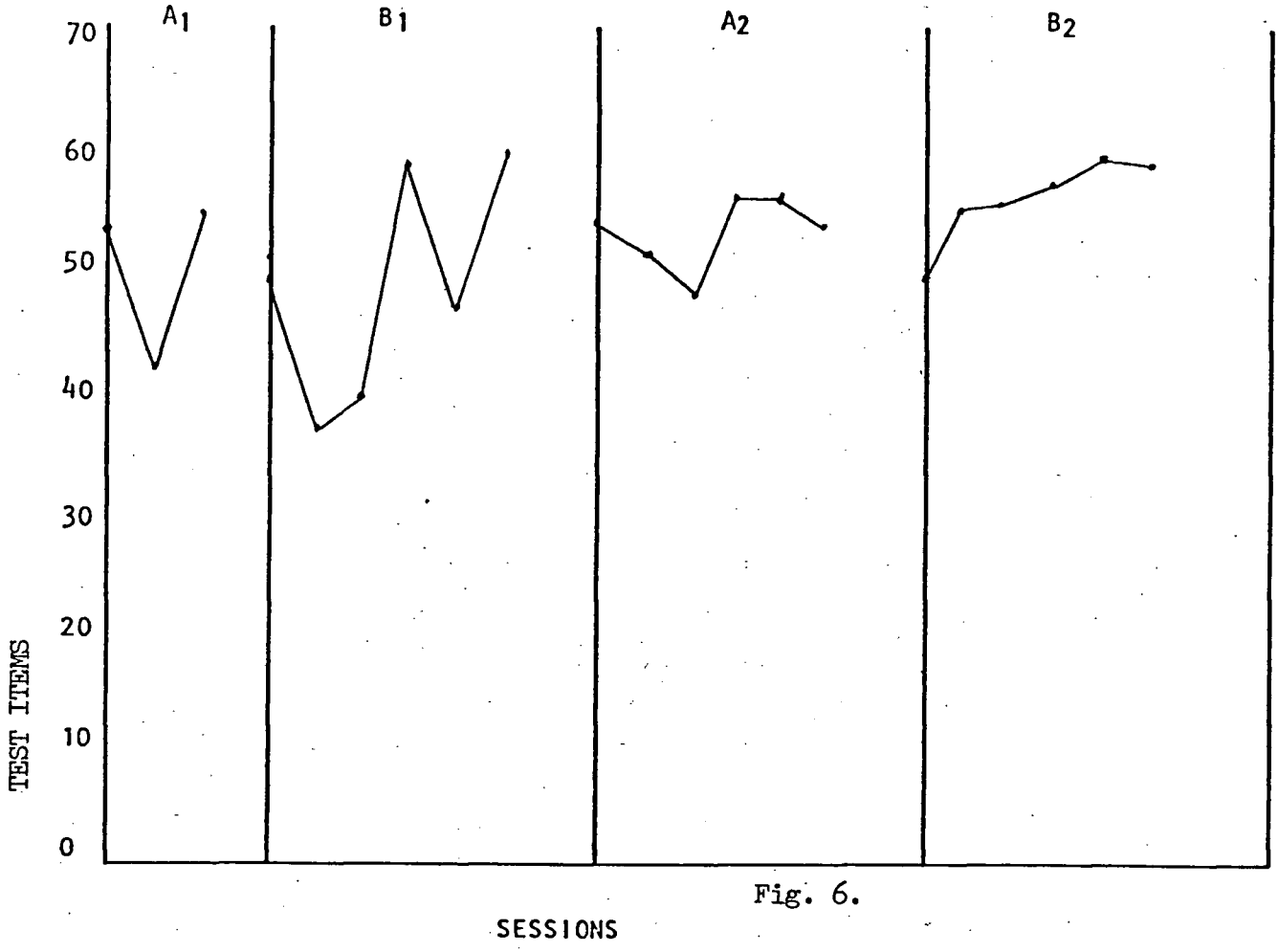

Fig. 6.

This particular student had excellent work habits, she had the ability to apply herself to any task given her. She could be considered a slow learner, not a learning disabled child. Her gains in test scores reflect this.

Subject 4, (Age: 10 yrs. 0 mos., female). Scores on the most recent aptitude tests were Slosson IQ 101, WISC-R 81. Statistical analysis revealed the following relationships:

Table IV

Correlation of Word Analysis Scores Between Phases

	B_1	B_2
A_1	1.66	1.39
A_2	2.12*	.82

*$p < .05$

Data for subjects receiving extra reading instruction - Subject 4

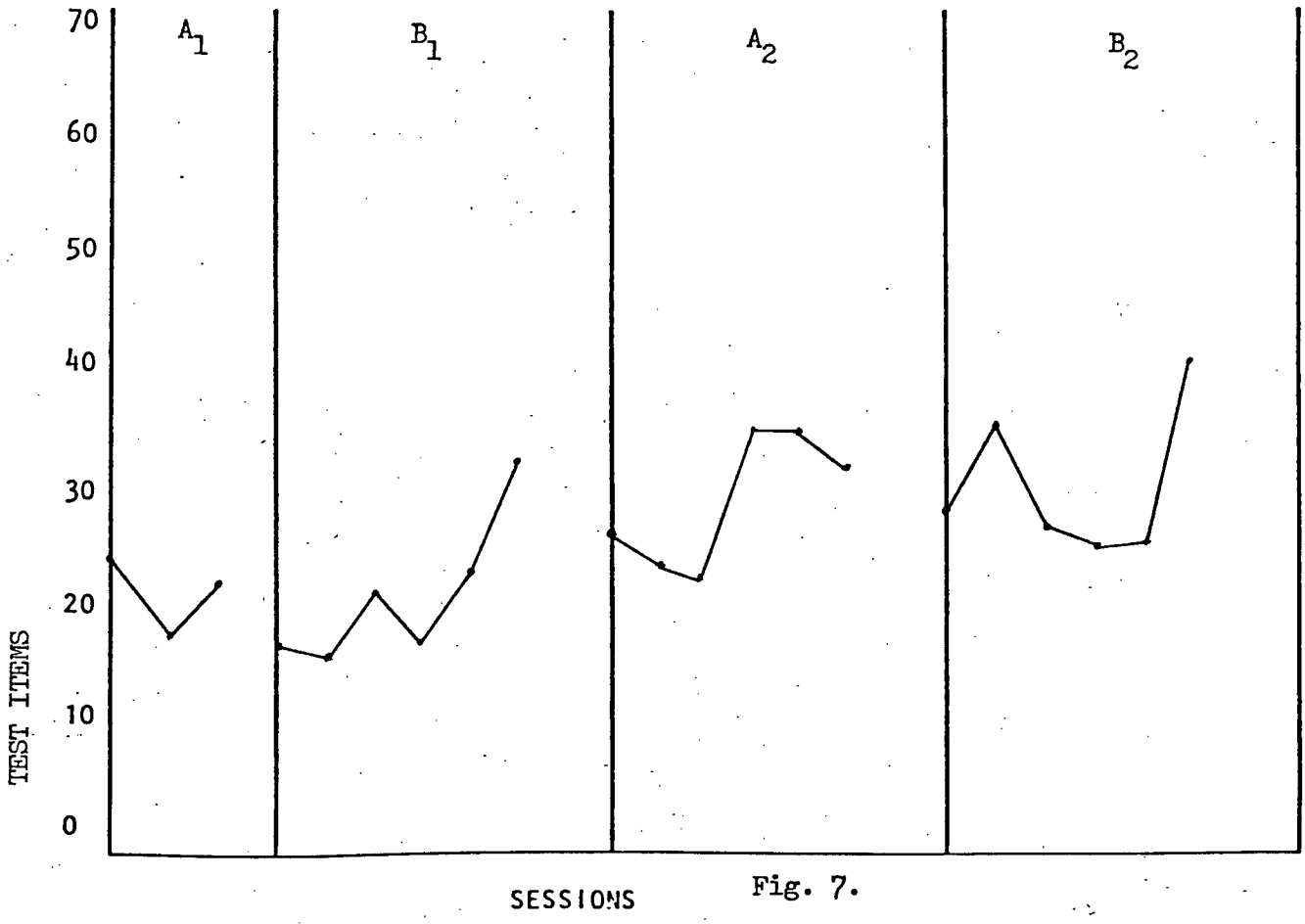

Fig. 7.

Subject 5, (Age: 11 yrs. 0 mos., male). Scores on the most recent aptitude tests were Slosson 93. Statistical analysis revealed the following relationships:

Table V

Correlation of Word Analysis Scores Between Phases

	B_1	B_2
A_1	1.30	
A_2	.82	

Note for this student testing on measures of word analysis skills was not completed as an integration program was in progress during the last phases of the study.

Data for subjects receiving extra reading instruction - Subject 5

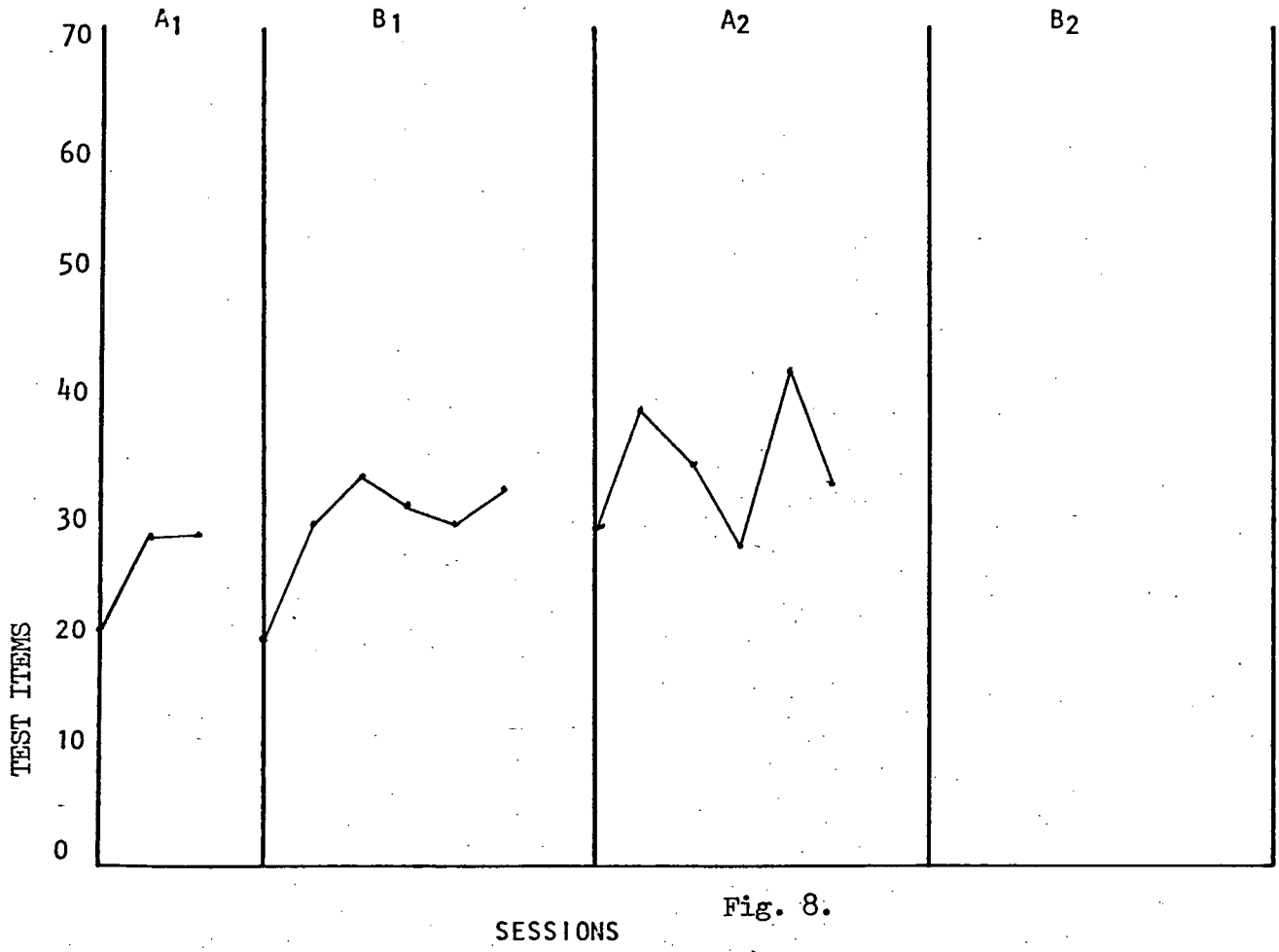

Fig. 8.

Subject 6, (Age: 11 yrs. 0 mos., male). Scores on the most recent aptitude test were Canadian Cognitive 87 IQ, Peabody Picture Vocabulary IQ 104. Statistical analysis revealed the following relationships:

Table VI

Correlation of Word Analysis Scores Between Phases

	B_1	B_2
A_1	1.61	
A_2	.16	

Note that for this student testing on measures of word analysis skills was not completed as an integration program was in progress during the last phases of the study.

Data for subjects receiving extra reading instruction - Subject 6

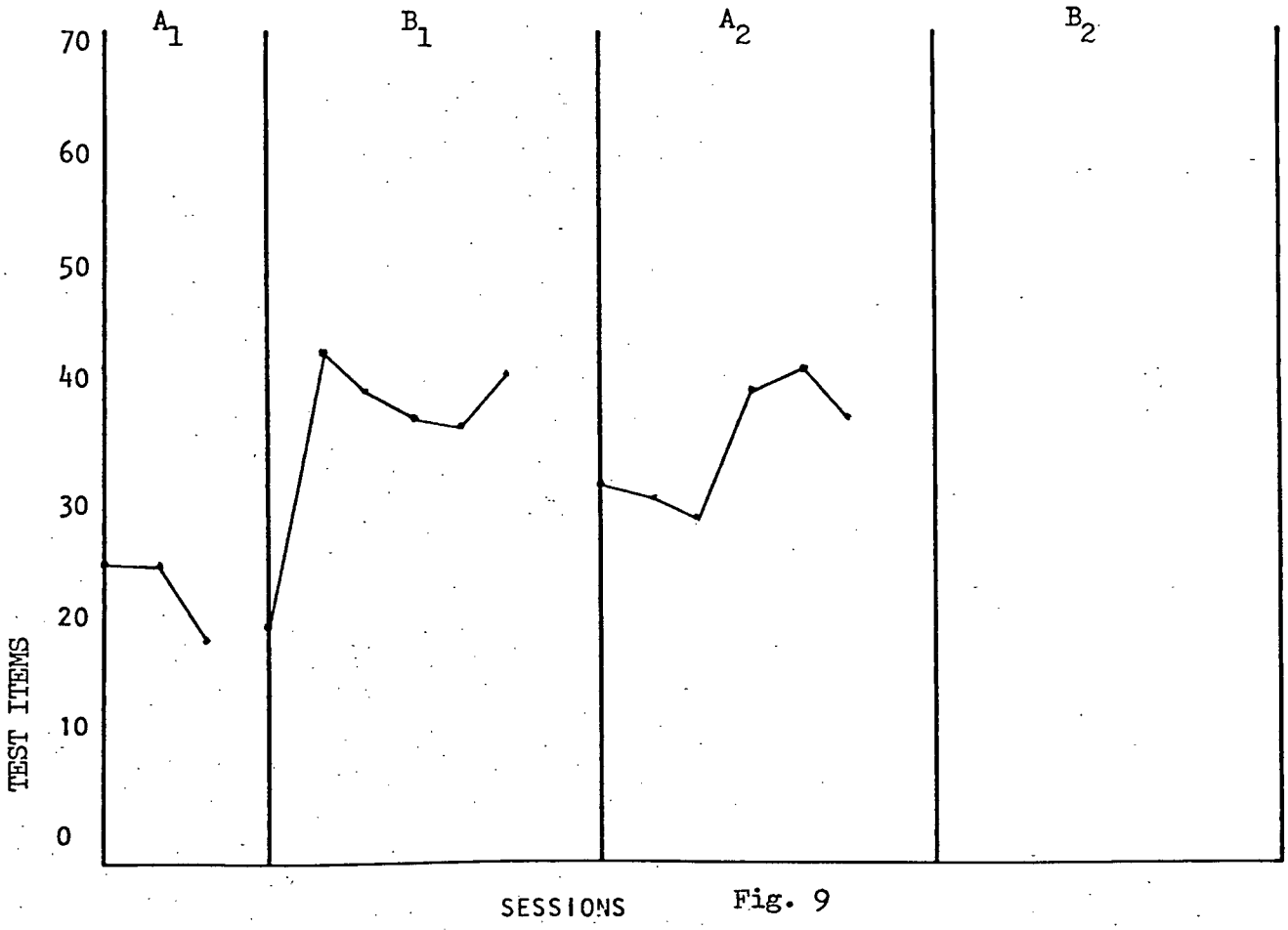

Fig. 9

The following results were derived for the experimental group.

Experimental Group:

Subject 1, (Age: 10 yrs. 8 mos., male). The most recent aptitude test yielded the following score, WISC-R: Verbal 98, Performance 95, Full Scale 96. Statistical analysis revealed the following relationships:

Table VII

Correlation of Word Analysis Scores Between Phases

	B_1	B_2
A_1	2.31*	1.75*
A_2	1.99*	1.52

*$p < .05$

The significant positive correlation found for A_1B_1, A_1B_2 and A_2B_1 supported the hypothesis.

Data for subjects receiving treatment program - Subject 1

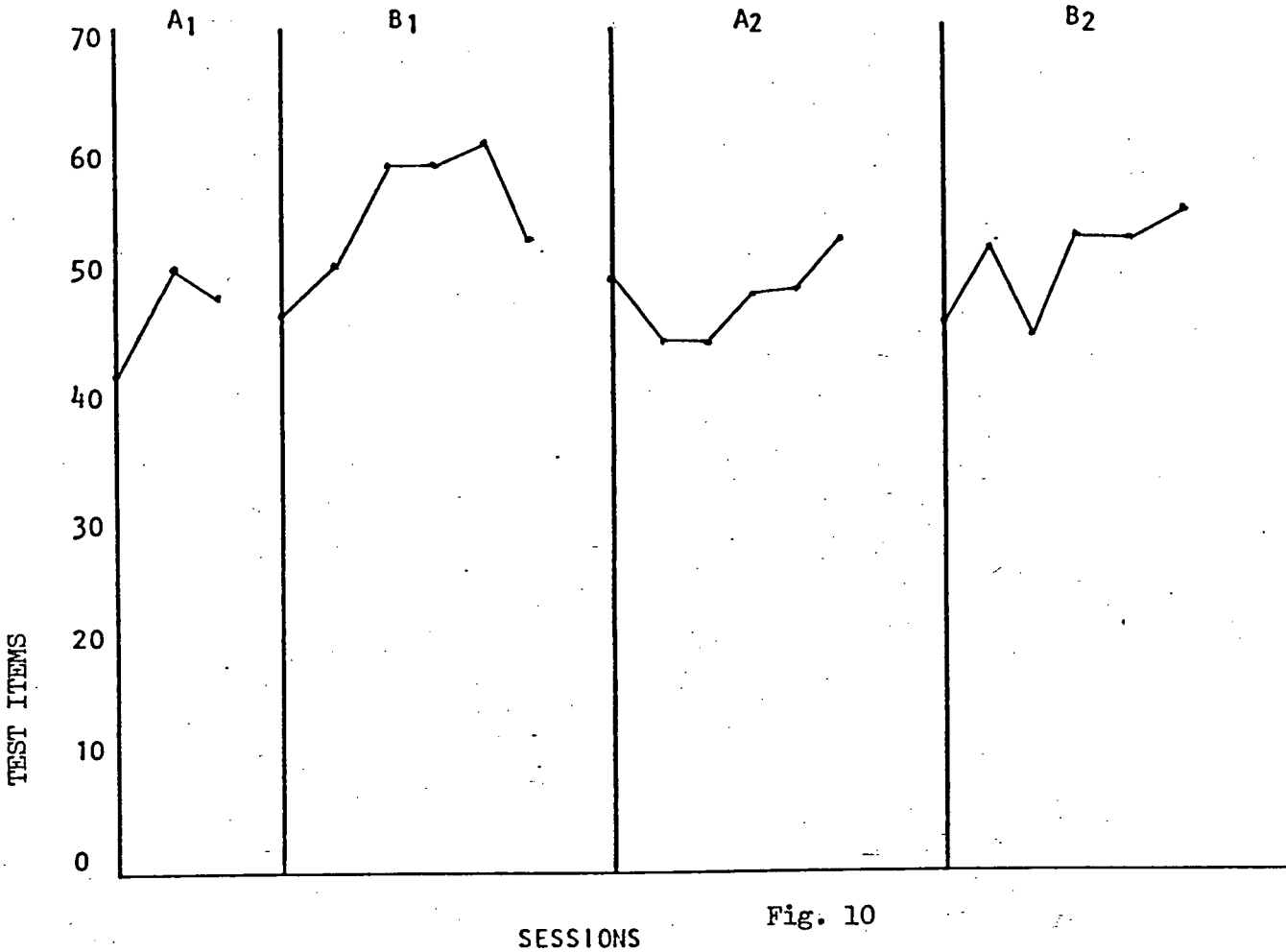

Fig. 10

The data on this particular student were considered to be an accurate representation of the affects of the treatment program.

Subject 2, (Age: 11 yrs. 3 mos., male). The most recent aptitude test yielded the following scores, WISC-R: Verbal 78, Performance 92, Full Scale 84. Statistical analysis revealed the following relationships:

Table VIII

Correlation of Word Analysis Scores Between Phases

	B_1	B_2
A_1	2.18*	2.87*
A_2	2.77*	2.70*

*$p < .05$

The significant positive correlation found for A_1B_1, A_1B_2, A_2B_1 and A_2B_2 supported the hypothesis. The data on this particular student were considered to be an accurate representation of the affects of the treatment program.

Data for subjects receiving treatment program - Subject 2

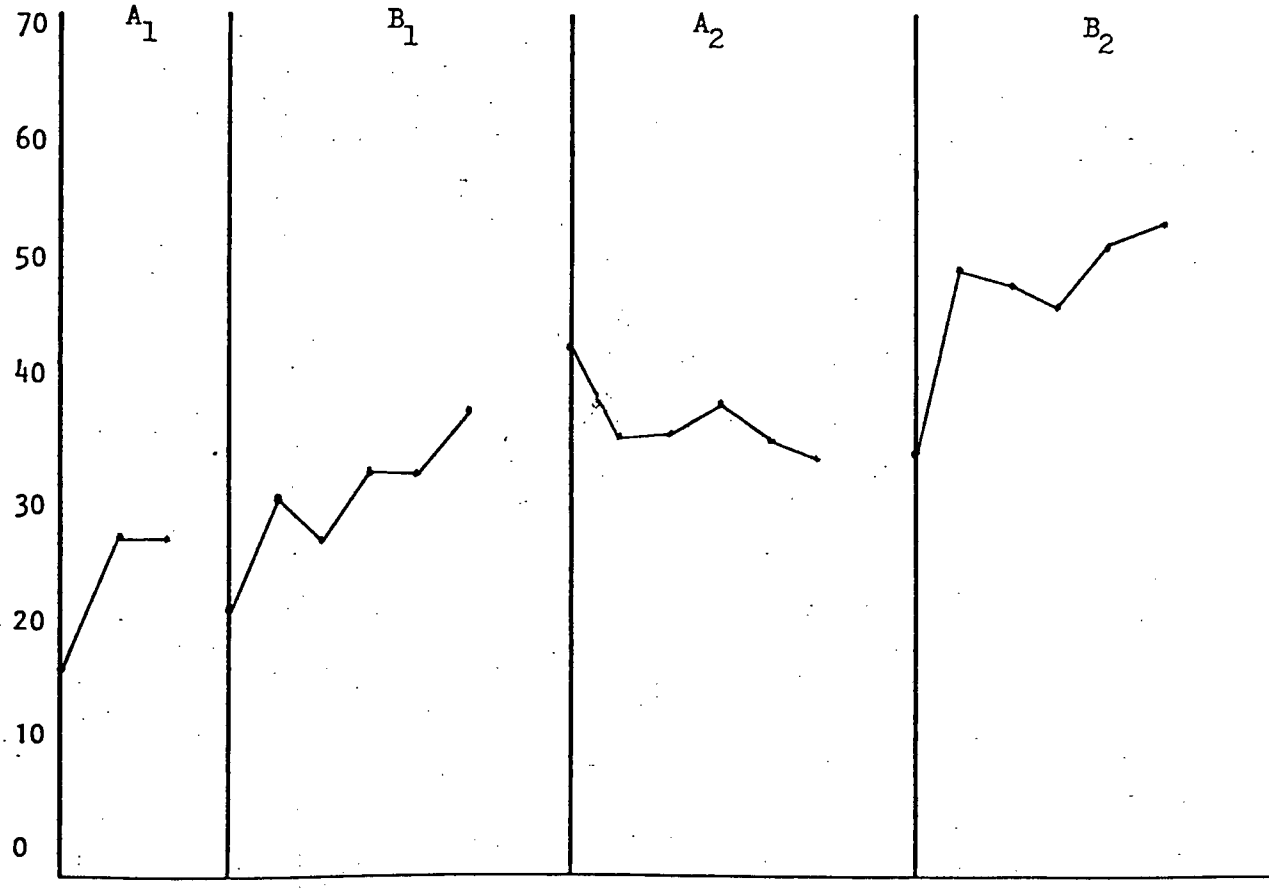

Fig. 11

Subject 3, (Age: 9 yrs. 8 mos., female). The most recent aptitude test yielded the following score, WISC-R: Verbal 80, Performance 75, Full Scale 71. Statistical analysis revealed the following relationships:

Table IX

Correlation of Word Analysis Scores Between Phases

	B_1	B_2
A_1	-.06	1.67
A_2	-1.20	2.43*

*$p < .05$

The significant positive correlation found for A_2B_2 supported the hypothesis. The data collected on this particular student was affected by extraneous factors. This particular student suffers from frequent family upsets which affect her academic performance, overall.

Data for subjects receiving treatment program - Subject 3

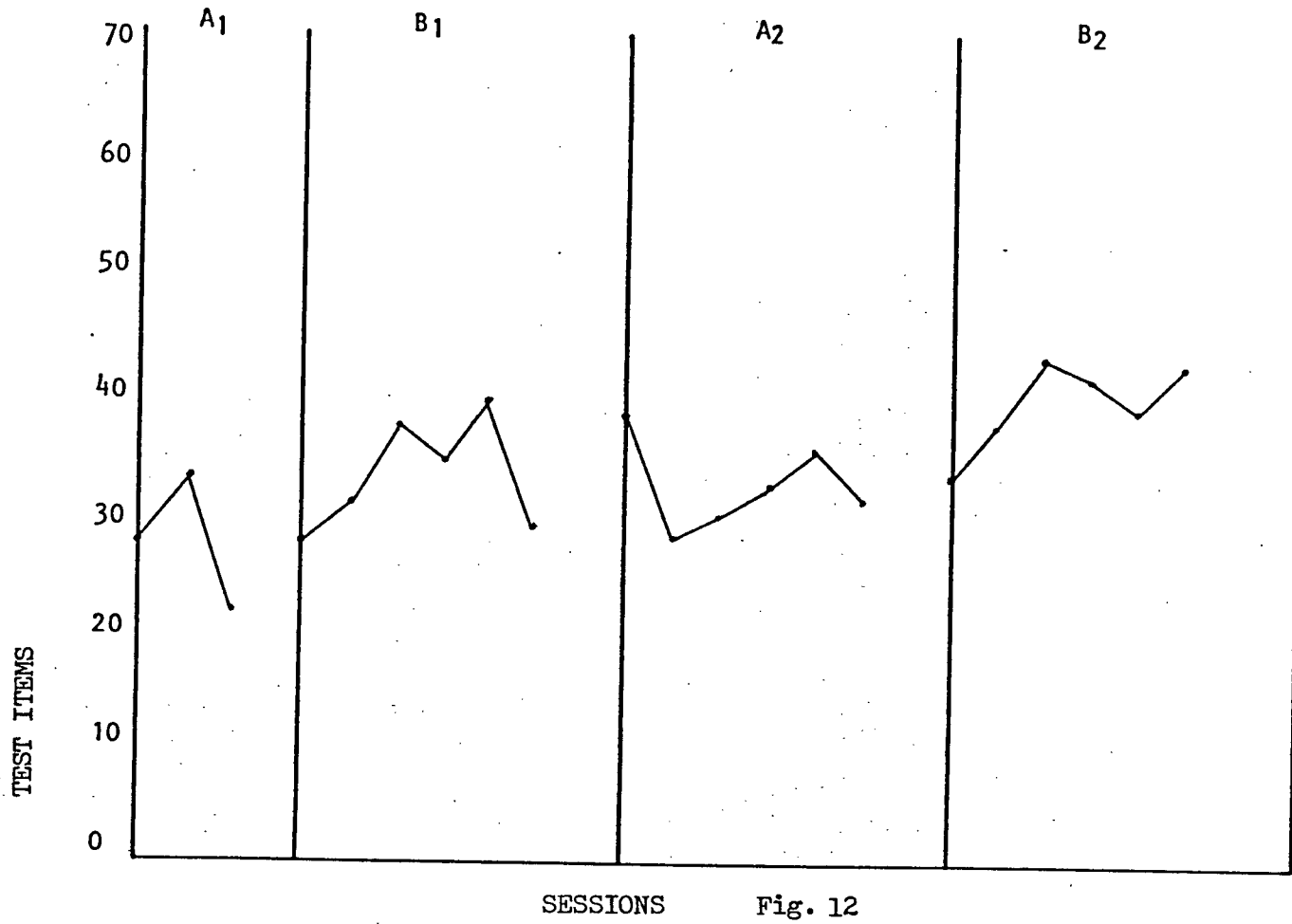

Fig. 12

Subject 4, (Age: 11 yrs. 1 mos., female). The most recent aptitude test yielded the following score, ITPA: 2 - 2½ years delay in all areas of language. Statistical analysis reveals the following relationships:

Table X

Correlation of Word Analysis Scores Between Phases

	B_1	B_2
A_1	1.63	2.63*
A_2	-.66	.77

*$p < .05$

The significant positive correlation found for A_1B_2 supported the hypothesis. This particular student has emotional problems which affect performance. The data collected on this student are not considered to accurately represent the affects of the treatment program.

Data for subjects receiving treatment program - Subject 4

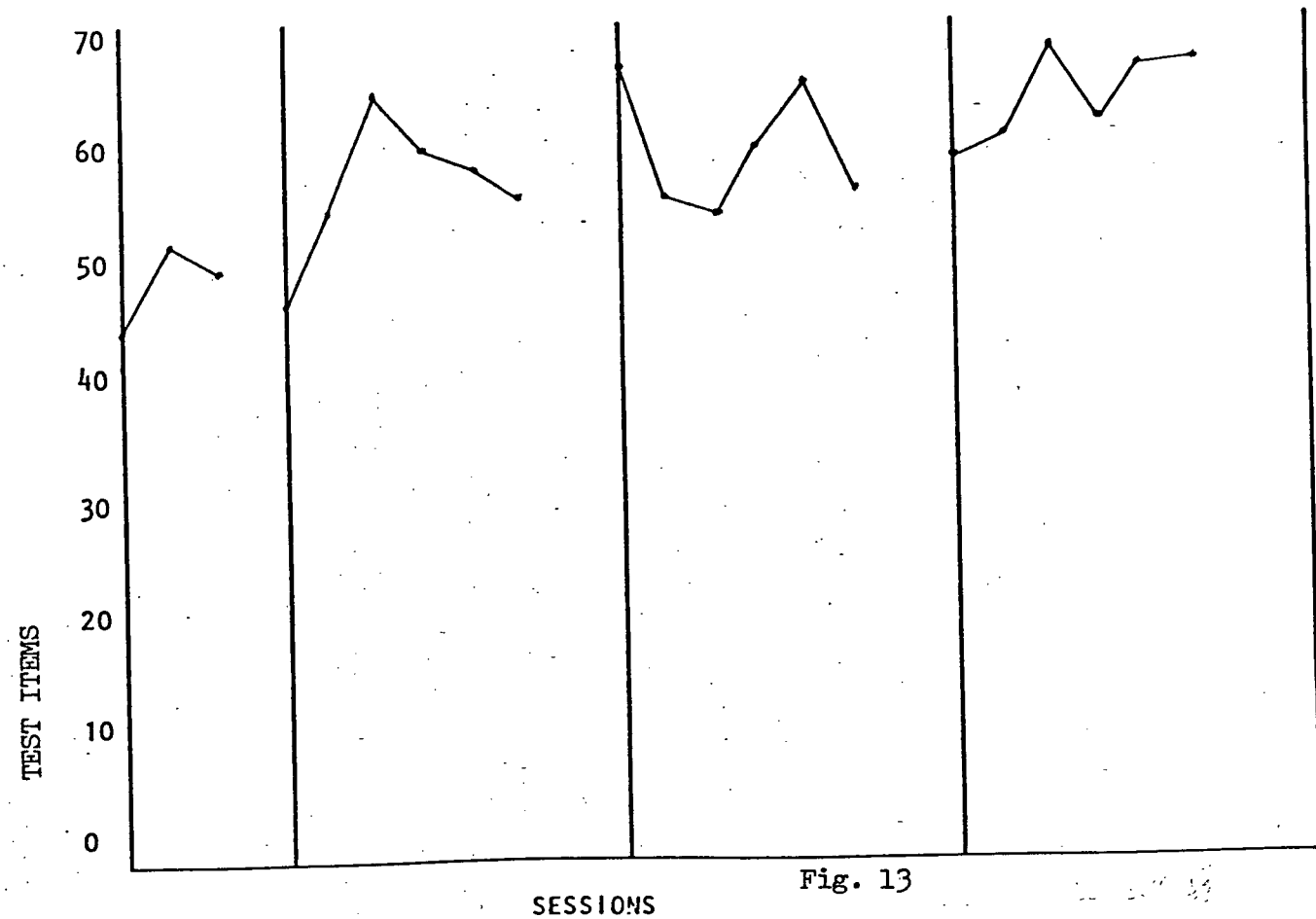

Fig. 13

Subject 5, (Age: 11 yrs. 11 mos., male). The most recent aptitude test yields the following scores, WISC-R: Verbal 106, Performance 105, Full scale 105. Statistical analysis reveals the following relationships:

Table XI

Correlation of Word Analysis Scores Between Phases

	B_1	B_2
A_1	2.27*	2.87*
A_2	.49	1.65*

*$p < .05$

The significant positive correlation found for A_1B_1, A_1B_2 and A_2B_2 supported the hypothesis.

The data collected on this particular student was considered to be an accurate representation of the affects of the treatment program.

Data for subjects receiving treatment program - Subject 5

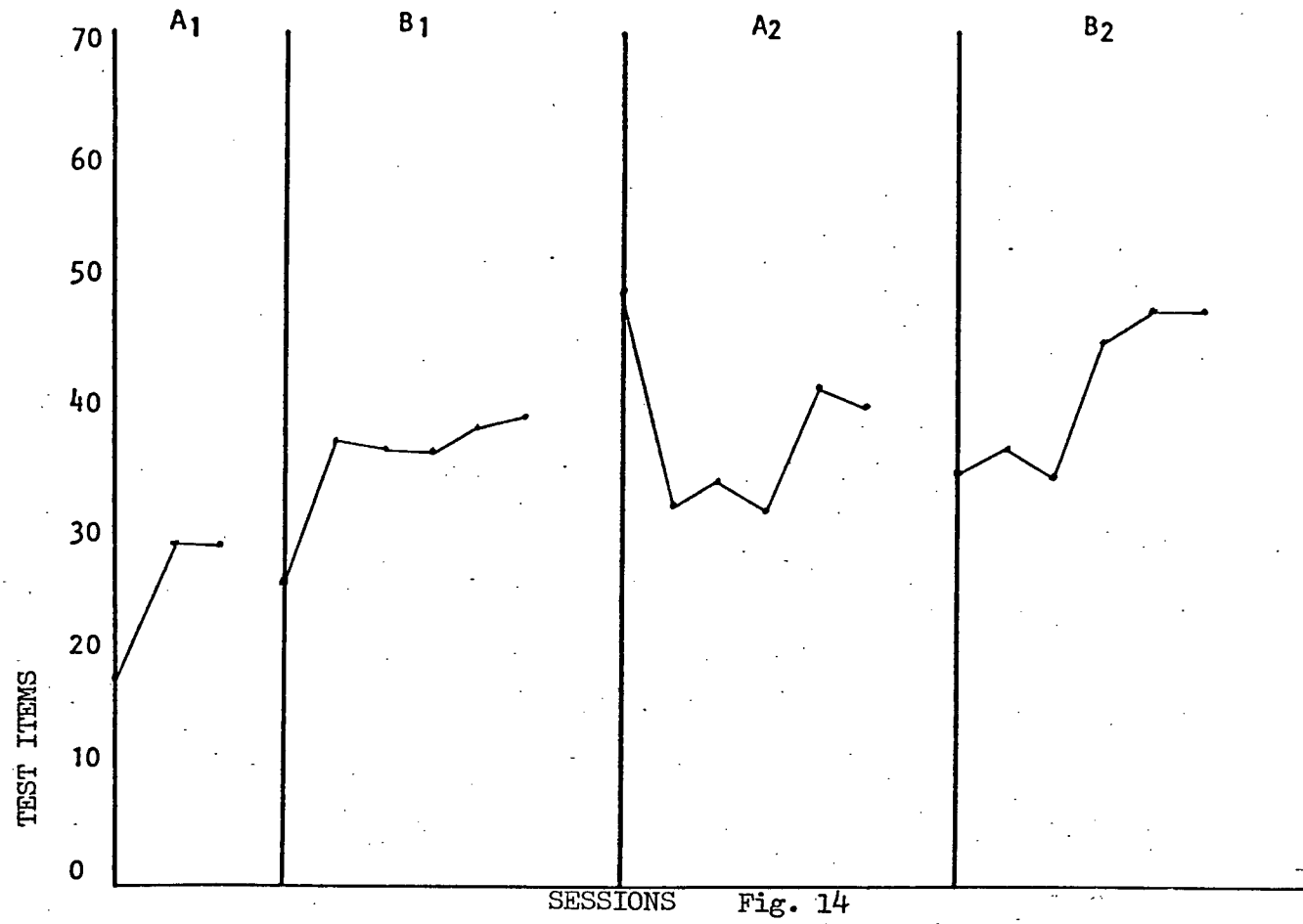

Fig. 14

Subject 6, (Age: 10 yrs. 11 mos., male). The most recent aptitude testing for this child yielded the following scores, WISC-R: Full Scale 96. Statistical analysis reveals the following relationships:

Table XII

Correlation of Word Analysis Scores Between Phases

	B_1	B_2
A_1	-.20	1.91*
A_2	.78	.14

*$p < .05$

The significant positive correlation found for A_1B_2 supported the hypothesis. This particular student is immature and appears to have severe emotional problems which affect performance. His parents have recently separated.

Data for subjects receiving treatment program - Subject 6

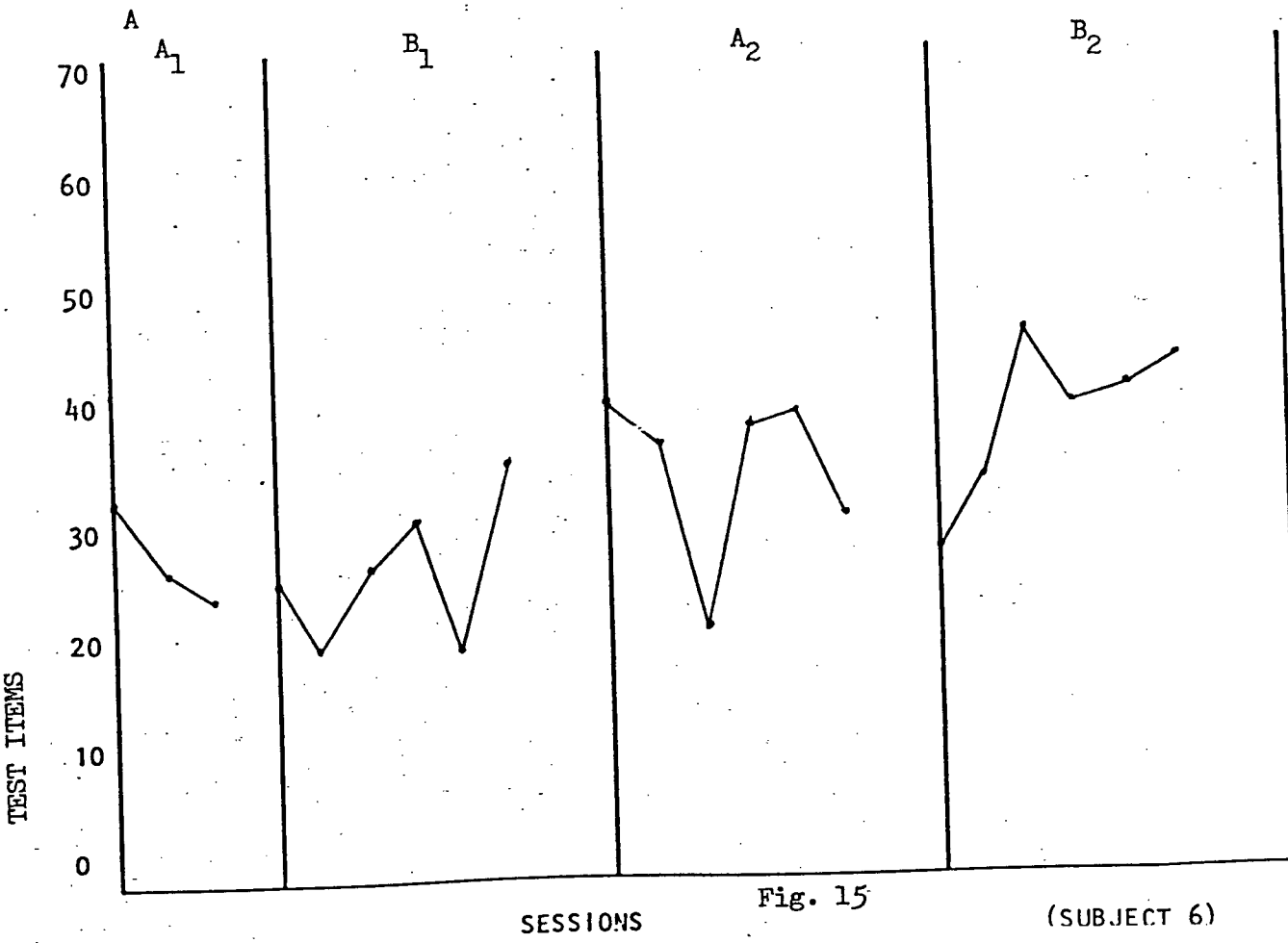

Fig. 15 (SUBJECT 6)

From the discussion of the results and extraneous factors which may have affected student performance it is clear that some students may not have been appropriate subjects. For example, subjects 1, 2 and 5 presented a more clear representation of the effects of the treatment program. They could be considered model students because no severe psychological encumbrances affected their performance.

It was interesting to note that during administration of the auditory discrimination task many children found it difficult to think of words for objects that could be described by the adjectives presented. These particular children seemingly understood the words but could not apply the concept. Admittedly, the process is the reverse of the usual order of the adjective-noun; however, it seemed unusually difficult for these children.

Summary of Combined Groups

Statistical analysis for the control group revealed the following overall pattern of results: the data show a steady increase in word analysis skills.

Although the experimental design for the present study was single case research it is important to observe the trends in the combined groups. Tables XIII and XIV demonstrate the overall patterns and gains for the group receiving treatment.

It was hypothesized that performance on tests of word analysis skills would show greater improvement for the group of subjects receiving a treatment program aimed at improving the appropriate use of successive

processing strategies. Variability in the data collected for each phase of the study is evaluated relative to changes in slope from one phase of the experiment to another. The significant positive correlations found (Table XIII and XIV) support the hypothesis.

Analysis of the data reveals the following trends. Statistical analysis of the data collected on the experimental group revealed different patterns from the data collected on the control group. Analysis of the data collected for the control group indicates no significant increase in word analysis skills between baseline scores and the scores collected during the first phase involving extra reading instruction. For subject 4 there was a significant increase in scores of word analysis tests between the first treatment phase and the second no-treatment phase. Between the two treatment phases A_2 and B_2 there is a significant increase in scores for subject 3. Analysis of scores of word analysis skills indicates a significant increase for subjects 2 and 3 between the first baseline phase and the final treatment phase. For the experimental group the analysis of data collected for first baseline scores and the first treatment phase indicates a significant increase for subject 1, 2 and 5. Analysis of the data collected for subject 1 and 2 indicates a significant increase between the first treatment phase and the second no-treatment phase. Between the two treatment phases A_2 and B_2 there is a significant increase in scores for 2 and 3. Analysis of scores of word analysis skills indicates a significant increase for subjects 2, 4 and 5 between the first baseline phase and the final treatment phase.

Analysis reveals a plateau within the no-treatment phases A_1 and A_2 and an increase in scores for the treatment phases for the experimental group. This trend would indicate that the treatment program accounts for gains in scores of word analysis skills. This trend is not as obvious for the control group. Visual inspection of the graphs of the results and the greater overall increases in scores for the treatment group support the hypothesis of the present study.

Discussion

The strength of the evidence from the present study is based on the attributes of the sample cases and the attributes of the treatment. First, there is a wide range of attributes across the 12 sample cases. We can identify common attributes between the sample and other learning disabled children. For example, subjects 1 and 2 were considered to be more typical of learning disabled children in that their learning problems were not a result of severe emotional problems and home upsets.

Analysis of the data collected from the present study led to the following conclusions:

a) the hypothesized outcome of the treatment, i.e. to improve the use of appropriate strategies, occurred on a subset of students receiving treatment and whose problems were not related to emotional problems and family upsets.

b) the treatment program may have been more effective had it continued for a longer period of time. Children with learning problems often

require treatment over an extended period of time to improve their learning behavior.

In this particular study it would not be realistic to expect regression within the B_1 phase in which the treatment program is withdrawn. Instead, we would expect more of a plateau in the data. The reason being that the treatment is aimed at producing an effect on a behavior, that is a learning strategy. It is not expected that once learned the change in behavior would no longer exist if the treatment program were withdrawn. Therefore, it is more realistic to expect a plateau in the data for the B_1 phase and not a return to baseline. This would be the case in any behavioral orientated experiment involving remedial programs.

TABLE XIII

C Scores

	Control Group						Experimental Group					
	S_I	S_2	S_3	S_4	S_5	S_6	S_1	S_2	S_3	S_4	S_5	S_6
A_1	.25	.50	-.46	-.34	-.50	.25	.02	.16	-.21	.07	.25	.41
A_1B_1	.35	.52	-.06	.49	.38	.47	.68	.64	-.02	.48	.67	-.06
A_2B_1	.13	.09	.15	.55	.21	.04	.52	.72	-.31	-.17	.13	.20
A_2B_2	.13	.28	.53	.21			.40	.70	.64	.20	.43	.04
A_1B_2	.52	.81	.72	.41			.31	.85	.49	.78	.85	.36

TABLE XIV

Z Scores

	Control Group						Experimental Group					
	S_1	S_2	S_3	S_4	S_5	S_6	S_1	S_2	S_3	S_4	S_5	S_6
A_1	.71	1.41	-1.31	-.97	-1.41	.71	.06	.44	-.60	.20	.71	1.15
A_1B_1	1.20	*1.76	-.20	*1.66	1.30	1.61	*2.31	*2.18	-.06	*1.63	*2.27	-.20
A_2B_1	.49	.36	.58	*2.12	.82	.16	*1.99	*2.77	-1.20	-.66	.49	.78
A_2B_2	.51	1.07	*2.02	.82			1.52	*2.70	*2.43	.77	*1.65	.14
A_1B_2	*1.78	*2.96	*2.45	1.39			*1.75	*2.87	*1.67	*2.63	*2.87	*1.91

* $p < .05$

CHAPTER 6

CONCLUSIONS

Discussion

The purpose of the present study was to investigate the potential of a strategy training program aimed at improving the use of successive processing strategies to improve word analysis skills for a class of learning disabled children. The aim was to learn more about the process of reading through learning more about the underlying processes associated with reading ability.

The present study adopts the simultaneous-successive model of information processes. Research (Das, 1980) indicates that learning disabled children have different patterns of abilities involving the differential use of successive and simultaneous strategies. For this group of children successive processing skills are also poorly diferentiated from their simultaneous processing strategies (Krywaniuk, 1974). As a result, successive strategies are often used inappropriately.

Reading requires successive processing of the material presented even though the concept being read is of a simultaneous nature. Successive processing is particularly important for children who have difficulty in reading. Successive processing is coding of disparate stimuli in a temporal array, imposing an order or sequence. A child with poor successive processing strategies will be unable to integrate input into its sequential order. This effects the child's ability to decode words easily.

Thus, the treatment program selected for use in this study was one that encouraged the appropriate use of successive processing strategies. The tasks did not relate directly to any academic area of school learning.

12 students, all members of a class for learning disabled children, participated in the study. Students were divided into two groups: one group received the treatment program, the other group received additional reading instruction for the same amount of time each day. Single subject research strategies was selected as the appropriate method of study. Performance on tests of word analysis skills was evaluated on an individual basis for each subject of the study every week for the duration of the study. Statistical analysis was conducted on the results for each of the four phases. Data for each student was also displayed on a graph for visual inspection.

The analysis of scores for the treatment and no-treatment group were recorded on a table so that the two groups could be compared. For the majority of students in the treatment group scores were significantly greater at the .05 level. The correlations reflect the fact that students who participated in the treatment program performed better on tests of word analysis skills than did the no-treatment group receiving extra reading instruction. These findings lent support to the research hypothesis of this study.

It was hypothesized that for a class of learning disabled children, performance on tests of word analysis skills would show greater improvement for the treatment group than for the group receiving additional reading

instruction. An analysis of the results of the tests supported this hypothesis.

Results of this study are congruent with the Kaufman (1978) and Krywaniuk (1974) study wherein a treatment program aimed at improving the use of successive processing strategies was successful.

Successive processing is critical for the acquisition of reading; especially for word analysis where the task demands require the student to process information in a specific serial order for correct completion.

The usefulness of a strategy training approach has been challenged by investigators. Mann (1979) questions the premise that instruction in cognitive processing leads to an improvement in academic learning. However, Terner (1976) states that the concept of cognitive processing is a cornerstone of the field of learning disabilities. The present study confirms the usefulness of this approach to provide a framework for remedial teaching.

Based on the results of this study a remedial program aimed at encouraging the use of successive processing strategies can improve reading skills.

Limitations of the Study

This study is designed with some variations to replicate Krywaniuk's (1974) study, the main difference being that the subjects are learning disabled children rather than native children. Krywaniuk's study did not provide information on the possible effects of the remedial program aimed at encouraging the use of successive processing on academic areas

of the child's learning. The present study investigates this issue by measuring reading performance, specifically word analysis, which is taught at the same time as a regular reading program.

A limitation of the study is that there was no latitude in the selection of students. The subjects are students in a class for children with learning disabilities. Of the original class of thirteen students, twelve were involved in the study. One child was not selected because of his severe emotional problems. Unfortunately, there was no control for other extraneous circumstances which may have affected the performance of the remaining subjects. Within this particular class, a large number of children also have less severe social and emotional problems which inevitably affect performance. In a discussion of the results of this study, factors which may have influenced each subjects' performance are presented. (see chapter 5)

Factors which have the potential to jeopardize the validity of the results of this study relate to internal and external validity. Campbell and Stanley (1963) summarize the distinction between both. Internal validity is the basic minimum without which any experiment is uninterpretable: Did in fact the experimental treatments make a difference in this specific experimental instance? External validity asks the question of generalizability: To what populations, settings, treatment variables, and measurement variables can this effect be generalized? (p.5).

Two extraneous variables relevant to the internal validity of this study are: maturation and testing. Maturation refers to processes within

the respondents operating as a function of the passage of time. Testing refers to the effects that taking a test will have on the scores of a second testing. However, maturation and testing are controlled in that they would affect the experimental and control groups equally. In addition, for the most part the individual administering the test was not aware of which students were receiving the treatment program and which students were receiving the additional reading instruction. Also, randomization of placement of students in either the control or experimental group helped to validate the results.

The four phase single research design rules out all threats to internal validity. The four phase design deals with internal validity in the following manner. First, the $A_1B_1A_2B_2$ design has the potential to indicate reliable control of the dependent variable by the independent variable. Briefly, A_1 involves measurement of the dependent variable (word analysis skills) over time, B_1, application of the independent variable (treatment program), A_2 and B_2 withdrawal of treatment and reapplication of the experimental variables. The reliability of the experimental variable is assumed established if behavior changes upon application of the experimental variable. Each successful replication of the experiment increases the reliability.

With regard to the effectiveness of the program for learning disabled children there are factors to be considered. The program could be used successfully on the particular child with learning problems that are primarily the result of learning disabilities. However, some students have unique attributes which may be relevant. These factors will have

to be considered before the program can be used appropriately.

In these ways factors jeopardizing external validity will be accounted for.

Implications for future research

Several possibilities for future research in the area of strategy differences in individuals with reading problems and the remediation and training of these strategies stem from this study.

It has been suggested that individuals with reading disabilities differ in the manner in which they process information. This variation in the selection of strategies should be researched further to confirm which strategies are involved with specific reading problems. This could be achieved through an investigation of the relationship between tests used to assess the cognitive functioning of the individual and his reading profile. In this way we could identify reading skills at a more specific level (e.g. vocabulary, inferencing, comprehension) which are influenced by different processing strategies.

Transfer is a key issue in studies of educational intervention. We have not provided data on the degree of generalization to other aspects of the child's behavior in school. It would be beneficial to determine what other academic and perhaps even social areas were influenced by a remedial program aimed at improving the use of appropriate strategies.

The question of the stability of the effects of remediation and training over time is also relevant. The investigation of both immediate and long term effects on a child's behavior following a treatment program is needed.

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