THE EFFECT OF SIMULTANEOUS AND SUCCESSIVE WORD PROCESSING STRATEGIES ON THE READING RECOGNITION, SPELLING, AND SUCCESSIVE COGNITIVE PROCESSING OF ELEMENTARY SCHOOL LEARNING DISABLED STUDENTS DEFICIENT IN SUCCESSIVE COGNITIVE PROCESSING

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PREFACE

This study is concerned with the application of simultaneous-successive cognitive processing theory to the classroom setting. Because of current confusion in the field of learning disabilities, this study is limited to children who are currently receiving help from a learning disability resource room. It is the hope of this author, that the study will indicate some beneficial areas of future instructional practice and research in the area of working with children with learning problems. It is hoped that future instructional practice in the teaching of academic subjects will consider more closely the ways in which children process information as a basis for instructional practice. It is also hoped that future research will develop studies which consider information processing theory in such a way that any consequent findings will have direct implications for instructional organization.

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CHAPTER I

THE RESEARCH PROBLEM

Introduction

One of the basic problems in educational psychology consultation is the identification of theoretical structures which can provide a framework for making practical suggestions to the classroom teacher. Without a meaningful theoretical structure, one can find that any ensuing recommendations become haphazard and meaningless, with limited potential for any follow-up which can determine the effectiveness of the recommendations.

The field of learning disabilities poses one of the greatest challenges to the educational psychologist. It appears that the only consistency in the field of learning disabilities has been the lack of consistency of any widely accepted theoretical structures. This situation has led some authors to admit there is a current state of confusion and demand that there be less confusion and more clarity (Gomez, 1967; Orlando and Lynch, 1974). Also, the current state of confusion has often made educational programming ill-founded and without a clear direction. This situation has also caused some authors (Orlando and Lynch, 1974; Glenn 1975; Hammill, 1976) to critically examine the current "state of the art" of learning disabilities diagnosis and remediation. Their conclusions and the questions they have raised further reflect the current ambiguities which exist in learning disabilities diagnosis and remediation.

The passage of the Education of the Handicapped Act (Public Law 94-142, 1975) firmly established learning disabilities as a handicapping condition and thus as a part of special education. However, the regulations for the implementation of Part B of the Education of the Handicapped Act (U.S. Office of Education, August 23, 1977) have done little to clear up confusion concerning the nature of learning disabilities. The definition of learning disabilities was stated as follows:

> Specific learning disability means a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations. The term includes such conditions as perceptual handicaps, brain injury, minimal brain disfunction, dyslexia, and developmental aphasia. The term does not include children who have learning problems which are primarily the result of visual, hearing, or motor handicaps, or mental retardation, or of environmental, cultural, or economic disadvantage (p. 42478).

It is rather evident that the preceding definition does little to clarify the nature of learning disabilities. Rather, the definition reflects the myriad theories of the nature of learning disabilities.

In an attempt to clarify the preceding definition, the U.S. Office of Education conducted public hearings in Washington, San Francisco, Denver, Chicago, and Boston in order to obtain input concerning the nature of learning disabilities. As a result of these hearings, some major changes were made in the procedures for evaluating learning disabilities (U.S. Office of Education, December 29, 1977). However, the report stated that although there was dissatisfaction with current definitions, no satisfactory alternatives were found. The resulting regulations became a definition by exclusion and defined what did not constitute learning disabilities. However, the report was still deficient in defining what <u>did</u> constitute the nature of learning disabilities. According to the report, if the child exhibits a severe discrepancy between expected and actual achievement in one of seven academic areas and does not belong in any of several categories (e.g., visually impaired), then the child is learning disabled. Ultimately, the eligibility team is the definer of learning disabled. In essence, P.L. 94-142 is a funding bill rather than a definitive classification bill.

The current confusion in the field of learning disabilities has not seemed to impede the growth and popularity of the concept. Coles (1978) conducted an extensive review of the validation studies of ten of the most widely used procedures for diagnosing learning disabilities. Coles found a frequent lack of an empirical base for the studies and frequent disagreement concerning the validity of the tests. Coles concluded that educators have often attempted to ally themselves with the medical profession in order to provide pseudo-scientific bases for learning problems which are frequently a result of the failure of the educational institution to provide adequate educational programs. Although somewhat cynical, this viewpoint would partially explain the current popularity and growth of learning disability programs.

Statement of the Problem

The preceding discussion briefly described the current ambiguities and confusions which exist in the field of learning disabilities. One major problem is in identifying a theoretical structure which has been derived from extensive work in the area of neurological and brain process functioning. This approach would be different from one which started from a theoretical construct, such as the psycholinguistic model, and then proceeded to determine if the construct actually existed. Having identified a structure which has sound bases in extensive neurological research, the next problem would be to identify teaching strategies, based upon the theory, which can improve either academic functioning or deficient processes by the theory. The final problem would be to determine whether the teaching strategies had a positive effect on the student's cognitive processes and/or academic achievement.

Purpose of the Study

One theory of cognitive processing, which has been derived from extensive neurological and brain research, is the theory of simultaneous and successive cognitive processes (Das, Kirby, and Jarman, 1979). The purposes of this study were to identify learning disabled students who were deficient in successive cognitive processing, implement teaching strategies which are designed to teach either simultaneous or successive word processing, and then to evaluate the effects of the teaching strategies on the student's functioning in reading recognition, spelling, and successive processing.

Background and Value of the Study

The recent emergence of simultaneous-successive cognitive processing theory has stimulated a variety of research studies, most of which have been conducted in Canada (Das, Kirby, and Jarman, 1975; Das, Kirby, and Jarman, 1979). However, it is also receiving attention by various educational psychologists in the United States (Naglieri, Kamphaus, and Kaufmann, 1980). Simultaneous-successive processing theory has been demonstrated to have various implications for psycho-educational diagnosis and programming. Various research studies have related simultaneous processing to reading comprehension and math, and successive processing to word recognition and spelling (Sprecht, 1976; Kirby and Das, 1977; Cummins and Das, 1977; McCleod, 1978; Das and Cummins, 1978). Other research studies have indicated that selective educational programming which is based on simultaneous-successive processing theory has positive effects on students' academic achievement and processing efficiency (Krywaniuk, 1974; Kaufman, 1978). Also, a variety of related research studies have suggested that learning disabled students often have deficiences in successive cognitive processing (Senf, 1969; Meier, 1971; Eakin and Douglas, 1971; Krywaniuk, 1974; Leton, 1974; Wirtenberg and Faw, 1975; Richie and Aten, 1976; Badian, 1977).

School psychologists are often placed in the position of evaluating students for placement in learning disabilities programs, when there are no clear guidelines to follow. Educational prescriptions are often made with little theoretical basis and with little information concerning their effectiveness. It would be of considerable value to the school psychologist to have a valid theoretical basis for the identification of processing deficiencies. It would also be valuable to identify a method for determining deficiencies in successive cognitive processing, which at the same time has positive implications for making recommendations concerning educational programming for word recognition and spelling. Such a study would also be of great value to the learning disabilities teacher in selecting and organizing educational materials according to a specific theoretical structure.

Assumptions

This study involved various assumptions. As such, they affected the direction and logical progression of the study. These assumptions included the following:

1. Deficiencies in either simultaneous or successive cognitive processing can be identified by selected psychological tasks.
2. Random assignment of students to teaching strategies will randomly distribute all confounding variables related to the internal characteristics of the students.
3. Pretesting and posttesting will demonstrate whether any changes have occurred as a result of the teaching strategies.

Limitations

This study had various limitations which may be listed as follows:

1. The study involved only elementary school children and, therefore, generalizability is limited to similar groups of children. Also, since the study involves only Vinita children, there is limited generalizability to children in other towns.
2. The study was conducted over a period of weeks and thus is not representative of changes which might occur over a period of months or years.
3. The psychological tasks were used for identifying deficient successive processing, so the study cannot be generalized to deficiencies in simultaneous processing.

4. The teaching strategies were especifically designed for this study. The conclusions of success or failure of the teaching strategies apply only to the materials which are used. Generalizing conclusions to other types of materials can only be a very tentative process.

Definitions

"Simultaneous processing" is the cognitive process whereby separate elements are synthesized into groups, many of which have spatial overtones. The fundamental characteristic of simultaneous processing is that any portion of the result is surveyable without dependence upon its position in the whole (Das, Kirby, and Jarman, 1975).

"Successive processing" is the processing of information in a serial order. The fundamental characteristic of successive processing is that the system is not totally surveyable at any point in time (Das, Kirby, and Jarman, 1975).

"Learning disabled student" is operationally defined in this study as a student who has on file an Individualized Education Plan and is receiving help from a learning disability resource room.

"Individualized Education Plan" is the written educational management document which specifies the child's educational program in compliance with P.L. 94-142.

"Learning Disability Resource Room" is a classroom designed to give the learning disabled student up to two hours of remediation help per day.

"Teaching Strategy" is an organized program of instruction which is applied in a systematic manner to the child.

CHAPTER II

REVIEW OF RELATED LITERATURE

Historical Perspective

Historical Roots

Sechenov (1878) originated the concepts of simultaneous and successive cognitive processes as the two principal forms in which external influences may act on our senses. Sechenov noted that the synthesis of stimuli into simultaneous groups is primarily associated with the visual, kinetic, and vestibular apparatuses and is responsible for the orientation of the body in space. He also noted that the synthesis of stimuli into successive units is primarily associated with the motor system and the acoustic sphere (Luria, 1973b, p. 79).

However, little attention was drawn to Sechenov's concepts until Immanuel Kant suggested that the spatial and temporal organization is extrinsic to sensory data and is something the mind imposes on stimuli. Kant further suggested that simultaneous ordering is related to understanding figures and their relations and successive ordering is present when events and objects are ordered one after the other (Das, Kirby, and Jarman, 1979, p. 47).

Later, Lashley (1951, p. 114) pointed out that temporal, serial organization of processes are a basic part of the frontal and fronto-temporal parts of the brain (Luria, 1973, p. 103). Furthermore, serial organization of processes is determined by a generalized, central, integrative process which is largely independent of the events which are ordered (Das, Kirby, and Jarman, 1979, p. 47).

In other developments, Hughlings Jackson, in the late 1860's, pioneered work on brain lesion research and pointed out that lesions of a circumscribed area of the brain never lead to a complete loss of function (Luria, 1966a, p. 17). Also, Pavlov re-examined the concept of brain functions and the principles of localization of functions (Luria, 1966a, p. 23). The work of these men, along with Vygotski and others, formed the basis of the later work of Luria (Luria, 1966a, pp. 30-38).

Luria's Organization of the Brain

The research of A. R. Luria is based upon the derivation of localization of functions in the brain by observing a lesion in a specific part of the brain and correlating it with observed behavioral abnormalities. Based on his brain lesion research, Luria proposed a three-block functional organization of the brain (Luria, 1970).

The first block of the brain consists of the brain stem, the diencephalon, and the medial regions of the cortex. The first block regulates the energy level and tone of the cortex, or waking and mental states, and provides the brain with a stable basis for the organization of its processes (Luria, 1970; Luria, 1973b, pp. 44-67).

The second block of the brain is located in the lateral regions of the neocortex on the convex surface of the hemispheres, in the posterior regions, including the visual (occipital), auditory (temporal), and general sensory (parietal) regions (Luria, 1973b, p. 67). This block of the brain is involved in the analysis, coding, and storage of information related to optic, acoustic, cutaneous, and kinesthetic stimuli (Luria, 1970). The third block of the brain is located in the frontal lobes and is involved with programming, regulating, and verifying mental activity (Luria, 1970).

The three blocks, or units, of the brain represent a hierarchical arrangement for the arousal, coding and analysis, and planning functions. Each of the units, itself, is also hierachical in structure and consists of at least three zones. The primary, or projection, area receives impulses from and sends impulses to the periphery. The secondary, or projection-association, area processes incoming information and prepares programs. The tertiary, or overlapping zone, area involves the most complex forms of mental activity which require the participation of many cortical areas (Luria, 1973b, p. 43).

Of particular interest in Luria's organization of the brain are the two forms of synthetic activity which occur in the second block of the brain. The first form is the synthesis of separate elements into simultaneous, and primarily spatial groups. The second form is successive synthesis which is the integration of external stimuli into successive series, distinguishable in time. As a result of simultaneous synthesis, successive elements are integrated into simultaneous groups and become surveyable at one point in time. Successive syntheses do not have the property of surveyability at one point in time. Rather each link which is integrated into a series can evoke only a particular chain of successive links which follow each other in serial order. Each form of synthesis has three levels. The perceptual level is involved with direct perception, the mnestic level is involved with the recall and organization of traces of previous experience, and the intellectual level is involved with the performance of complex intellectual operations (Luria, 1966b, pp. 73-127). Luria's functional organization of the brain, especially in respect to the second block, has helped stimulate further studies. Pribram (1958), Lashley (1960), and McFarlane-Smith (1964) have also conducted research on the localization of the functions of the brain. Although they also subscribe to the existence of parallel (simultaneous) and serial (successive) processes, there is a lack of agreement on the actual localization of these synthetic cortical processes. Luria's research has also led to further work concerning cognitive information processing models.

Simultaneous-Successive Processing Model

Structure of the Model

Based on Luria's model, Das, Kirby, and Jarman (1975) proposed a model of information integration which has four units consisting of the input, the sensory register, the central processing, and the output. External input can be through visual, auditory, tactile, olfactory, gustatory, kinesthetic, or interoceptive receptors. The method of presentation can be either simultaneous or successive. The stimulus information then goes to the sensory register which acts as a buffer and then "reads out" information serially to the central processing unit. The external input and sensory register involve Luria's first block of the brain (Das, Kirby, and Jarman, 1975).

The central processing unit involves the second and third blocks of Luria's organization of the brain and has three major components. The first two components are involved with processing separate information into simultaneous groups and with processing discrete information into temporally organized successive series, respectively. The essential nature of simultaneous processing is that any part of the result is surveyable at one point in time without dependence upon its position in the whole. The essential nature of successive processing is that the complete system is not totally surveyable at any point in time. Instead, a system of cues consecutively activates each aspect. These two components are equivalent to Luria's second block of the brain, and either component can be one of three varieties consisting of direct perception, mnestic processes, and complex intellectual processes. The third component is the decision-making and planning component which corresponds to Luria's third block of the brain. The processing in these three components is not affected by modality since either visual or auditory information can be processed either simultaneously or successively. The use of either one or both modes of processing depends on the habitual mode of processing information as determined by socio-cultural and genetic factors and by the demands of a specific task (Das, Kirby, and Jarman, 1975).

The fourth unit consists of the output which can involve either simultaneous or successive processing in all forms of responding. Thus, output behavior does not depend either on the manner in which the information was coded or on the verbal or motor aspects of the output behavior itself, but rather determines and organizes output performance in accordance with the specific requirements of the task (Das, Kirby, and Jarman, 1975).

Validation Studies

A variety of studies have been conducted to explore various aspects of simultaneous and successive cognitive processes. The major method used has been confirmatory rather than exploratory factor analysis (Das, Kirby, and Jarman, 1975). The most commonly used tests of a simultaneous processing factor have been: Raven's Coloured Progressive Matrices (Ravens, 1956), Figure Copying (Ilg and Ames, 1964), and Memory-for-Designs (Graham and Kendall, 1960). These tests require the construction of a spatial pattern or scheme and thus fulfill the requirements of a test of simultaneous processing (Das, Kirby, and Jarman, 1979, pp. 52, 209-213). Other tests which have sometimes been used as measures of simultaneous processing have been: Visualization (Cummins, 1973), Paradigmatic Verbal Clustering (Das, Kirby, and Jarman, 1975), and Concrete Paired Associates (Cummins, 1973). Kirby and Das (1977) also demonstrated that traditional tests of spatial ability correlate highly with simultaneous processing.

The most commonly used tests of a successive processing factor have been Digit Span, Visual Short-Term Memory, and Serial Recall. Although the tests are essentially memory tests, the factor they define is not, in essence, a memory factory but rather involves the requirement of maintaining a temporal sequence (Das, Kirby, and Jarman, 1975; Kirby and Das, 1978a) Das, Kirby, and Jarman, 1979, pp. 53, 213-216.

A third factor, speed, has also emerged in some of the factor analytic studies. This factor has emerged when using Stroop's Color Naming and Word Naming tests (Stroop, 1935; Das, 1973; Jarman and Krywaniuk, 1978; Das, Kirby, and Jarman, 1979, pp. 53, 54, 216-218).

However, a methodological problem arises when considering the use of these tests in research. None of the tests, except for Raven's Progressive Matrices, have suitable normative data which can be converted to standard scores. Most of the tests are experimental in nature and give information in the form of raw scores. This fact limits the target research group to one age or grade level. However, a variety of confirmatory factor analytic studies have been conducted to demonstrate the relationship of simultaneous and successive cognitive processing with language, grade level, modality, school achievement, intellectual level, learning disability, and culture and socioeconomic status.

Relation to Language. Luria (1975, p. 68), on the basis of his studies, divided grammatical constructions into contextual grammatical structures, which link together the elements of a statement into a concrete whole, and the communication of relationships. Successive synthesis underlies the processing of contextual grammatical structures and simultaneous synthesis underlies the communication of relationships. Simultaneous synthesis is also related to the comprehension of logical grammatical structure and to converting concrete perception into abstract thinking (Das, Kirby, and Jarman, 1979, p. 39).

Cummins and Das (1978) conducted a study with 60 grade three children in which they predicted significant relationships between successive processing and performance on linguistic tasks which require the analysis of the sequential linear structure of the input (i.e., syntactically mature expressive speech). They also predicted that the grasping of quasi-spatial conceptual relationships required simultaneous processing. The study supported their contentions and pointed to a wider implication that processing rather than abilities should be the basis for the interpretation of cognitive functioning.

Relation to Grade Level. Das and Molloy (1975) conducted a study on 60 grade one and 60 grade four boys with IQ in the dull normal range. They obtained factor structures which were essentially the same for both grade levels and three factors which emerged were Successive, Simultaneous, and Speed. However Figure Copying, in addition to a high simultaneous loading on grade one children, had a small loading on the successive factor indicating that younger children are more likely to demonstrate some degree of strategy ambivalence.

Relation to Modality. Jarman (1978) conducted a study with 240 grade four children in three IQ categories to determine the relation of cross-modal and intramodal matching to simultaneous and successive synthesis and intellectual level. No pattern of processes was found in the factor analysis that was systematically related to sensory modalities. With increasing levels of intelligence, differential factor patterns of the four cross-modal and intramodal tests disappeared entirely.

Relation to School Achievement. A variety of studies have been conducted which related simultaneous and successive processing to various areas of academic achievement, particularly reading and math. Das (1973b) conducted a study on 9- to 11-year-old Canadian and Indian children and derived a four-factor structure consisting of simultaneous processing, successive processing, speed, and verbal-educational, indicating that the school achievement factors have more in common with each other than with the simultaneous-successive processing. Das and Molloy (1975) found the same four-factor structure with 60 grade four students. Sprecht (1976) obtained the same result in a study of 65 low-achieving high school students.

Krywaniuk (1974) found that a high-achieving group of students were superior to low-achieving students on all of the simultaneous-successive tasks, and especially the simultaneous tasks. However, the four factors of simultaneous processing, successive processing, speed, and verbal-educational still emerged for both groups. Kirby and Das (1977) also found that students who were high in both simultaneous and successive processing consistently performed best on reading achievement and students who were low in simultaneous and successive processing consistently performed worst on reading achievement.

Sprecht (1976) conducted a variety of multiple regression studies and found that mathematics achievement was best predicted by Figure Copying, then Color Naming, then Serial Recall, then Progressive Matrices. Reading achievement was best predicted by Serial Recall, then Word Reading, then Digit Span.

Cummins and Das (1977) concluded that among children who are likely to experience difficulty in reading, competence in successive processing is strongly related to the mastery of initial decoding skills. However, among normal readers, at more advanced levels of reading skills, simultaneous processing is at least, if not more, important in the reading process, and especially in comprehension in reading. Their findings also demonstrated that successive processing correlated significantly with the Wide Range Achievement Test (WRAT) oral reading and spelling subtests and simultaneous processing correlated significantly with the WRAT arithmetic.

McCleod (1978) supported previous research with the finding that reading vocabulary, comprehension, and inferencing were related to simultaneous processing. Also, children who predominantly use successive processing have difficulty with backward-looking inferences. In similar research, Das and Cummins (1978) obtained positive correlations between successive processing and oral reading and spelling scores of adolescent EMR students.

The conclusions reached by research on the relation of simultaneous-successive processing to school achievement has also been supported by other researchers. Reading disability has been found to be significantly related to the level of performance on tasks which involve sequential processing (Doehring, 1968; Kinsbourne and Warrington, 1966). Blackman and Burger (1972) and Blackman et al. (1976) reported a high relationship between sequential memory skills and the acquisition of word recognition skills among EMR children. However, they suggested that more complex cognitive variables may have a greater importance at more advanced levels of skill acquisition, such as reading comprehension. Richie and Aten (1976) found that reading disabled children have lower ability in auditory nonverbal and visual sequences than children with adequate reading ability. Badian (1977) found that reading disabled children performed poorly on auditory-visual integration and suggested the reason is due to poor auditory sequential memory rather than to poor intermodal integration ability or to poor temporal spatial transfer. Krywaniuk (1974) also found low achievers to be low in verbal-successive processing skills.

Several tentative conclusions may be drawn from these research studies. Reading disability is manifest in poor word recognition and reading comprehension skills. Word recognition and spelling are related to successive processing and reading comprehension is related to simultaneous processing, as is mathematics. Also, a reading disabled child is often not proficient in planning composition, although empirical data is lacking for the planning function (Das, Kirby, and Jarman, 1979, p. 192). Whenever expression is involved with academic achievement, it may be highly related to planning ability. Thus, the school achievement factor may also be a partial measure of planning and goal-setting behaviors (Das, Kirby, and Jarman, 1979, pp. 72, 85).

Relation to Intellectual Level. Das (1972) compared 60 nonretarded children and 60 retarded children, matched on mental age. Although the nonretarded children were superior to the retarded children, both groups had two factors which may be interpreted as simultaneous and successive processing. However, the two groups had disparate loadings on some tests which lead Das to conclude that the two groups may be using different modes of processing for the two tasks. Jarman and Das (1977) conducted a study of 60 boys, aged 9-10, in each of three verbal IQ ranges (71-90, 91-110, 111-130). The results indicated that the IQ groups were significantly different on simultaneous tests and less so on successive tests. However, there was no high degree of specialization of either simultaneous or successive processing according to the IQ group. The difference between these results and those of Das (1972) might be explained by the fact that the mean IQ of these results is 81.7 and those of Das (1972) was 67.08. However, Jarman (1978b) studied a group of 67 retarded children (mean IQ = 66.17) and found the pattern of simultaneous and successive to be the same as the nonretarded group in Das' (1972) study, even though the mean scores on the tests were lower. Jarman concluded that methodology accounted for the differences in the study by Das (1972). Another study in solving two-term syllogism problems, used 52 EMR children and found both simultaneous and successive cognitive processing (Das, Kirby, and Jarman, 1979, p. 99).

Two studies have been conducted which relate the Wechsler Intelligence Scale for Children (WISC) to simultaneous and successive cognitive processing of mentally retarded children. Das and Cummins (1978) used 52 EMR children in a study and found that simultaneous processing was negatively related to the WISC Performance IQ. The WISC Verbal IQ was related to neither form of processing strategy. Naglieri, Kamphaus, and Kaufman (1980) obtained factor loadings on the WISC-R (Wechsler, 1974) standardization sample and found that Picture Completion, Picture Arrangement, Block Design, Object Assembly, and Mazes were strongly related to simultaneous processing. Digit Span and Coding were strongly related to successive processing. However, with a group of EMR students (mean IQ = 58) Picture Completion, Block Design, Object Assembly, Coding, and Mazes were strongly related to simultaneous processing. Similarities, Digit Span, and Picture Arrangement were strongly related to successive processing. Thus, EMR students use a different mode of processing on some tasks than do nonretarded students.

A variety of related studies have been conducted which also point to pertinent information on simultaneous and successive processing. Batemen and Wetherell (1965) and Das (1972) reported that educable mentally retarded (EMR) children are characterized by deficiencies in sequential processing. Other investigators have found that the performance of EMR children on short-term memory tasks which involve sequential processing is significantly related to academic achievement (Blackman and Burger, 1972; Walker, Roodin, and Lamb, 1975; Blackman, Bilsky, Burger, and Mar, 1976).

Relation to Learning Disability. Only two studies have been conducted with learning disabled children with the specific intent of investigating simultaneous and successive cognitive processing. Leong (1974) studied 58 disabled readers (over two years below grade norms) and 58 control children. He found that the simultaneous and successive patterns in the experimental and control groups were similar but not identical. The disabled readers performed poorly in both simultaneous and successive tests. Also, there was some indication that normal children make use of a sequential scanning strategy and the disabled readers use a more global strategy (Das, Leong, and Williams, 1978; Das, Kirby, and Jarman, 1979, pp. 103-105).

Williams (1976) studied an amorphous group of 60 learning disabled students categorized by hyperactive, hypoactive, and normactive. The three groups could not be distinguished on the basis of simultaneous and successive cognitive processing. The results of the factor analyses showed the same pattern of processing in the learning disabled children as in samples of normal children in past studies. However, the learning disabled children performed poorly in one-half of the simultaneous and successive tasks and performed as well, only on a measure of speed. Williams concluded that although hyperactivity does have cognitive consequences, these consequences are not confined to any processing mode. He further postulated that cognitive processes such as planning and decision making (Luria's third block of the brain) may be sensitive to hyperactivity as an individual difference variable (Das, Leong, and Williams, 1978; Das, Kirby, and Jarman, 1979, p. 108).

A variety of studies have been conducted on learning disabled children which, although not specifically investigating simultaneous-successive processing, do have implications to the mode of processing. Bloom and Broder (1950) conducted research with college students and found that low aptitude college students do not engage in sequential construction of understanding, and rely on a guess or an impression, rather than sequentially attacking a problem. Strauss and Kephart (1955) observed that the main difficulty with the brain-injured child was spatial integration, which is the inability to see simultaneous relations. Goins (1958) and DeHirsch (1973) demonstrated that children perceive and process stimuli in two essential ways, as parts of the whole stimulus (successive?) and as a whole stimulus (simultaneous?). Senf (1969) concluded that learning disabled children consistently have difficulty in following instructional demands and in consistently ordering stimuli. Meier (1971) and Leton (1974) concluded from their studies that learning disabled children have difficulty in processing sequential information. Eakin and Douglas (1971) suggest that the disabled reader has not automatized the process skills of reading. Poorly developed automatic habits are most noticeable when the child is faced with sequential material, although comprehension may be unimpaired. Richie and Aten (1976) conducted studies comparing reading disabled children with normal readers and found that reading disabled children have poorer ability in auditory nonverbal and visual sequences. Krywaniuk (1974) found that low achievers have poor verbal successive skills. Wirtenberg and Faw (1975) concluded that the learning disabled child attacks new problems in a trial-and-error manner rather than sequentially attacking the problem. Finally, Badian (1977) concluded that the poor performance of retarded readers on auditory-visual integration tasks is due to poor temporal sequential memory rather than to poor intermodal integration ability or to poor temporal spatial transfer ability.

Relation to Culture and Socioeconomic Status. Luria (1971, p. 262) views cognitive activities as a social phenomenon in origin and as processes formed during the course of mastery of general human experiences. Thus, cognitive processes are not independent and unchanging functions but rather are processes occurring in concrete, practical activities (Das, Kirby, and Jarman, 1979, p. 118). A variety of studies have been conducted in order to determine the relation between simultaneous-successive processing and culture and socioeconomic status.

Das (1973a) studied high-caste Orissa children in India and found two rather than three factors. The first factor consisted of successive processing and speed, and the second factor consisted of simultaneous processing. Das (1973b) suggested that sequential processing may be used by certain non-white groups in tasks which usually elicit simultaneous processing in white children. Krywaniuk (1974) compared low-achieving white and native American children and found that the native American children were similar in performance in simultaneous processing but different in successive processing. The results suggested the children had not learned to use successive processes effectively due to a cultural preference for the simultaneous mode of processing. Das and Singha (1975) studied cognitive differences due to caste and class in India. They found that the urban poor Brahmin children were no different from the urban rich. However, they did find urban-rural differences. Das later concluded from further studies with aboriginal children that because of a processing preference in their culture, aboriginal children use successive processing with simultaneous tasks (Das, Kirby, and Jarman, 1979, p. 125).

Manos (1975) studied high and low socioeconomic status (SES) Canadian whites and high and low SES Canadian blacks. On school-related tasks the high SES were higher than the low SES but did not differ on simultaneous-successive processing. On only two of the five simultaneous and successive tasks did the white and black groups differ. Das, Manos, and Kanungo (1975) found that math is predicted by figure copying (simultaneous) in both low and high SES groups, but in the low SES group Serial Recall surpasses figure copying in the prediction of math. The study concluded that the low SES child is more reliant on the successive mode of processing than the high SES child. Finally, Das, Kirby, and Jarman (1979, p. 127), having reviewed the existing research on the relation of culture and SES to mode of processing, concluded that neither SES nor ethnic differences seem to be consistently related to simulanteous-successive processing.

Comparisons with Other Models

As one studies the literature on simultaneous-successive processing, an inevitable consideration is whether simultaneous-successive processing theory is the same as another theory of a different name and whether there is some overlap between simultaneous-successive processing theory and other theories. Simultaneous-successive processing theory can be compared and contrasted with three categories of models which are most relevant to this study: Hierarchical cognitive abilities, Cognitive styles, and Hemispheric assymetry.

Hierarchical Cognitive Abilities

Vernon (1969), Burt (1972), and many other British psychologists have advocated a general hierarchical bond between all cognitive abilities. In this hierarchy, reasoning and abstraction are always given the top rank while memory occupies a lower rank. Jensen (1970) also advocated a hierarchical model when he proposed two levels of cognitive abilities. Level I consists of associative learning or rote memory and Level II consists of reasoning or abstraction. The issue which arises is whether successive processing is similar to associative learning or memory and whether simultaneous processing is similar to reasoning and abstraction. Das (1973b) obtained a four-factor structure which consisted of simultaneous processing, successive processing, speed, and a school achievement factor which was similar to Vernon's (1969) verbal-educational factor. Das concluded that simultaneous and successive processing modes were alternatives to reasoning and memory and that intelligence was not marked by a preference to either mode except where cultural or individual preference exists for the use of a specific mode. Kirby (1976) and Kirby and Das (1978a) conducted studies to assess the relationship among simultaneous and successive processing and traditional abilities as measured by the Primary Mental Abilities test battery. They found that simultaneous processing was far more related to spatial ability than to reasoning. Furthermore, simultaneous processing was no more related to reasoning than it was to memory and both simultaneous and successive processing were equally and significantly related to memory. They concluded that simultaneous and successive processing could not be identified with reasoning and memory, respectively. Das, Kirby, and Jarman (1979, p. 139) and Jarman (1978) after reviewing the literature on simultaneous-successive processing conclude that there is little overlap between simultaneous-successive processing theory and Jensen's Level I and Level II abilities since both simultaneous and successive processing are means of coding and both forms of processing occur in simple and complex cognitive tasks.

However, Vernon, Ryba, and Lang (1978) reviewed the literature on simultaneous-successive processing and made several criticisms of the existing research. They find it implausible that there could be complexity levels within the processing modes but not between them since simultaneous synthesis is, by logical implication, more related to higher-order cognitive abilities than is successive recall of stimuli, which requires little or no transformation, reorganization, or manipulation of sensory input. However, Vernon, Ryba, and Lang do not address the issue of successive synthesis being apparent in such tasks as the WISC-R Picture Arrangement which is a higher order non-memory task. They also criticized the use of Serial Recall and Word Learning to measure successive processing since the two tests were so similar. However, later research has used other tests which have also established successive processing as a distinct factor.

Cognitive Styles

No research has yet been conducted to compare and contrast cognitive styles and simultaneous-successive processing. However, Das, Kirby, and Jarman (1979) make some pertinent suggestions. When compared with field dependent-field independent cognitive style (Witkin, Moore, Goodenough, and Cox, 1977), it is anticipated that simultaneous processing would be manifested in tests of field independence in the same way it is related to tests of spatial ability (Das, Kirby, and Jarman, 1979, pp. 140-141). In a comparison with serialism-holism cognitive style theory (Pask, 1975), serialists are probably high in successive processing ability and holists are high in simultaneous processing ability (Das, Kirby, and Jarman, 1979, p. 142). Reflection-impulsivity cognitive style (Kagan, Rosman, Day, Albert, and Phillips, 1964) does not seem to be related to simultaneous-successive processing but rather to Luria's blocks three and one of the brain, respectively (Das, Kirby, and Jarman, 1979, p. 143).

Hemispheric Assymetry

Recent studies (Cohen, 1973; Nebes, 1974, Sememes, 1968) have suggested processing differences between brain hemispheres with the left hemisphere specializing in serial (successive?) processing and the right specializing in parallel (simultaneous?) processing. However, Luria's model is a back to front distinction. Nebes (1974) reviewed existing split-brain research and concluded that the type of information processing which is required to solve the problem determines which hemisphere is dominant for a particular task. Das, Kirby, and Jarman (1979, pp. 148-150) conclude that the crucial difference between the laterality model and Luria's model is that the former is code content (verbal, etc.) specific while Luria's model is not. Simultaneous-successive processing can be applied to codes of all sorts, although particular forms of coding may be more regularly applied to certain types of information. It is also possible that the temporal-parietal-occipital area of the right hemisphere is more parallel then the corresponding area of the left hemisphere and the fronto-temporal area of the left hemisphere is more serial than that of the right.

Das, Kirby, and Jarman (1979, p. 153) after having reviewed a variety of theories conclude that coding is multidimensional, input is analyzed on a number of dimensions, and this analysis cannot be adequately summarized dichotomously, since codes themselves are recoded and processed. The planning function (Luria's block three) is important to any theory and all three blocks of Luria's model are highly interdependent.

Teaching Strategies

Das, Kirby, and Jarman (1979, pp. 86-87) suggest that there are three approaches to remediation. The first approach consists of improving process and if improved reading is the eventual goal, even a process-oriented approach must use reading-based materials. The second approach consists of designing educational programs which make use of the processing strengths of the student. The third approach consists of teaching the student to employ the optimal process which is necessary in a task. This approach assumes that there is no processing deficit, but rather a strategy weakness. The third approach is probably the simplest and most effective to implement.

Das, Kirby, and Jarman (1979, p. 159) also identify two major difficulties which the low-achieving child has. The low-achieving child does not organize material and may not see the necessity of doing so. Also, the child does not use whatever verbal-successive skills he/she has in solving a problem.

Only two studies have been conducted which consider remediation and simultaneous-successive processing. Krywaniuk (1974) used Canadian native Cree children in grades three and four in a school in a Reserve. The tasks in the intervention program consisted of six types of tasks related to successive processing. One group received 14 hours of training and the other group received three hours of training. Group one showed significant gains on the Schonell, Serial Learning and Visual Short-Term Memory tests demonstrating that there was success in the training of successive processing strategies (Krywaniuk and Das, 1976).

Kaufman (1978) conducted a study with 68 grade four children categorized into 34 average and 34 below-average children. The intervention group received 10 hours of training which involved 10 types of tasks. The non-intervention group received the regular classroom program. The intervention procedure had a significant positive effect on all of the successive tests and all but one of the simultaneous tests. This study would also indicate that strategies can be taught (Kaufman and Kaufman, 1979). However, these two studies (i.e., Krywaniuk, 1974; Kaufman, 1978) used the first of the three previously explained approaches to remediation, and neither used words or simulated words in the intervention tasks.

A variety of other studies relate to the general area of teaching strategies. Bakker (1967) found supportive evidence in his work with reading disabled children which indicated that learning problems can be caused by individual inabilities or delays in switching strategies. Klausmeier and Meinke (1968) concluded that individuals process information according to some systematic plan and optimal performance is facilitated when a strategy is provided. Dornbush and Basow (1970) indicated that sequential or successive presentation facilitates auditory recall, and simultaneous presentation facilitates visual recall.

Farnham-Diggory (1970) found that simultaneous and successive strategies can be used alternatively. Williams and Ackerman (1971) concluded that distinctive letters can be learned when introduced simultaneously, but highly similar letters must be introduced successively for optimal learning. Byran (1972) indicated that the use of mediational strategies are necessary for mastering auditory and visual sequencing and that learning disability may be related to inadequate mediational strategies. Along similar lines, Sabatino and Hayden (1970) suggest that information processing behaviors offer the potential for a systematic method of relating prescriptive teaching inputs to specific strengths and weaknesses. D'Annunzio and Steg (1974) emphasized the importance of knowing a child's learning strategies by noting a child's response to a presented stimulus in order to draw inferences regarding the child's operational strengths and weaknesses.

Torgeson (1977) concluded that a learning disabled child is an inactive learner who has no efficient learning strategies and no awareness of the need to develop efficient learning strategies. He further suggests that the modification or development of processing should be an effective remedial technique. This concept is similar to that of many other authors who contend that teaching the individual how to learn is as important as the content being presented, but it is often neglected in formal education (Meeker, 1964; Riegel, Taylor, and Danner, 1973; Brown and Barclay, 1976).

Summary

Das, Kirby, and Jarman (1975, 1979) have proposed a model of information integration which is based upon the work of Luria. The model proposes, along with other concepts, that the brain codes information either simultaneously or successively. Simultaneous and successive processing have been demonstrated to be related to different aspects of language functioning. Simultaneous and successive processing have been found to be present at different grade levels and in different modalities. Simultaneous and successive processing are differentially related to different aspects of school achievement but both types of processing are found in both high- and low-achieving students, although low-achieving students tend to perform at a lower level on both types of processing tasks than high-achieving students. Both simultaneous and successive processing are found at different intellectual levels. Simultaneous and successive processing are also present in the "learning disabled" population although learning disabled children often have not learned to effectively use successive processing strategies. Finally, both simultaneous and successive processing have been found in different cultural groups and socioeconomic status levels. However, different cultures may have a preferred mode of processing strategy which can differentially affect the mode of processing which is used for a specific task.

Simultaneous-successive processing does have some relationship to existing hierarchical models, cognitive style models, and hemispheric assymetry models. Research in this area is limited but does indicate that some theories may be overlapping with certain aspects of simultaneous-successive processing theory.

Preliminary studies have found that simultaneous and successive processing do have relevant implications for educational programming and that processing strategy can be taught. Although research in this area is still very limited, studies do indicate the importance of focusing on teaching the student how to learn and process information.

CHAPTER III

METHOD AND PROCEDURE

Introduction

The basic purpose of the methodology and procedures in this study was to determine the effect on learning disabled students of successive word processing teaching strategies. To accomplish this goal, the students were first categorized as low in successive cognitive processing. Testing was conducted to determine pretreatment levels of functioning on various tasks. Then the students were assigned to either simultaneous or successive teaching strategies with an appropriate control group. After the teaching strategies were applied, posttreatment testing was conducted to determine what changes occurred in the students' reading recognition, spelling and successive processing. Finally, appropriate statistical analyses was then conducted to determine whether the changes are significant.

Instrumentation

Two types of assessment instruments were used in this study: (1) a standardized instrument used to identify a deficiency in successive cognitive processing, and (2) hierarchical word lists used to measure comparative increases in word recognition and spelling.

Three criteria were used in the selection of the test for measuring a deficiency in successive cognitive processing. The first criterion required the scores to be norm-referenced. Many of the research instruments used in previous research use only raw scores. Thus, the use of such instruments would limit the research to one grade level. The second criterion required the test to be as "pure" a measure as possible of successive cognitive processing, hence with all possible confounding variables removed. This criterion also required the test to have a strong rationale for measuring the purported mode of cognitive processing through a close similarity with the stated processing definitions and previous research instruments. The third criterion required the test to be readily available to school psychologists. This criterion would increase the practical application of the study.

The Visual Aural Digit Span (VADS) test (Koppitz, 1977) was used to identify deficiencies in successive cognitive processing. The tests which were used to identify deficiencies in successive processing in previous research consisted of sequential memory tasks (Das, Kirby, and Jarman, 1979). However, the tasks have not been equally matched for the auditory and visual modalities. Typically, the auditory sequential memory tasks have consisted of digit span tasks and serial recall of word tasks (Das, Kirby, and Jarman, 1979). The visual sequential memory tasks have typically consisted of grids with five blocks. Numbers or letters are shown one at a time positioned in one of the blocks. After five numbers or letters are shown, the subject must write the appropriate numbers or letters in a blank grid. Two possible major confounding variables are possible when unequal tasks are used for the auditory and visual modalities. The first possible confounding variable is the effect of words on memory. In a serial recall of words, some students may be more familiar with the words than other students and thus perform better on word memory tasks. Also, some students may have developed such a negative attitude toward reading and other academic tasks that they perform poorly on word memory tasks, even though their memory is good (Koppitz, 1977, pp. 6-9). The VADS test uses digits for both auditory and visual sequential memory tasks. This procedure eliminates the previously mentioned confounding variables. The VADS test uses both oral and written output for both auditory and visual sequential memory tasks. This procedure helps to eliminate any confounding variables related to oral or written output. In essence, the VADS test controls more variables than the successive processing tasks used in previous research. In addition, the VADS test scores have norms and can be converted to T-scores (i.e., 10z + 50) which control for age differences.

No testing instruments were used to identify students who are deficient in simultaneous processing. There are several reasons for excluding simultaneous assessment tasks. Except for the Ravens Coloured Progressive Matrices, none of the currently used simultaneous tasks can be converted to standard scores. Thus, only one grade or age level could be used if simultaneous processing was considered in the study. Also, current literature demonstrates the relationship between successive processing and word recognition and spelling but not between simultaneous processing and word recognition and spelling (Sprecht, 1976; Kirby and Das, 1977; Cummins and Das, 1977; McCleod, 1978; Das and Cummins, 1978). Furthermore, current literature indicates that a frequent problem with learning disabled children is a deficiency in sequential or successive processing (Senf, 1969; Meier, 1971; Eakin and Douglas, 1971; Leton, 1974; Krywaniuk, 1974; Richie and Aten, 1976; Wirtenberg and Faw, 1975; Badian, 1977). For these reasons, the scope of this study considered only the student who was deficient in successive cognitive processing. Any variables related to simultaneous processing were randomly distributed among the three groups of students in this study.

To assess comparative increases in reading recognition and spelling, two word lists were used, both of which are based on a curriculum ladder (Starlin and Starlin, 1972). One word list consisted of 50 simulated words which were used in the pre and posttest, and which were taught to the students with either a simultaneous or successive word processing strategy (see Appendix A). The use of simulated words helped eliminate confounding variables related to previous exposure to the words. The second word list consisted of 50 English words, matched on the curriculum ladder steps with the simulated words, was used in the pre and posttesting only in order to determine whether the teaching strategies had any transference effect to actual English words (see Appendix A).

Selection of Research Sample

The basis of the selection of the students to be included in the study was a measured deficiency in successive cognitive processing. The VADS test yields scores for grades K-6 in four major areas: (1) aural digit span with oral response, (2) aural digit span with written response, (3) visual digit span with oral response, and (4) visual digit span with written response. The VADS test yields a total score which is a combination of the preceding four areas.

The VADS test was administered to 40 students, grades two through five, who were receiving IEP-specified remediation help in a Learning

Disability Resource Room. Kindergarten through second grade students (ages 5-7) were not used in the study since they are still on a readiness level, and would not yet be ready for word recognition and spelling studies. A deficiency in successive processing was defined as a VADS test total score which is at or below the 25th percentile. Thirty students, ages 8-12, who met the deficiency criterion were used in this study (i.e., 75% of the LD students). These students were randomly assigned to one of the three teaching strategies (10 students per group) used in this study.

Selection of Teaching Strategies

Two basic approaches can be used in the application of teaching strategies to deficiencies in simultaneous or successive cognitive processing. The first approach would use curriculum materials which do not actually teach the student words with either a simultaneous or successive approach, but rather attempt to teach the mode of processing. For example, this approach would teach successive processing with curriculum materials such as sequencing of beads, picture sequencing according to the temporal nature of event occurrence, and various auditory and visual sequential memory tasks. This teaching strategy approach has been used in two previous research studies (Krywaniuk, 1974; Kaufman, 1978).

A second approach would use words which are presented in such a way that either a simultaneous or a successive processing strategy is used for processing and remembering the words. This approach was used in this study.

Three categories of word processing teaching strategies were used in this study: (1) simultaneous word processing teaching strategy,

(2) successive word processing teaching strategy, and (3) combined word processing teaching strategy. Previously mentioned research studies have demonstrated that successive processing is important for learning word recognition and spelling (e.g., Kirby and Das, 1977; Das and Cummins, 1978). However, it would be of theoretical and practical interest to know what effects a simultaneous word processing strategy would have with the students who are deficient in successive processing. It is possible that either the simultaneous or combined word processing strategy might be beneficial to students who are deficient in successive processing.

With all three categories of teaching strategies, video-tape presentations were used for the word processing strategies. Directions which were given by the teacher were read from a script (see Appendix E). This procedure helped negate confounding variables related to teacher personality and instructional style. Furthermore, the teachers were not informed of the expected outcomes of hypotheses of the study until after the completion of the study.

Several precautions were taken with the students in order to eliminate possible confounding variables (see Appendix A). The printing of the words was the same for the pre and posttesting, simultaneous teaching strategy, successive teaching strategy, and combined teaching strategy. The viewing screen was situated so only the relevant students could view the presentation. A listening station with earphones was used for the audio part of the word presentation. These precautions helped negate confounding variables related to perceptual differences due to variant printing of words, additional exposure to the other category of teaching strategy, and extraneous stimuli which interfere with the word presentations. The teaching strategy was presented to the students as a regular instructional activity in order to simulate the usual instructional situation.

The simultaneous word processing teaching strategy consisted of a visual presentation of the complete simulated word. Two seconds prior to the presentation, the word was pronounced. The word was presented and remained on the screen the same number of seconds (i.e., two seconds for each word pronunciation, two seconds for each letter) as with the successive word processing teaching strategy. Then the word was pronounced again. The same procedure was used for the other words in the simulated word list. The order of presentation was according to the curriculum ladder and began with the easier words and progressed upwards to the more difficult words. The total presentation consisted of all the simulated words in the list (see Appendix A).

The simultaneous word processing strategy was essentially the sight word approach which is often used in schools. Since all of the word elements are present at one point in time, this approach would satisfy the requirements of a simultaneous task applied to word processing. Thus no help was given to the student in successive processing which is necessary for successful word recognition and spelling. It is possible that the students may have imposed their own internal successive processing to the words without any help. However, this possibility is remote since the students in the study were those who were deficient in successive processing.

The successive word processing teaching strategy consisted of the same simulated words, presented in the same order as those used in the simultaneous teaching strategy. However, the screen was blank when the was first pronounced, then each letter was pronounced as it was added to the word until the complete word was presented (e.g., for the simulated word "lat:" the screen is blank as "lat" is pronounced, the "l" is shown as the letter is spoken, then "a" is added to show "la" and the letter "a" is spoken, then "t" is added to show "lat" and the letter "t" is spoken). The letters of the word were pronounced with the usual pronunciation of letters of the alphabet, rather than the phonetic sound of the letter as it is pronounced in the word. The use of the phonetic sound would involve a greater degree of auditory acuity and discrimination ability, and this could become a confounding variable. Each additional letter received a two-second exposure. When the word was completed, it was pronounced again. After the word was pronounced, it received an additional two-second exposure, and then the presentation proceeded to the next word. The total presentation consisted of all the simulated words in the list. Since each letter of the word was presented temporally and successively, this approach would satisfy the requirements of a successive task applied to word processing.

The combined word processing teaching strategy provided a third group comparison. This group of students received the simultaneous word processing teaching strategy one day, and the successive word processing teaching strategy the next day. It should be noted that the nature of this research negated the possibility of using a no-treatment control group. Since two of the hypotheses were directly concerned with the numbers of simulated words learned, a no-treatment control group would automatically yield significant results, yielding the study useless. Therefore, a no-treatment control group was deemed not feasible for this study. Rather, a combined treatment group was used.

Research Hypotheses

This research study tested five hypotheses related to between-groups differences in the VADS scores, in simulated word recognition and spelling, and in English word recognition and spelling. The first hypothesis considers the effect of the teaching strategies on the successive cognitive processing of the students. The next two hypotheses consider the direct learning effects of the teaching strategies on the simulated words which were also used in the teaching strategy application. The last two hypotheses consider the transfer learning effects of the teaching strategies on English words which are similar to the simulated words.

Hypothesis No. 1

Null Hypothesis No. 1: There will be no between-groups differences in the increase of the VADS test scores.

Research Hypothesis No. 1: There will be between-groups differences in the increase of the VADS test scores.

Hypothesis No. 2

Null Hypothesis No. 2: There will be no between-groups differences in the increase of simulated words which are successfully read.

Research Hypothesis No. 2: There will be between-groups differences in the increase of simulated words which are successfully read.

Hypothesis No. 3

Null Hypothesis No. 3: There will be no between-groups differences in the increase of simulated words which are correctly spelled.

Research Hypothesis No. 3: There will be between-groups differences in the increase of simulated words which are correctly spelled.

Hypothesis No. 4

Null Hypothesis No. 4: There will be no between-groups differences in the increase of English words which are successfully read.

Research Hypothesis No. 4: There will be between-groups differences in the increase of English words which are successfully read.

Hypothesis No. 5

Null Hypothesis No. 5: There will be no between-groups differences in the increase of the number of English words which are correctly spelled.

Research Hypothesis No. 5: There will be between-groups differences in the increase of English words which are correctly spelled.

Research Treatment Procedures

Pre and Posttesting

All students in the study were pretested with the VADS during the sample selection. All students were also pretested in both spelling and reading recognition on both the simulated word list and the English word list. For all students, testing was conducted on the week (on Thursday and Friday) previous to the beginning of the study. The presentation of words in the pretesting was in a different order than the presentation of words in the teaching strategies. Spelling was tested first and then reading recognition in order to negate any effects of short-term visual memory. The simulated words were tested first and then the English words in order to negate any effects of transference from the English words to the simulated words. For purposes of testing spelling, the English words were pronounced and then given orally in the context of a sentence (see Appendix B).

Posttesting with the VADS and the first posttesting of the simulated words was conducted on the Monday which followed the two weeks of the application of the teaching strategy. The three-day delay between teaching and posttesting helped negate confounding variables related to short-term memory. The first posttesting of the English words was conducted on the Tuesday following the two weeks of the application of the teaching strategy. Posttesting of simulated and English words consisted of spelling first and then word recognition. The second posttesting of the simulated words was on Monday of the next week and the second posttesting of the English words was on Tuesday of the next week. The purpose of the second posttesting was to further eliminate any short-term memory effects and to determine the extended time effect of the teaching strategies. Appendices C and D present the pre and posttest spelling and reading instructions which were given to the students.

Teaching Strategy Application

Each group of students received the appropriate (either simultaneous or successive) video-tape word processing presentation once a day for two weeks. The combined teaching strategy group received the simultaneous presentation one day and the successive presentation the next for a total of five days of each type of presentation. The students in each of the three teaching strategy groups were assigned to their groups on a random basis. All students began the video-tape word processing presentations on the Monday of one week and finished on the Friday of the following week.

Analysis of Data

The score data comparisons which were analyzed consisted of two types. The first type of comparison was between the three groups who receive the simultaneous, successive, or combined teaching strategy. The second type of comparison was of the repeated measure scores for any one of the three groups. Therefore, the procedure which was used to analyze the data was a Split-Plot Factorial Analysis of Variance (SPF-p.q) since the procedure incorporates both the completely randomized design (between group effects) and the randomized block design (within-group or repeated measure effects) into one design (Kirk, 1968, pp. 245-283).

The five hypotheses were tested with score data which consists of three levels of between-group treatments and three levels of within-group treatments. The three levels of between-group treatments consisted of the three types of teaching strategies. The three levels of within-group treatments consisted of the pretesting before the teaching strategies began, the posttesting on the Monday and Tuesday following the end of the two weeks of word processing teaching strategy, and the one-week delayed posttesting on the next Monday and Tuesday. Therefore, the design used to test the hypotheses was the SPF-3.3 design.

The SPF-p.q design requires that the usual four assumptions for analysis of variance be fulfilled. These four assumptions are that the observations are drawn from normally distributed populations and represent random samples from populations, the variances of the populations are equal, and the numerator and denominator of the F ratio are independent (Kirk, 1968, p. 43). In addition to these assumptions the SPF-p.q design requires that the experiment meet several other assumptions. The experiment must have two or more treatments, with each treatment having two or more levels. The number of combinations of treatment levels must be greater than the desired number of observations within each block. When repeated measures on the subjects are obtained, each block must contain only one subject (Kirk, 1968, p. 245). Also, the repeated measures for one level should not affect performance on subsequent levels (Kirk, 1968, p. 248).

CHAPTER IV

RESULTS

Introduction

The purpose of this chapter is to present the results of the statistical analyses of the five research hypotheses which were formulated for this study. The emphasis of this study was to determine whether there were differential effects of the simultaneous, successive, and combined teaching strategies on five dependent variables. The dependent variables consisted of successive processing, simulated word reading (recognition), simulated word spelling, English word reading (recognition), and English word spelling. Separate split-plot factorial analyses of variance with three between groups (simultaneous, successive, combined) and three repeated measures (pretest, posttest, delayed posttest) were conducted for each of the five dependent measures.

Tests of the Research Hypotheses

Each of the research hypotheses is discussed separately in terms of the statistical results of the data. Means and standard deviations for each of the dependent variables at the assessment periods for the three groups are also presented.

Research Hypothesis No. 1: There will be between-groups differences in the increase of the VADS test scores.

Observation of Table I reveals various differences. The VADS

TABLE I

ANALYSIS OF VARIANCE SUMMARY TABLE FOR VADS T-SCORES

Source	SS	df	MS	F	P
Between Subjects	5438.45	29			
A (Treatment Groups)	2640.62	2	1320.31	12.74	.0001
Subj. w. groups	2797.83	27	103.62		
Within Subjects	2409.34	60			
B (Periods of Time)	1024.36	2	512.18	25.37	.0001
A x B	294.71	4	73.68	3.65	.0106
B x Subj. w. groups	1090.27	54	20.19		
Total	7847.79	89			

T-scores evidenced a significant Treatment Groups effect ($F_{2,27} = 12.74$, $p = .0001$), a significant Periods of Time effect ($F_{2,54} = 25.37$, $p = .0001$), and a significant Treatment Groups by Periods of Time interaction ($F_{4,54} = 3.65$, $p = .0106$). The analyses of variance for the simple effects breakdown of the Treatment Groups by Periods of Time interaction are presented in Table II. The analyses reveal that there was a significant difference between the groups at assessment period one (b_1), before the implementation of the teaching strategy ($F_{2,81} = 3.54$, $p < .05$). There is also a significant and greater difference ($F_{2,81} = 10.34$, $p < .01$) between the groups at the second assessment period (b_2), the first posttest after the implementation of the teaching strategy. At assessment period three (b_3), the one week delayed posttest, the difference between the groups is even greater ($F_{2,81} = 16.69$, $p < .01$).

Post hoc comparisons of the treatment group means using Tukey's ratio (Kirk, 1968, p. 268) revealed certain trends which are also illustrated in Table III and graphed in Figure 1. At assessment period one there was a significant difference ($p < .05$) between the means of the simultaneous (A_1) and successive (A_2) groups but not between any other pairs of means. At the second assessment period there was a significant difference ($p < .05$) between A_2-A_3 (combined), and A_2-A_1. At the third assessment period there was a significant difference between A_2-A_3, A_2-A_1, and A_3-A_1. Thus, at the end of the one week delayed posttesting, the mean of the successive group was significantly higher than the means of the simultaneous and combined groups, and the mean of the combined group was significantly higher than the mean of the simultaneous group.

Table II also reveals no difference across periods of time for the simultaneous group ($F_{2,54} = 3.07$, $p > .05$), a significant increase across

TABLE II

SIMPLE EFFECTS BREAKDOWN OF THE GROUPS BY ASSESSMENT PERIODS INTERACTION: VADS T-SCORES

Sources	SS	df	MS	F
A x B				
A at b_1	340.07	2	170.04	3.54*
A at b_2	993.07	2	496.54	10.34**
A at b_3	1602.20	2	801.10	16.69**
Pooled Error	3888.10	81	48.00	
B at a_1	123.80	2	61.90	3.07
B at a_2	1000.27	2	500.14	24.77**
B at a_3	195.00	2	97.50	4.83*
B x Subj. w. groups	1090.27	54	20.19	

*$p < .05$

**$p < .01$

TABLE III

MEANS AND STANDARD DEVIATIONS OF THE VADS T-SCORES AT THE ASSESSMENT PERIODS FOR THE THREE TREATMENT GROUPS*

Treatment Groups	Assessment Periods 1 $\bar{x}$	1 SD	2 $\bar{x}$	2 SD	3 $\bar{x}$	3 SD
Simultaneous	29.80	5.75	34.70	8.07	33.00	8.87
Successive	37.70	7.68	48.70	4.74	50.90	6.90
Combined	35.80	6.05	40.30	7.38	41.80	5.92

*n = 10 for each group

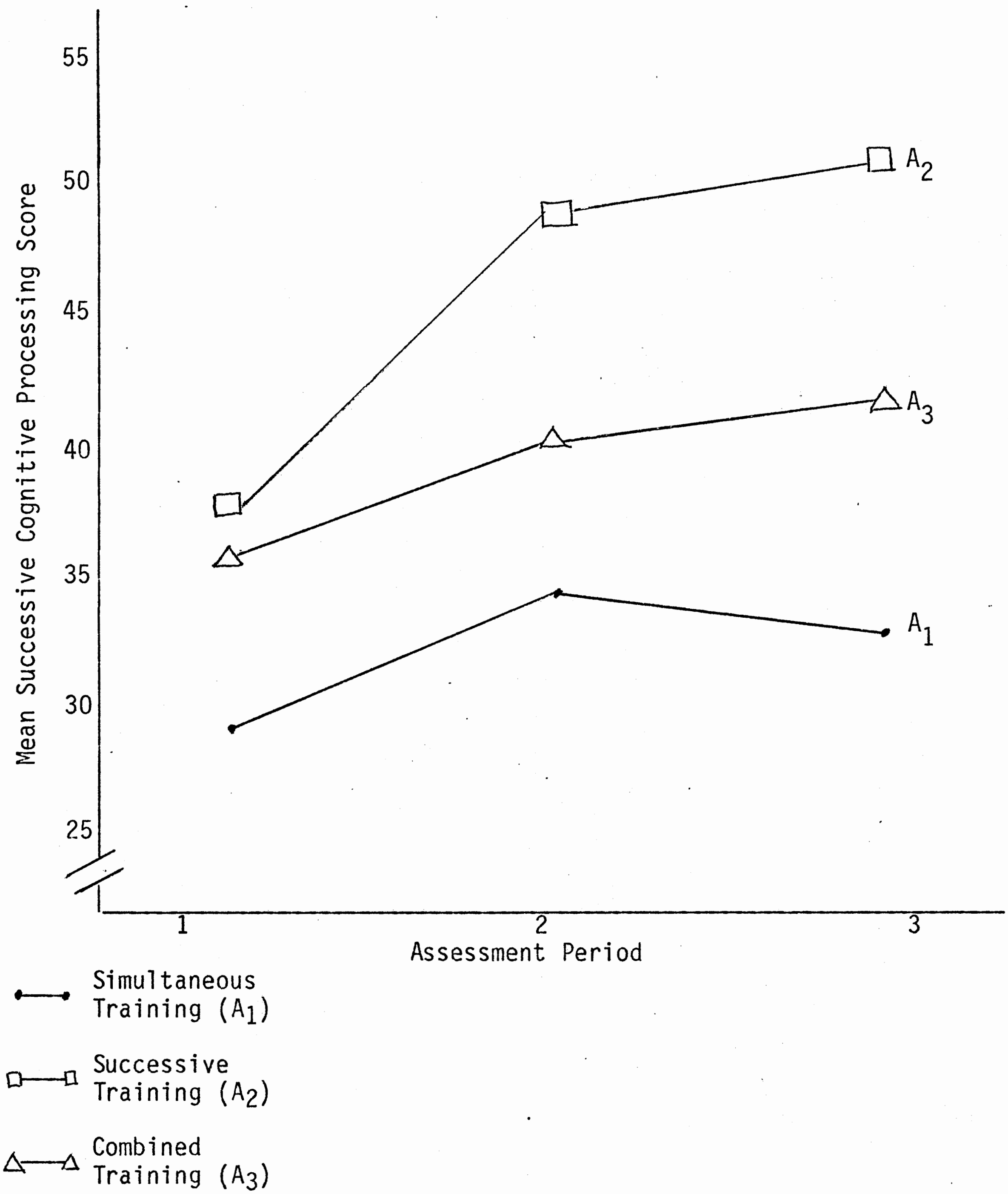

Figure 1. Groups by Assessment Periods Interaction: VADS T-Scores

periods of time for the successive group ($F_{2,54}$ = 24.77, p < .01), and a significant increase across periods of time for the combined group ($F_{2,54}$ = 4.83, p < .05). Post hoc comparisons of means using Tukey's ratio revealed that there was a significant increase (p < .05) between assessment periods one and two for the successive group but not for either the simultaneous or combined group. At assessment period three, a significant difference (p < .05) existed between the means of the simultaneous and combined groups.

The presence of the significant Treatment Groups by Periods of Time interaction and the follow-up simple effects analyses and comparisons of means isolated a significant increase in successive processing for the successive and combined teaching strategies. Thus, null hypothesis number one is rejected in favor of research hypothesis number one.

Research Hypothesis No. 2: There will be between-groups differences in the increase of simulated words which are successfully read.

Observation of Table IV reveals various differences. The simulated reading scores did not evidence a significant Treatment Groups effect ($F_{2,27}$ = 2.25, p = .1250). However, the simulated reading scores did evidence a significant Periods of Time effect ($F_{2,54}$ = 82.18, p = .0001) and a significant Treatment Groups by Periods of Time interaction ($F_{4,54}$ = 3.10, p = .0229). The analyses of variance for the simple effects breakdown of the Treatment Groups by Periods of Time interaction are presented in Table V. The F's for A at b were tested with conservative df to control for heterogeneity of variance of between and within subjects error terms (Kirk, 1968, p. 262). The analyses reveal that there was not a signficant difference between the groups at either the first or second assessment periods, but there was significant difference

TABLE IV

ANALYSIS OF VARIANCE SUMMARY TABLE FOR
SIMULATED READING

Sources	SS	df	MS	F	P
Between Subjects	14398.93	29			
A (Treatment Groups)	2055.80	2	1027.90	2.25	.1250
Subj. w. groups	12343.13	27	457.52		
Within Subjects	3442.67	60			
B (Periods of Time)	2452.20	2	1226.10	82.18	.0001
A x B	184.80	4	46.20	3.10	.0229
B x Subj. w. groups	805.67	54	14.92		
Total	17841.60	89			

TABLE V

SIMPLE EFFECTS BREAKDOWN OF THE GROUPS BY ASSESSMENT PERIODS INTERACTION: SIMULATED READING

Sources	SS	dF	MS	F
A x B				
A at b_1	248.27	2	124.14	0.76
A at b_2	835.47	2	417.74	2.57
A at b_3	1156.87	2	578.44	3.56*
Pooled Error	13148.80	81	162.33	
B at a_1	335.40	2	167.70	11.24**
B at a_2	1334.40	2	667.20	44.72**
B at a_3	967.20	2	483.60	32.41**
B x Subj. w. groups	805.67	54	14.92	

*$p < .05$

**$p < .01$

between the groups at the third assessment period ($F_{2,81} = 3.56$, $p < .05$).

Post hoc comparisons of the treatment group means using Tukey's ratio (Kirk, 1968, p. 268) revealed certain trends which are also illustrated in Table VI and graphed in Figure 2. No significant pairwise comparisons of treatment group means were revealed at either the first or second assessment periods. At the third assessment period, there was a signficant difference ($p < .05$) between the successive and the simultaneous groups, but not between any other groups. Thus, it was not until the one week delayed posttesting that the successive group mean was significantly higher than the simultaneous group mean.

Table V also reveals a significant increase across periods of time for the simultaneous group ($F_{2,54} = 11.25$, $p < .01$), the successive group ($F_{2,54} = 44.72$, $p < 0.1$), and the combined group ($F_{2,54} = 32.41$, $p < .01$). Thus, there was a significant increase in the number of simulated words successfully read for all three teaching groups. Post hoc comparisons of means using Tukey's ratio revealed that there was a significant increase ($p < .05$) in the means of the successive group between the first and third assessment periods. However, there were no other significant periods of time pairwise comparisons for any of the three treatment groups.

The presence of the significant Treatment Groups by Periods of Time interaction and the follow-up simple effects analyses and comparisons of means isolated a significant increase in the number of simulated words successfully read for all three groups. Thus, null hypothesis number two is rejected in favor of research hypothesis number two.

Research Hypothesis No. 3: There will be between-groups

TABLE VI

MEANS AND STANDARD DEVIATIONS OF THE SIMULATED READING SCORES AT THE ASSESSMENT PERIODS FOR THE THREE TREATMENT GROUPS*

Treatment Groups	Assessment Periods					
	1		2		3	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Simultaneous	9.50	10.76	16.10	13.40	17.00	13.13
Successive	16.30	10.79	28.30	13.24	31.90	12.92
Combined	14.50	12.47	25.90	12.86	27.10	14.61

*n = 10 for each group

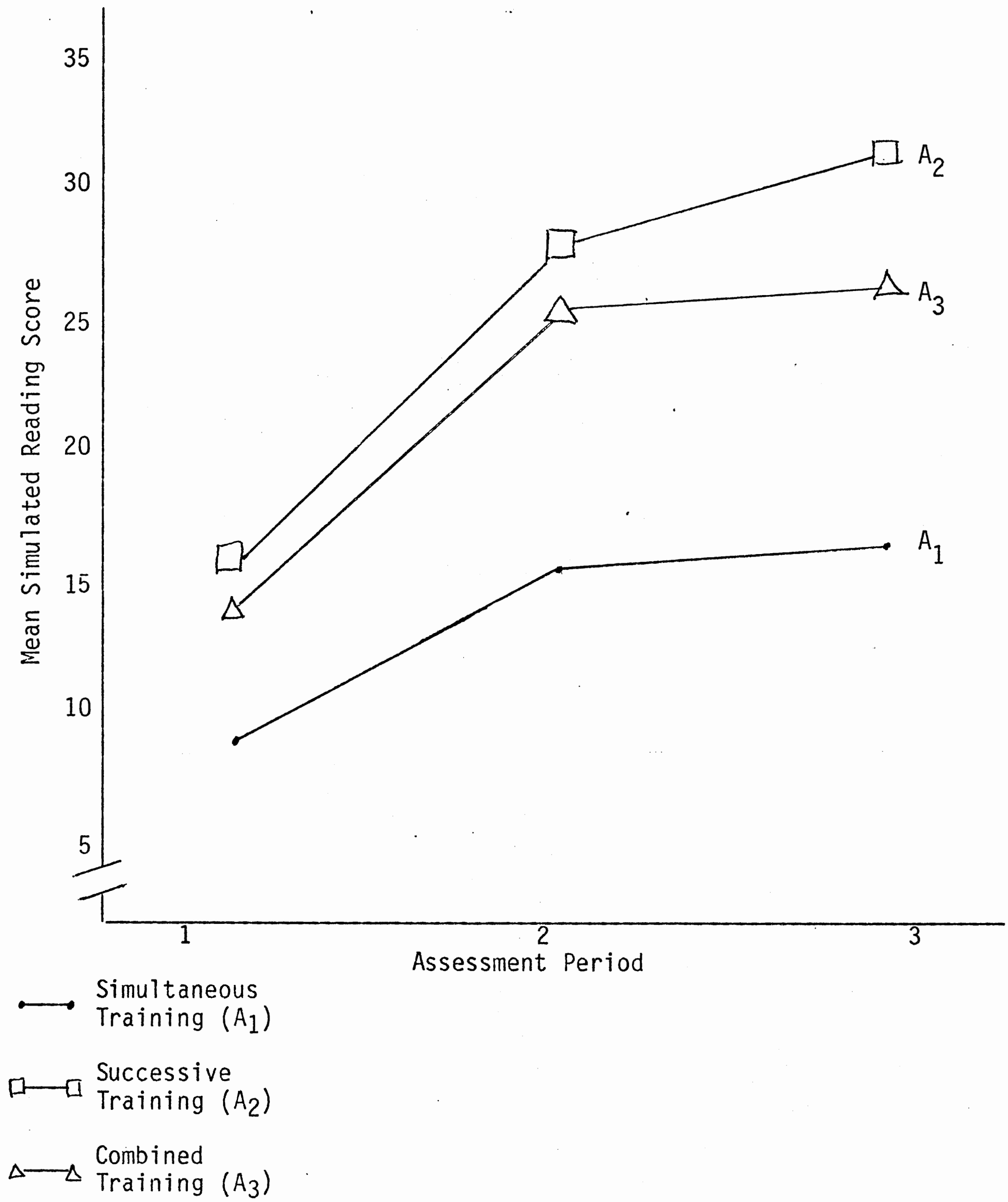

Figure 2. Groups by Assessment Periods Interaction: Simulated Reading

differences in the increase of simulated words which are correctly spelled.

Observation of Table VII reveals various differences. The simulated spelling scores evidenced a significant Treatment Groups effect ($F_{2,27}$ = 3.57, p = .0420), a significant Periods of Time effect ($F_{2,54}$ = 22.37, p = .0001), and a nonsignificant Treatment Groups by Periods of Time interaction ($F_{4,54}$ = 1.64, p = .1781). The analyses of variance for the simple effects breakdown of the Treatment Groups by Periods of time interaction are presented in Table VIII. The F's for A at b were tested with conservative df to control for heterogeneity of variance of between and within subjects error terms (Kirk, 1968, p. 262). The analyses reveal that there was not a significant difference between the groups at the first assessment period ($F_{2,81}$ = 1.44, $p > .05$). However, there was a significant difference between the groups at the second assessment period ($F_{2,81}$ = 4.44, $p < .05$), and at the third assessment period ($F_{2,81}$ = 4.09, $p < .05$). Post hoc comparisons of the treatment group means using Tukey's ratio (Kirk, 1968, p. 268) revealed certain trends which are also illustrated in Table IX and graphed in Figure 3. At assessment period one, there are no significant pairwise comparisons between group means. At assessment periods two and three, the combined group mean is significantly ($p < .05$) higher than the simultaneous group mean.

Table VIII also reveals no difference across periods of time for the simultaneous group ($F_{2,54}$ = 1.83, $p > .05$), a significant increase across periods of time for the successive group ($F_{2,54}$ = 12.89, $p < .01$), and a significant increase across periods of time for the combined group ($F_{2,54}$ = 10.93, $p < .01$). Post hoc comparisons of means using

TABLE VII

ANALYSIS OF VARIANCE SUMMARY TABLE FOR SIMULATED SPELLING

Sources	SS	df	MS	F	P
Between Subjects	6893.16	29			
A (Treatment Groups)	1442.69	2	721.34	3.57	.0420
Subj. w. groups	5450.47	27	201.87		
Within Subjects	1557.33	60			
B (Periods of Time)	661.69	2	330.84	22.37	.0001
A x B	96.91	4	24.23	1.64	.1781
B x Subj. w. groups	798.73	54	14.79		
Total	8450.49	89			

TABLE VIII

SIMPLE EFFECTS BREAKDOWN OF THE GROUPS BY ASSESSMENT PERIODS INTERACTION: SIMULATED SPELLING

Sources	SS	df	MS	F
A x B				
A at b_1	222.07	2	111.04	1.44
A at b_2	685.27	2	342.64	4.44*
A at b_3	632.27	2	316.14	4.09*
Pooled Error	6249.20	81	77.15	
B at a_1	54.07	2	27.04	1.83
B at a_2	381.27	2	190.64	12.89**
B at a_3	323.27	2	161.64	10.93**
B x Subj. w. groups	798.73	54	14.79	

*$p < .05$

**$p < .01$

TABLE IX

MEANS AND STANDARD DEVIATIONS OF THE SIMULATED SPELLING SCORES AT THE ASSESSMENT PERIODS FOR THE THREE TREATMENT GROUPS*

Treatment Groups	Assessment Periods					
	1		2		3	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Simultaneous	5.10	4.89	7.60	7.37	8.20	7.08
Successive	9.20	8.19	15.90	11.36	17.40	11.79
Combined	11.70	6.80	18.90	9.48	18.40	9.74

*n = 10 for each group

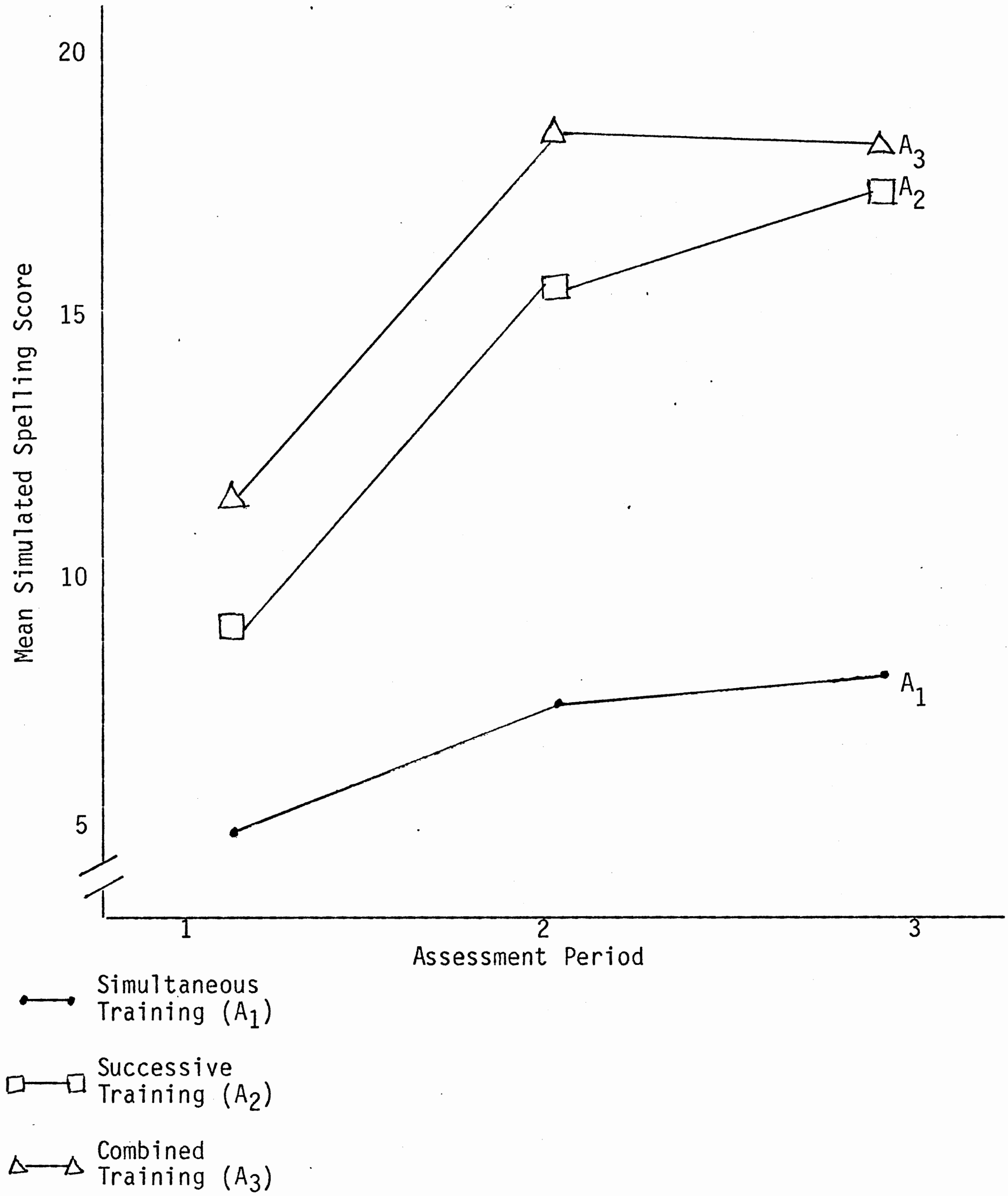

Figure 3. Groups by Assessment Periods Interaction: Simulated Spelling

Tukey's ratio did not reveal any significant increases between assessment periods for any of the three groups.

The follow-up simple effects analyses reveal that there was a significant difference ($p < .05$) between the groups at the second and third assessment periods. Also, the successive and combined groups evidenced significant ($p < .01$) increases in the number of simulated words correctly spelled across periods of time, but the simultaneous group did not. Thus null hypothesis number three is rejected in favor of research hypothesis number three.

Research Hypothesis No. 4: There will be between-groups differences in the increase of English words which are successfully read.

Observation of Table X reveals various differences. The English reading scores did not evidence a significant Treatment Groups effect ($F_{2,27} = 1.71$, $p = .2005$). However, the English reading scores did evidence a significant Periods of Time effect ($F_{2,54} = 23.13$, $p = .0001$) and a significant Treatment Groups by Periods of Time interaction ($F_{4,54} = 2.55$, $p = .0494$). The analyses of variance for the simple effects breakdown of the Treatment Groups by Periods of Time interaction are presented in Table XI, and illustrated in Table XII and graphed in Figure 4. The F's for A at b were tested with conservative df to control for heterogeneity of variance of between and within subjects error terms (Kirk, 1968, p. 262). The analyses reveal that there was not a significant difference between groups at any of the three assessment periods. Post hoc comparisons of the treatment group means using Tukey's ratio (Kirk, 1968, p. 268) did not reveal any significant pairwise comparisons between any of the three groups at any of the three assessment periods.

TABLE X

ANALYSIS OF VARIANCE SUMMARY TABLE FOR
ENGLISH READING

Sources	SS	df	MS	F	P
Between Subjects	18380.46	29			
A (Treatment Groups)	2062.96	2	1031.48	1.71	.2005
Subj. w. groups	16317.50	27	604.35		
Within Subjects	739.33	60			
B (Periods of Time)	309.62	2	154.81	23.13	.0001
A x B	68.31	4	17.08	2.55	.0494
B x Subj. w. groups	361.40	54	6.69		
Total	19119.79	89			

TABLE XI

SIMPLE EFFECTS BREAKDOWN OF THE GROUPS BY ASSESSMENT PERIODS INTERACTION: ENGLISH READING

Sources	SS	df	MS	F
A x B				
A at b_1	782.60	2	391.30	1.27
A at b_2	677.40	2	338.70	1.10
A at b_3	671.27	2	335.64	1.09
Pooled Error	16678.90	81	308.87	
B at a_1	116.07	2	58.04	8.67**
B at a_2	237.07	2	118.54	17.71**
B at a_3	24.80	2	12.40	1.85
B x Subj. w. groups	361.40	54	6.69	

**$p < .01$

TABLE XII

MEANS AND STANDARD DEVIATIONS OF THE ENGLISH READING SCORES AT THE ASSESSMENT PERIODS FOR THE THREE TREATMENT GROUPS*

Treatment Groups	Assessment Periods					
	1		2		3	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Simultaneous	24.30	15.86	28.20	16.68	28.70	16.27
Successive	32.80	15.51	37.80	14.79	39.40	14.06
Combined	36.50	11.35	38.70	12.20	37.90	11.12

*n = 10 for each group

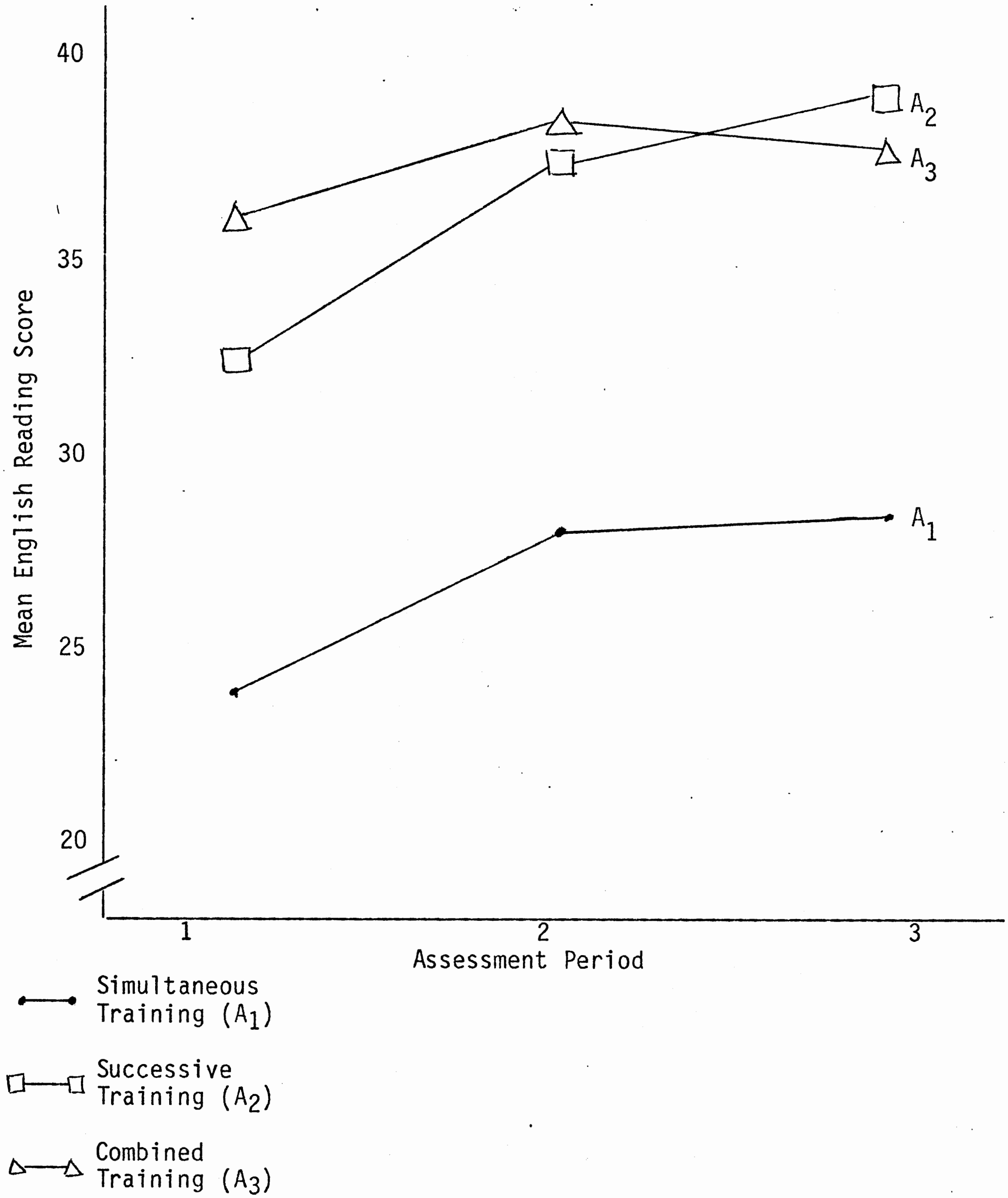

Figure 4. Groups by Assessment Periods Interaction: English Reading

However, Table XI reveals a significant increase across periods of time for the simultaneous group ($F_{2,54} = 8.67$, $p < .01$) and the successive group ($F_{2,54} = 17.71$, $p < .01$). The combined group did not evidence a significant increase across periods of time ($F_{2,54} = 1.85$, $p > .05$). Thus, the greatest increase across periods of time was evidenced by the successive group. Post hoc comparisons of means using Tukey's ratio did not reveal any significant pairwise comparisons for any of the three groups across periods of time.

The presence of the significant Treatment Groups by Periods of time interaction and the follow-up simple effects analyses isolated a significant increase in the number of English words read for the successive and simultaneous teaching strategies, but not for the combined teaching strategy. Thus, null hypothesis number four is rejected in favor of research hypothesis number four.

Research Hypothesis No. 5: There will be between-groups differences in the increase of English words which are correctly spelled.

Observation of Table XIII reveals various differences. The English spelling scores did not evidence a significant Treatment Groups effect ($F_{2,27} = 2.94$, $p = .0701$), but did evidence a significant Periods of Time effect ($F_{2,54} = 16.18$, $p = .0001$). However, the English spelling scores did not evidence a significant Treatment Groups by Periods of Time interaction ($F_{4,54} = 0.16$, $p = .9569$) as illustrated by Table XIV and graphed in Figure 5. Post hoc comparisons of means using Tukey's ratio (Kirk, 1968, p. 268) did not reveal any significant pairwise comparisons either between treatment groups at the three assessment periods or across periods of time for any of the three treatment groups.

The presence of the significant Periods of Time effect indicated a

TABLE XIII

ANALYSIS OF VARIANCE SUMMARY TABLE FOR ENGLISH SPELLING

Sources	SS	df	MS	F	P
Between Subjects	16069.07	29			
A (Treatment Groups)	2871.20	2	1435.60	2.94	.0701
Subj. w. groups	13197.87	27	488.81		
Within Subjects	673.33	60			
B (Periods of Time)	250.40	2	125.20	16.18	.0001
A x B	5.00	4	1.25	0.16	.9569
B x Subj. w. groups	417.93	54	7.74		
Total	16742.40	89			

TABLE XIV

MEANS AND STANDARD DEVIATIONS OF THE ENGLISH SPELLING SCORES AT THE ASSESSMENT PERIODS FOR THE THREE TREATMENT GROUPS*

Treatment Groups	Assessment Periods 1 $\bar{x}$	1 SD	2 $\bar{x}$	2 SD	3 $\bar{x}$	3 SD
Simultaneous	14.60	11.24	17.30	12.31	18.10	13.52
Successive	24.50	13.44	28.50	15.56	28.80	15.13
Combined	27.50	9.98	30.40	12.76	31.10	11.77

*n = 10 for each group

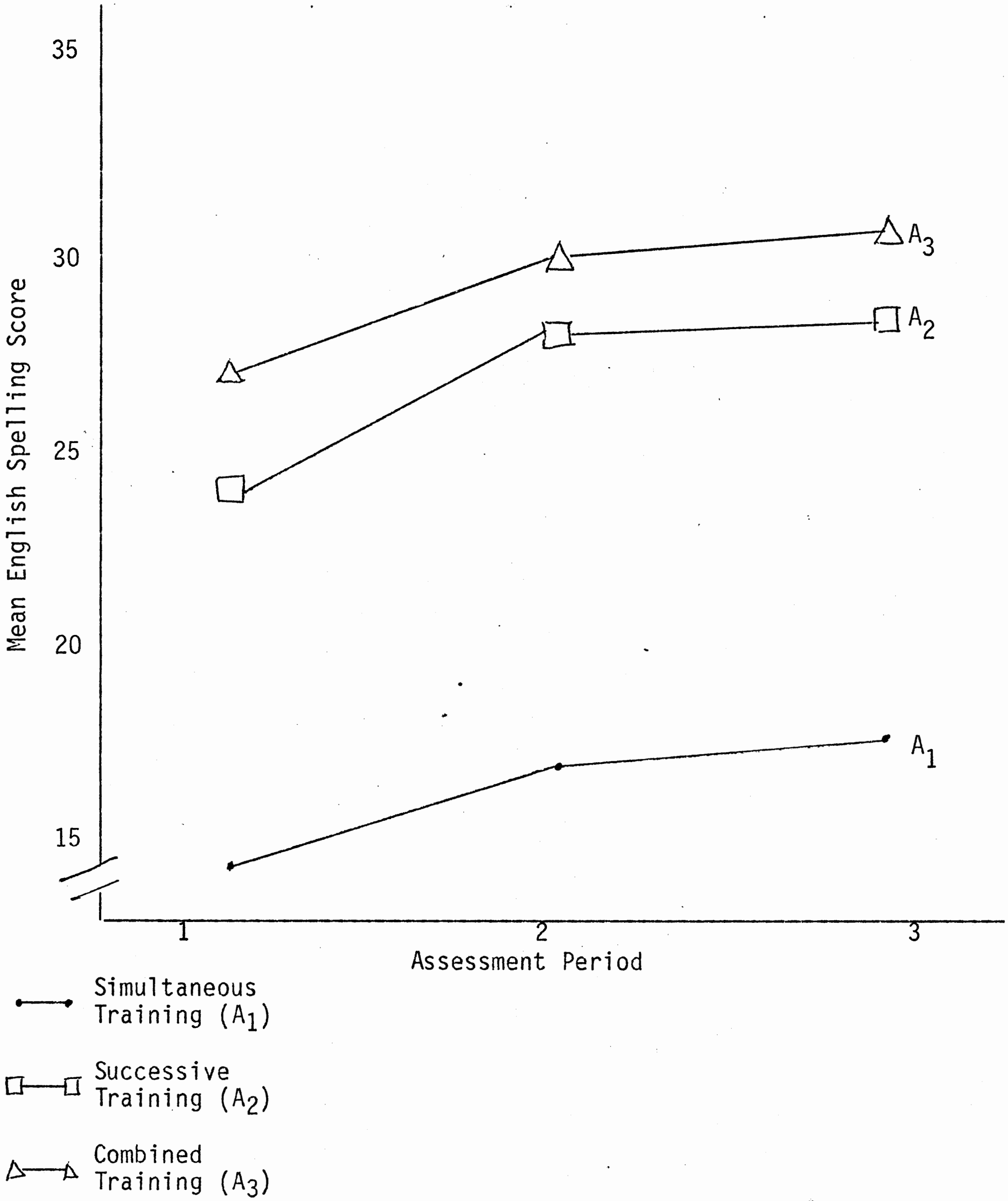

Figure 5. Groups by Assessment Periods Interaction: English Spelling

significant increase in the number of English words correctly spelled. However, further analyses did not isolate a significant differential effect between the three groups. Therefore, the data failed to reject null hypothesis number five.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary of the Investigation

The present study examined the effects of three types of teaching strategies on five dependent variables. The three types of teaching strategies consisted of a simultaneous word processing strategy, a successive word processing strategy, and a combination of the simultaneous and successive word processing strategies. The five dependent variables were successive cognitive processing, reading recognition of simulated words, spelling of simulated words, reading recognition of English words, and spelling of English words. Children receiving help in learning disability resource rooms were evaluated with the Visual Aural Digit Span (VADS) Test (Koppitz, 1977). A total of 30 students, ages 8-12, who scored at or below the 25th percentile on the Total score of the VADS were selected to be included in the study and were randomly assigned to one of three groups: a simultaneous teaching strategy group (n = 10), a successive teaching strategy group (n = 10), and a combined teaching strategy group (n = 10). Prior to the teaching strategy intervention, all the students were also evaluated on their reading recognition and spelling of a list of 50 simulated words, and their reading recognition and spelling of a list of 50 English words (see Appendix A). Each group received the appropriate video-taped teaching intervention strategy once a day (approximately 10 minutes) for two weeks using simulated words. On the first two days following the completion of the teaching intervention, all the students were reevaluated on the five dependent variables, and then one week later were again evaluated on the five dependent variables. The study was a double blind study in that neither the teachers or students were informed of the expected outcomes, and the examiner was not informed of the teaching strategy to which the students belonged. Each of the five dependent variables was analyzed with a Split-Plot Factorial ANOVA design (Kirk, 1968) that consisted of three treatment groups and three repeated measures.

Conclusions

Within the limits and scope of this study, five conclusions are suggested by the results presented in Chapter IV.

Hypothesis No. 1

Both the successive and combined teaching strategies significantly increased successive cognitive processing, over a two week period, with the successive teaching strategy having the greatest effect.

Hypothesis No. 2

All three teaching strategies significantly increased the reading recognition of simulated words over a two week period. The successive teaching strategy evidenced the greatest increase followed by the combined and simultaneous teaching strategies, respectively.

Hypothesis No. 3

Both the successive and combined teaching strategies significantly increased the spelling of simulated words, over a two week period, with the successive teaching strategy having the greatest effect.

Hypothesis No. 4

Both the simultaneous and successive teaching strategies significantly increased the reading recognition of English words, over a two week period, with the successive teaching strategy having the greatest effect.

Hypothesis No. 5

Although there was a significant increase in the spelling of English words, there was no difference between the three teaching strategies over a two week period.

Discussion

The findings of the present study indicated that (a) the successive teaching strategy had a significant effect on successive cognitive processing, simulated word reading, simulated word spelling, and English word reading, which was also greater than the effect of the other two teaching strategies; (b) the combined teaching strategy had a significant effect on successive cognitive processing, simulated word reading, and simulated word spelling, which was less than the effect of the successive teaching strategy, but more than the effect of the simultaneous teaching strategy; (c) the simultaneous teaching strategy had a significant effect on simulated word reading and English word reading; (d) the differences between the three teaching strategies increased with each assessment period; and (e) as the testing tasks required more transference and generalization of skills learned in the teaching intervention, the differences between the three groups became smaller and less consistent. The discussion to follow will focus on two major areas. First, interpretation of the findings for each hypothesis will be addressed, and their relation to any previous related research will be discussed. Second, implications of the present study will be considered.

Das, Kirby, and Jarman (1979, pp. 86, 87) suggested that one approach to remediation consists of improving cognitive processing. They further pointed out that if improved reading is the eventual goal, even a process-oriented approach must use reading-based materials. None of the related literature or research has addressed the effect of a word processing strategy on cognitive processing, although Krywaniuk (1974) and Kaufman (1978) have previously demonstrated that cognitive processing efficiency can be modified. However, they did not use reading based materials. Therefore, on hypothesis one, it is of practical significance that the successive word processing strategy, which was designed to increase reading recognition and spelling skills, had a significant effect on successive cognitive processing. The simultaneous word processing teaching strategy, on the other hand, had no significant effect on successive cognitive processing. The combined teaching strategy, which consisted of alternating the simultaneous and successive word processing strategies, also had a significant effect on successive cognitive processing. However, the effect was not as great as the successive teaching strategy, presumably because of the presence of the simultaneous teaching strategy. As with the successive teaching strategy, there was a slight increase in successive cognitive processing at the third assessment period indicating that a successive processing strategy had been learned and was maintained over a period of one week. This trend is in contrast to the simultaneous teaching strategy.

Therefore, this research study would imply that the efficiency of successive cognitive processing can be modified and increased. The comparison of the effects of the successive and combined teaching strategies would suggest that a significant effect on successive cognitive processing could have been obtained with only one-half the amount of time as was used with the successive teaching strategy in this study. This study demonstrated that teaching a successive word processing strategy also increased successive cognitive processing. Therefore, this study would suggest that it may be unnecessary and inaccurate to conceptualize successive cognitive processing and word recognition as being separate and as requiring separate types of remediation. Under certain carefully designed situations, the teaching of word recognition can also teach successive cognitive processing.

Das, Kirby, and Jarman (1979, pp. 86, 87) suggested that a second approach to remediation consists of designing programs which make use of the processing strengths of the student. A third approach consists of teaching the student to employ the optimal process which is necessary in a task. However, none of the related literature and research addresses these remediation approaches from the perspective of simultaneous-successive cognitive processing.

Hypotheses two to five consider the effect of teaching the student to employ the optimal process which is necessary in a task. Das and Cummins (1977) concluded that among children with reading difficulty, competence in successive processing is strongly related to the mastery of initial decoding skills. Das and Cummins (1978) concluded later that successive processing was highly related to and necessary for oral reading and spelling.

The students which were included in this current research study were students who were deficient in successive cognitive processing. Thus, it was unlikely that the students were employing the optimal process (i.e., successive cognitive processing) which was necessary for successful reading recognition and spelling. The successive teaching strategy taught the optimal process necessary for the task, and the simultaneous teaching strategy (essentially a sight word approach) did not teach the optimal process necessary for the task. The combined teaching strategy taught the optimal process half of the time. Therefore, one would expect that the successive teaching strategy would evidence the greatest effect on reading recognition and spelling, followed by the combined and simultaneous teaching strategies, respectively. The teaching strategies used simulated words and were essentially a reading recognition activity. Therefore, it would be expected that the teaching strategies would evidence the greatest effect on simulated reading and the least effect on English spelling, since the latter requires more transference of skills learned in the intervention.

Students evidenced a significant increase in simulated word reading in all three treatment groups. However, as expected, the successive teaching strategy had the greatest effect followed by the combined and simultaneous teaching strategies, respectively. Reading growth continued after intervention with the successive teaching strategy group to the extent that by the third assessment period (one week delayed post-test) there was a significant difference between the successive and simultaneous treatment group means. The results would indicate that, with this group of students, the sight word (i.e., simultaneous) approach did produce results; however, far superior results were obtained by employing a successive word processing approach.

Simulated spelling requires some transference of skills learned in the treatment group intervention. Therefore, it would be expected, considering the short duration of the teaching intervention, that there would be little time for experience in transference of skills, and the differential treatment group effect would not be as great. As expected, the successive teaching strategy evidenced the greatest effect, followed by the combined teaching strategy (see Table VIII). The simultaneous treatment group did not evidence a significant increase in simulated spelling. The most likely reason would be that optimal strategies were not learned initially and thus no transference could occur in a different situation. The results would indicate that, with this group of students, the successive word processing approach produces superior results in spelling. The simultaneous approach (i.e., sight word approach) would not be beneficial.

The English words were matched according to the simulated words but were not actually taught in the intervention teaching strategies. Therefore, any increase in the reading recognition or spelling of English words required the transference of skills learned in the intervention teaching strategy. The successive teaching strategy had the greatest effect on English word reading following by the simultaneous teaching strategy. The combined teaching strategy did not have a significant effect on the reading recognition of English words. This change from the previous three dependent variables suggests several possibilities which may have caused the combined teaching strategy to have less than a positive effect. The change every day of teaching strategies may have been confusing to the students and they became unsure about the appropriate way to process the words. Switching strategies may have created a situation in which the students could not adequately learn either strategy. Also, switching strategies may have become frustrating to the extent that transference of skills did not occur. However, it is possible that a different result may have been obtained over a longer period of time.

The spelling of English words required the greatest amount of transference of skills. Although there was a significant increase of English word spelling across periods of time there was no significant difference between the three groups at any one of the assessment periods, or when compared across all three periods. However, Table XII and Figure 5 demonstrate that the successive teaching strategy evidenced the greatest increase in the number of English words correctly spelled. The most likely interpretation would be that the time period for the intervention strategy was not sufficient for the occurrence of full transference of skills learned in the intervention strategy. An extended period of time using the three teaching strategies might have produced a differential teaching strategy effect.

While the present research demonstrated the effectiveness of a successive teaching strategy for modifying successive cognitive processing, simulated word reading, simulated word spelling, and English word reading of this group of LD children (i.e., deficient in successive cognitive processing), generalization of treatment effects to English spelling was not found. In general, the finding regarding successive cognitive processing is consistent with research indicating that successive cognitive processing is amenable to modification (Krywanuik, 1974, Kaufman, 1978). The success of the combined teaching strategy appeared to be largely the result of the successive word processing strategy. However, the present study raises the possibility that a combined teaching strategy may have a less than positive effect on the generalization and transference of skills.

As the tasks requried more transference of skills, the differences between the groups became smaller and less consistent. Although this phenomenon could be explained by the short duration of the study (i.e., two weeks), there are other possibilities. Children who are deficient in successive processing may require help in the optimal processing for each type of task they encounter. Thus, just because they have improved their successive processing on one task is no guarantee that they will apply appropriate successive processing in other tasks. If successive processing is necessary for a different academic area, the teacher may have to teach the student the optimal processing strategy within the context of that academic area. If a teacher wishes to teach the successive processing necessary for spelling, then it would appear to be necessary to teach spelling with a successive processing approach rather than teaching sequencing skills and expecting the students to generalize those skills to other tasks. It is possible that with extended remediation students will become able to generalize skills, but the existing research does not support such an assumption.

Implications for Practitioners

The results of this study imply a variety of procedures which have practical implications for school psychologists and teachers. The VADS test would appear to be a useful instrument to include in the standard battery of diagnostic tasks used by the school psychologist. The VADS test could be considered a useful instrument for measuring successive cognitive processing. If a student is at or below the 25th percentile on the VADS, it would seem to be safe to assume that the student is not employing successive processing effectively on tasks which require successive processing.

This information from the VADS would lead to a variety of recommendations. The students should be given experience in sequencing tasks in order to increase their successive processing efficiency. The teaching of word recognition should employ a successive word processing teaching strategy. However, it would appear that at least initially, the students should also be taught spelling with a successive approach since generalization of skills from word recognition may not occur. Furthermore, the teacher should become aware of other situations in class which require successive processing (e.g., multiple sequenced verbal directions). In those situations, the teacher should also concentrate on helping the student to successively process the information. Otherwise, the student may continue to experience failure in other situations which require successive processing, even though the student has learned the appropriate processing strategy in some academic areas.

Recommendations for Further Research

Although the present study indicated that a successive word processing strategy was effective in increasing the efficiency of successive cognitive processing with elementary school LD children deficient in successive cognitive processing, the study failed to demonstrate a significant differential treatment group effect on all the academic areas of the study. Due to the findings and limitations of this study, the following recommendations are made:

1. Future research should investigate the maintenance of increased efficiency in successive cognitive processing. The findings of the present study indicated a significant increase in successive cognitive processing following a brief period of intervention. The stability of such a change should be examined by follow-up assessments over a longer interval.

2. The present study investigated the effects of three teaching strategies with children deficient in successive cognitive processing. However, for other children such as those who are high in successive processing, different results might be obtained. Therefore, future research should investigate the effects with the following groups of children: high in successive processing, high in simultaneous processing, deficient in simultaneous processing, high in both simultaneous and successive processing, deficient in both simultaneous and successive processing, high in successive processing and deficient in simultaneous processing, high in simultaneous processing and deficient in successive processing.

3. The present study investigated the effects with children who are receiving remediation help in LD resource rooms. Future research should also investigate the effects with additional populations of children such as the educable mentally handicapped and normal school population.

4. The present study investigated the effects with elementary school children. Future research should also investigate the effects with the junior high, senior high, and adult populations.
5. The present study included children in the age range from eight to twelve. Future research should investigate whether there exists a differential effect by age.
6. The present study considered the effects on successive cognitive processing. Future research should also investigate the effect on simultaneous cognitive processing.
7. The present study considered the effects on reading recognition and spelling. Future research should also investigate the effects on other academic areas such as oral expression, written expression, listening comprehension, reading comprehension, arithmetic calculation, and mathematic concepts.
8. Future research should investigate the tasks in which successive processing is facilitative to simultaneous processing or vice versa. A related investigation could consider whether simultaneous tasks tend to be more complex than successive tasks and whether simultaneous-successive processing tasks are hierarchically related with successive processing being at a lower complexity level than simultaneous processing.

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APPENDICES

APPENDIX A

WORD CATEGORIES WITH CORRESPONDING SIMULATED WORDS AND ENGLISH WORDS USED IN THE EXPERIMENTAL STUDY

Word Categories with Corresponding Simulated Words

and English Words Used in the Experimental Study

	Word Category	Simulated Word	English Word
1.	short a cvc words	lat	hat
2.	short i cvc words	hig	big
3.	short u cvc words	dut	nut
4.	short o cvc words	mot	hot
5.	short e cvc words	ped	red
6.	short vowel "bl-", "cl'", "pl-" words	clon	clog
7.	short vowel "fl-", "gl-", "sl-" words	glap	flap
8.	short vowel "sk-", "sp-", "st-", "sw-" words	skib	skin
9.	short vowel "sc-", "sm-", "sn-", "tw-" words	snad	snag
10.	short vowel "br-", "cr-", "dr-" words	breg	brag
11.	short vowel "fr-", "tr-", words	frek	fret
12.	short vowel "gr-", "pr-", words	prog	prod
13.	short vowel "-nd", "-nt", "-nk" words	fent	sent
14.	short vowel "-st", "-sk" words	jask	bask
15.	short vowel "-lp", "-ld", words	neld	held
16.	short vowel "-ft", "-xt", "-pt" words	jext	next
17.	short vowel "-lt", "-lk", "-mp" words	balt	melt
18.	short vowel "-ck" words	gack	back

	Word Category	Simulated Word	English Word
19.	short vowel "th(v)" words	thib	this
20.	short vowel "th(uv)" words	lath	bath
21.	short vowel "ch" words	fich	rich
22.	short vowel "-tch" words	datch	match
23.	short vowel "sh" words	shog	shop
24.	short vowel "ng" words	mung	rung
25.	short vowel "-ing" words	rixing	mixing
26.	short vowel "wh" words	whed	when
27.	long a-e words	dake	cake
28.	long i-e words	hime	dime
29.	long o-e words	fode	rode
30.	long u-e words	nube	cube
31.	long e-e words	scebe	scene
32.	ai words	taid	tail
33.	ee words	meed	need
34.	ea words	vead	read
35.	oa words	loat	boat
36.	ay words	tay	day
37.	ow words	drow	blow
38.	ar words	flark	shark
39.	ir words	fird	bird
40.	or words	sorn	corn
41.	ur words	hurn	burn
42.	er words	merb	verb
43.	ou words	lout	shout
44.	oo words	doon	moon

	Word Category	Simulated Word	English Word
45.	ow words	fow	cow
46.	oi words	moil	soil
47.	oy words	goy	boy
48.	ew words	prew	grew
49.	au words	aulo	auto
50.	aw words	blaw	draw

APPENDIX B

SENTENCES USED IN THE PRE AND POSTTESTING OF SPELLING ON THE ENGLISH WORDS

Sentences Used in the Pre and Posttesting of Spelling on the English Words

1. hat............He wears a hat on his head.....................hat
2. big............The elephant is big............................big
3. nut............A pecan is a nut...............................nut
4. hot............A hot stove will burn..........................hot
5. red............Red is a color.................................red
6. clog...........Don't clog up the sink.........................clog
7. flap...........The bird will flap its wings...................flap
8. skin...........The sun can burn your skin....................skin
9. snag...........The thorn will snag his shirt..................snag
10. brag...........She will brag about her grades................brag
11. fret...........Don't always fret about your homework.........fret
12. prod...........Go prod the dog with a stick..................prod
13. sent...........Mother sent her to the store..................sent
14. bask...........Come and bask in the sun......................bask
15. held...........He held the toy in his hands..................held
16. next...........You are next in line..........................next
17. melt...........Butter will melt in the heat..................melt
18. back...........Turn your back to me..........................back
19. this...........This is spelling..............................this
20. bath...........We take a bath to get clean...................bath
21. rich...........Rich people have money........................rich
22. match..........Use a match to light the fire................match
23. shop...........The toy shop is open..........................shop
24. rung...........The doorbell has rung.........................rung
25. mixing.........He is mixing the finger paint...............mixing

26. when............<u>When</u> will you behave?...........................when

27. cake............I like chocolate <u>cake</u>..........................cake

28. dime............A <u>dime</u> is money.................................dime

29. rode............She <u>rode</u> on the horse.........................rode

30. cube............A <u>cube</u> of ice is cold..........................cube

31. scene...........A lake is a pretty <u>scene</u>......................scene

32. tail............The dog's <u>tail</u> is broken......................tail

33. need............We <u>need</u> food to grow...........................need

34. read............Please <u>read</u> the book...........................read

35. boat............The <u>boat</u> sank...................................boat

36. day.............One <u>day</u> is 24 hours..............................day

37. blow............<u>Blow</u> the candles out.............................blow

38. shark...........A <u>shark</u> lives in the sea......................shark

39. bird............A <u>bird</u> can fly.................................bird

40. corn............<u>Corn</u> is good to eat..............................corn

41. burn............Fire will <u>burn</u> your skin......................burn

42. verb............A <u>verb</u> is part of a sentence..................verb

43. shout...........<u>Shout</u> you name out loud.......................shout

44. moon............The <u>moon</u> circles the earth....................moon

45. cow.............We get milk from a <u>cow</u>..........................cow

46. soil............<u>Soil</u> is the same as dirt......................soil

47. boy.............A <u>boy</u> grows up to be a man.....................boy

48. grew............The tree <u>grew</u> bigger...........................grew

49. auto............An <u>auto</u> is a car................................auto

50. draw............<u>Draw</u> a picture for me...........................draw

APPENDIX C

PRETEST INSTRUCTIONS TO STUDENTS

Pretest Instructions to Students

Simulated Words-Spelling

This is a spelling test. But we are going to spell some funny words that don't mean anything. For example, "og", o-g. Is that a real word? No --og is not a real word. None of these are real words. I would like to see how many of these funny words you can spell, but I don't expect you to be able to spell them. Write the first funny word here (pointing to line #1) and go down this way (pointing down the column) as I say each word. Try to spell every word.

Simulated Words-Reading

This is a reading test, but now I want you to read some funny words that don't mean anything. As I show each word to you on a card, I want you to do your best to read the word.

English Words-Spelling

This is a spelling test, and now I will use real words. I would like to see how many of these words you can spell. I will say the word, then read a sentence with the word in it, then say the word again. Write the first word here (pointing to line #1) and go down this way (pointing down the column) as I say each word. Try to spell every word.

English Words-Reading

This is a reading test, but now I want you to read some real words. As I show each word to you on a card, I want you to do your best to read the word.

APPENDIX D

POSTTEST INSTRUCTIONS TO STUDENTS

Posttest Instructions to Students

Simulated Words-Spelling

We are going to have a spelling test again. I want to see how well you can spell the funny words you have just been learning on the television. Remember, none of these are real words. Write the first funny word here (pointing to line #1) and go down this way (pointing down the column) as I say each word. Try to spell every word.

Simulated Words-Reading

This is a reading test, but now I want to see how well you can read the funny words you have just been learning on the television. As I show each word to you on a card, I want you to do your best to read the word.

English Words-Spelling

This is another spelling test, and now I will use real words. I would like to see how many of these words you can spell this time. I will say the word, then read a sentence with the word in it, then say the word again. Write the first word here (pointing to line #1) and go down this way (pointing down the column) as I say each word. Try to spell every word.

English Words-Reading

This is another reading test, but now I want you to read some real words. I want to see how well you can read the words this time. As I show each word to you on a card, I want you to do your best to read the word.

APPENDIX E

TEACHING INSTRUCTIONS TO STUDENTS

Teaching Instructions to Students

Today we are going to start learning the funny words that you tried to spell and read last week. Remember, none of these words are real words. The words are all shown on television. I want you to pay close attention and see how well you can learn the words.

VITA

Kenneth Lester Hobby

Candidate for the Degree of

Doctor of Philosophy

Thesis: THE EFFECT OF SIMULTANEOUS AND SUCCESSIVE WORD PROCESSING STRATEGIES ON THE READING RECOGNITION, SPELLING AND SUCCESSIVE COGNITIVE PROCESSING OF ELEMENTARY SCHOOL LEARNING DISABLED STUDENTS DEFICIENT IN SUCCESSIVE COGNITIVE PROCESSING

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