THE RELATIONSHIP OF SEQUENTIAL AND SIMULTANEOUS PROCESSING TO SCHOLASTIC ACHIEVEMENT OF REFERRED STUDENTS FROM LOWER SOCIOECONOMIC RURAL BACKGROUNDS

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PREFACE

I wish to express my sincere gratitude to all of the people who have assisted me in this work. In particular, I am especially indebted to my major adviser, Dr. Paul G. Warden for his knowledge, advice, and encouragement.

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CHAPTER I

INTRODUCTION

In the present chapter the historical roots of the attempts to predict man's intellectual abilities are examined, from the traditional methods to the more current updated methods, as well as some of the problems which helped direct the transition in the attempts to make better predictions of human intelligence and mental processing abilities. The current methods of assessing mental processing, and achievement, as a form of measuring intelligence and abilities are also presented. The focus of the problems and purposes of the current study are also examined along with the limitations that are involved in conducting the present study.

Historical Roots of Intelligence Assessment

Intelligence testing is far from a recently developed phenomenon; however, the accurate assessment of intelligence is still today a major goal of professionals in the field of school psychology. The need for a definition and assessment of intelligence became apparent in the nineteenth century, and with the works of Sir Francis Galton in 1883 came the development of the testing movement (Anastasi, 1976).

Galton's interest was in the area of individual differences between both related and unrelated persons. Through the belief that sensory descrimination was a method of assessing a person's intellect, Galton devised many tests for the assessment of visual and auditory descrimination. Galton was also prominent in the constructon of questionnaires, rating scales, and with free-association techniques (Anastasi, 1976). The primary importance of Galton's work, however, was his view that intelligence had two basic characteristics; intelligence/achievement is largely inherited, and intelligence is seen as a unitary construct (Das, Kirby & Jarmon, 1979).

From the inspirations of Galton's works others began to expand the search for an accurate assessment measure of intelligence. Among the first to attempt this task was James Cattell, who introduced the term mental tests into the psychological literature (Anastasi, 1976). Cattell also felt the need for assessing sensory descrimination and developed tests similar to those of Galton in which sensory descrimination and reaction time were measured. Following James Cattell's philosophy were a group of European psychologists who developed various instruments designed to measure such sensory descrimination factors. Among these psychologists were Kraeplin in 1895, Oehrn in 1889, and Ebbinghaus in 1897, who developed tests of perception, memory, association, and motor function (Anastasi, 1976).

Psychologists Alfred Binet, Victor Henri, and Theodore

Simon, in an article published soon after the emergence of these new intelligence measures, were critical of the available tests being used at that time for being too dependent on sensory information (Anastasi, 1976). They believed that the current measures needlessly concentrated on simple, specialized abilities, and that the key to intelligence was to be found by tapping the higher mental processes of the brain. An extensive and varied list of tests was proposed, covering such functions as memory, imagination, attention, comprehension, suggestibilty, aesthetic appreciation, and many others (Anastasi, 1982). It was this type of intelligence assessment which led to the development of the now-famous Binet intelligence scales. The Binet-Simon scales were looked upon, almost from their introduction in America in 1916, as being essential for the assessment and diagnosis of mental retardation (Sattler, 1982).

The Stanford-Binet went through several decades, as well as several revisions, being the preferred instrument for the assessment of intelligence. It was not until well after the Wechsler Intelligence scales were introduced, and after the poorly reviewed 1960 Stanford-Binet revision, that the value of the Stanford-Binet began to be questioned (Lutey and Copeland, 1982). After the poorly reviewed 1960 revision of the Stanford-Binet, another revison was presented in 1972, but the Stanford-Binet has never regained the popularity it held for such a long period of time. Critics of the Stanford-Binet cited the failure to update test items and biases concerning test items as major reasons for the decline in popularity of the Stanford-Binet (Lutey and Copeland, 1982).

Wechsler began publishing intelligence tests in 1939 with the introduction of the Wechsler Bellevue I, which was followed by Bellevue II and Wechsler's other intelligence scales including scales which were designed to measure intelligence in certain age ranges: preschool, school-age, and adult (Lutey and Copeland, 1982). The popularity that the Wechsler scales have gained over previous intelligence scales has been attributed to the more careful construction and norming of the scales than were conducted previously.

The Stanford-Binet and Wechsler scales, as well as many other tests, have drawn a great amount of criticism from many who have cited problems with bias in several areas: innappropriate content, innappropriate standardization samples, examiner and language bias, inequitable social consequences, measurement of different constructs, and differential predictive validity (Lutey and Copeland, 1982).

There has recently been an instrument designed which, hopefully, will offer a resolution to many problems related to intelligence testing today. This newly developed instrument is the Kaufman Assessment Battery for Children (KAB-C). The K-ABC addresses the problem of test bias in intellectual assessment, and many procedures were implemented by Kaufman in the development of his instrument, such as updated test items, which attempt to control, or at least minimize the amount of bias in the assessment of students

(Kaufman & Kaufman, 1983).

Mental Processing and Achievement

What is of primary importance when assessing the value of the K-ABC as a new evaluation tool is that it yields scores for participants in terms of a mental processing composite, consisting of a simultaneous and sequential processing score, as well as yielding a separate achievement level score for the student. Simultaneous and sequential (also termed successive) mental processing definitions will be examined further in chapter II, however a short but thorough definition to these two forms of mental processing was presented by Kaufman and Kaufman (1983, p.30) when they stated that "simultaneous or holistic problem solving is accomplished by processing many stimuli at once, rather than stimulus-by-stimulus (or feature-by-feature) as is characteristic of sequential problem solving". Unlike simultaneous and sequential mental processing, which indicate problem solving skills in novel situations, the measure of achievement assesses factual knowledge and skills that are acquired within the school setting or through alertness to the environment (Kaufman & Kaufman, 1983). According to Kaufman and Kaufman (1983, p.33) "children who perform well on the mental processing scales would be expected to apply these intellectual abilities to the academic setting and to everyday learning situations and, hence, to perform well on the achievement subtests".

The problem upon which this study is based is one of testing and measuring the relationship, if any, between students' level of mental processing and their scholastic achievement level, indicating the predictability of achievement from the mental processing level displayed.

Since the introduction of Binet's first intelligence scale, intelligence testers held as their goal to be able to accurately predict school achievement. The argument continued on which method would best indicate or predict school achievement; was it the concept of general ability, or was it the multifactorial predictors which were most effective in predicting achievement (Das, Kirby, Jarman, 1979). Though these types of measures have been shown on occasion to predict scholastic achievement, there are a lot of problems with the nature of the prediction. The major problem is the lack of theory involved in relating intelligence and achievement (Das, Kirby & Jarman, 1979). Das, Kirby & Jarman (1979, p.69) summarizes the problems that have been involved with intelligence/achievement prediction in the past stating that

> Because a theory of the nature of intelligence has been lacking, it has not been possible to specify exactly how this general ability manifests itself in school performance. We do not know why intelligence predicts achievement, hence we do not know alot to do when low achievement is predicted.

The simultaneous-successive (sequential) mental processing model seems to have been a large step forward in the area of intelligence/achievement prediction, primarily because the model is theory based. According to Das, Kirby &

Jarman (1979, p.71) "Relations that appear between its constructs and achievement should be explicable in terms of the model and need not fall back on 'blind' prediction". Then it is evidenced that the use of a theory-based model is the correct, or preferred model, to use if more accurate prediction of scholastic achievement from intelligence measures is desired. There is, however, no evidence to base a belief that simultaneous and sequential processing will always correlate higher with achievement than will traditional intelligence measures. On the other hand the advantages in using the simultaneous-sequential model are in understanding the correlation that is obtained, and a rational base for the remediation of low achievement (Das, Kirby & Jarman, 1979).

Research Hypothesis

It is hypothesized that significant relationships will be found to exist among scores obtained on simultaneous and sequential mental processing scales, and scores obtained on achievement level scales. The research hypothesis will be tested using the multiple regression method of multivariate statistical analysis.

Problem Statement

If in fact a significant relationship between mental processing and achievement is found to exist within this defined population, then the next task would be to find which areas of achievement correlate most, and least, with simultaneous and sequential processing. Through discovering whether or not correlations in these defined areas are found, it is hoped that the results will spawn further research as well as experimentation in this area which would, hopefully, move closer toward more accurate prediction of intelligence and achievement within the defined population. It is further hoped that by contributing to the body of knowledge, in this area, an impact can be made which would aid future researchers in developing a range of intervention possibilities that can ultimately be implemented to help students, in the defined population, with low achievement.

Das, Kirby, and Jarman (1979) present some possible methods of remediation which could help improve the mental processing of those students who fall in this low-achievement range. They propose three strategies to help students avoid low achievement: Improving Process, Design of Alternative Educational Environments, and Teaching of Strategies (Das, Kirby & Jarman, 1979). Improving process involves designing a remedial program which teaches the students how to improve their processing skills. Designing of alternate educational environments involves changing the educational structure to make use of whatever strengths that the student does display, if no further improvement of processing can be made. The final method proposed is the teaching of strategies which involves teaching processing strategies to the student so that they perform to the best of their ability on any given task. The third strategy differs from the other two in that no processing deficit is assumed to be present, but rather a strategy weakness is present which needs to be improved (Das, Kirby & Jarman, 1979).

Purpose of the Study

The purpose for looking at simultaneous/sequential processing, and its relationship to scholastic achievement is threefold. First of all, if a significant relationship is found to exist between simultaneous/sequential processing and achievement, then by using this model we will be able to better understand the relationship that exists. Secondly, through understanding the relationship that exists we would have a more stronger base from which to make predictions of scholastic achievement from the mental processing abilities of students. Finally, and most importantly, if correlations are found to exist in the areas of simultaneous/sequential mental processing and school achievement, it will, hopefully, lay the groundwork for future investigations in this area, with the possibility of moving further toward proposing options for working with low achieving students within the defined population.

Limitations

The results of this study will obviously be limited in generalizability to only those students who are from a lower socioeconomic, rural community. This study, and its results, are also limited in the fact that the students were all referred for educational evaluation and were chosen from particular rural regions of Oklahoma, making the results generalizable only to students who are referred and who are from similar geographic regions.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

Very little empirical research has previously been conducted correlating level of mental processing to levels of specific areas of academic achievement. No research was found to exist looking at the relationship of mental processing level and level of achievement using an instrument which was designed to measure both of these areas. Further still, no research was found to exist correlating mental processing level and level of achievement using a population sample consisting of rural, lower socioeconomic students who had been referred for educational evaluation. The research found relating to these pertinent areas is presented in this chapter as a base upon which to build the current study. A brief investigation of earlier theories of simultaneous and sequential mental processing is presented, followed by more current theories, presented by various psychologists, which address issues pertaining to mental processing and achievement. Also presented is a rationale which justifies the selection of the defined population sample to be used in the current study. The chapter concludes with the researcher's hypotheses concerning the outcomes of the present study.

Early Theories of Mental Processing

For more than a century, it has been argued that two different types of cognitive processing operates within different hemispheres of the brain. One of the initial investigations looking at these cognitive processes was conducted by I.M. Sechenov. Sechenov (1878; cited in Majovski, 1984). was on record as being the first major theorist to suggest that human mental processes can be seen as belonging to one of two defined groups. The first group Sechenov viewed as being the integration of elements into simultaneous groups. Sechenov (1878) refered to these groups as simultaneous, and primarily spatial groups. The second group Sechenov saw as being the process of putting elements into a successive series. Sechenov refered to this group as the integration of individual stimuli which is arriving consecutively in the brain into temporally organized successive series (Sechenov, 1878).

The pioneering ideas of Sechenov (1878) were of extreme influence on the works of Russian psychologist A.R. Luria who chose to further investigate and to improve on Sechenov's philosophies. Luria (1966) chose to refer to the two modes of mental processing, set forth by Sechenov, as simply simultaneous and successive syntheses. Luria (1966) wished to qualify the meanings of the terms "simultaneous" and "successive" according to his terminology. He states that

> These terms are not sufficiently accurate. In fact, in the first case what is meant is the synthesis of successive (arriving one after the other) elements into simultaneous spatial schemes, and in the second-the synthesis of separate elements into successive series (Luria, 1966, p.74).

Luria's theory shows the brain as being divided into three major functional units or systems: arousal, process, and planning. The arousal and attention unit is located in the upper brain stem and reticular formation of the brain. The unit which is related to the processes of input, decoding, and storage of integrated informaton is found in the occipital, parietal, and frontal-temporal regions of the brain. The third unit which is responsible for the planning and the programming of the behavior is located in the frontal lobe area of the brain (Das, Kirby, Jarmon, 1975). Of these three functional units of the brain, the unit responsible for integrating information that is brought into the brain engages in two forms of activity; simultaneous and successive processing.

Luria's (1966) theory places emphasis on the contributions of each hemisphere of the brain, and he proposes that each hemisphere contributes differently to the processing of information, therefore, not isolating a specific process within a particular region or hemisphere of the brain (Majovski, 1984). Luria views the brain as being hierarchically organized, integrating messages from its lower centers as well as across its hemispheres (Majovski, 1984). Luria (1966) explains this process further by stating

> First it must be pointed out that these two forms of synthesis are originally associated with different afferent systems. I.M. Sechenov... pointed out that the synthesis of stimuli into simultaneous groups, essential for the creation of an adequate image of the outside world, is generally associated with the visual, kinetic, and vestibular apparatuses, responsible for the orientation of the body in space. Conversely, synthesis of stimuli into successive series is primarily associated with the motor system, on the one hand, and the acoustic sphere on the other. This alone will show that different areas of the cortex take part to a different degree in both forms of synthetic activity. This discovery, that different brain structures are predominately concerned with either of these forms of synthesis, rests on an anatomical basis (Luria, 1966, pp. 79-80).

Luria's (1966) hypotheses, that all of the parts of the brain are actively involved in the receiving and integrating of information, was one which was extremely influential on the philosophies and experiments of other theorists who followed him. The Luria model does not, however, predict relationships between the functional processing units and academic achievement. The research results that have been studied in this area of cognitive processing lends support to such a relationship.

Current Theories of Mental Processing and Achievement

J.P. Das (1975) was one such psychologist who adhered to many of the theories put forth by Luria on how the human brain receives and processes information. Das (1975), as well as other colleagues in the field of cognitive functioning research, studied Luria's works and experiments and set forth to define further the functions of the brain's processess. Das' (1975) definitions of simultaneous and successive were very similar to those put forth by Luria. In simultaneous processing, or integration as processing is also called, one must arrange incoming stimuli in a simultaneous manner in order to arrive at a judgement. More specifically simultaneous processing deals with the "synthesis of individual elements into simultaneous, and above all, spatial groups" (Das and Molloy, 1975, p. 213).

Das' (1975) view of successive integration was that it deals with seriation and is marked by the absence of the property of surveyability. "In successive processing, stimuli are arranged in sequence in order to arrive at task solution" (Das and Molloy, 1975, p.213).

Das felt that simultaneous integration had linkage with a spatial-visual factor, and successive integration could be linked to temporal-auditory factors. Das also followed these conclusions with the feeling that, at the same time, auditory events may be linked to simultaneous processing, just as visual events might require forms of successive processing (Das and Molloy, 1975).

As can be seen, Das and others propose similar definitions of simultaneous and successive processing modes; however, Das does not strictly accept the left hemisphere/right hemisphere theory to explain the two processing modes (Kaufman, 1982). Along with adhering to many of Luria's hypotheses of mental processing, Das felt that further investigation of these dual modes of processing was needed to determine if any link existed between simultaneous/sequential processing and school achievement (Kaufman, 1982).

In one such study conducted by Das, Manos, and Kanunga, (1975) the results indicated that both simultaneous and successive mental processing were important if the students were to be generally successful in the area of reading. In the same study Das and his collegues also found that the better readers, those who scored highest in the area of reading achievement, tended to rely more heavily on simultaneous processing.

Hunt (1980) in his study which focused on learning by intentional-incidental methods discovered that the students who were found to be high on the simultaneous factor were also found to process more incidental information. In another study, Hunt, Fitzgerald, and Randhawa (1975) discovered that those students who were found to score higher on the simultaneous factor also retained verbal material in memory for a longer period of time. Hunt along with Randhawa (1983) conducted a study which dealt with the interaction of mental processing units and levels of scholastic achievement. Their findings reflected a significant overall relationship between mental processing and achievement; "the high simultaneous and high successive groups did better on all the achievement variables than did the corresponding low simultaneous and low successive group" (Hunt and Randhawa, 1983, p. 210). In the same study Hunt and Randhawa (1983) also discovered that when measuring students' mathematics achievement, those students who scored high in simultaneous and successive mental processing obtained the highest scores in the area of mathematic achievement. Hunt and Randhawa also found the same type of results when looking at reading achievement; students who were high in the simultaneous and successive categories also obtained the highest scores in the area of reading achievement (Hunt and Randhawa, 1983).

Prior to the experiment conducted by Das and Kirby (1977) on the relationship of reading achievement, I.Q., and simultaneous-successive processing, Das stated supporting views and hypotheses concerning the predictability of scholastic achievement from the level of an individual's simultaneous-successive processing. Das (1977) stated that

> The relationship between these two modes of coding and school achievement have not yet been clearly spelled out. One could expect from the terms of the model that certain tasks performed in the school could be more amenable to one or the other form of coding or processing. At the same time, it would be clear that both forms of processing would be required in most complex tasks related to school achievement, particularily those in the language domain. In this area, for instance, both the order of words and the relations between words are important (Das, Kirby, 1977, p. 565).

Das (1977) goes on to say that in the area of prediction;

> It is possible to generate predictions from the model. Because complex achievement tasks would depend on both forms of processing, high levels of achievement should only be attainable by individuals processing high levels of both simultaneous and successive processing ability (Das, Kirby, 1977, p. 565).

In Das and Kirby's (1977) study, the purpose was to discover whether or not those students who were tested and found to be high in both simultaneous and successive processing were also found to be high in school achievement. They also wished to discover whether those students who were high in either one of the mental processing modes were able to attain moderate levels of achievement. Das and Kirby utilized several different tests in order to create a battery of tests which would accurately assess a student's simultaneous-successive processing and school achievement. The results of Das and Kirby's (1977) experiment were found to indicate that "the level of simultaneous and successive processing is related to all four measures of school achievement; proficiency with both forms of processing is necessary, but neither, by itself, is sufficient for high achievement" (Das, Kirby, 1977, p. 568). Das went on to explain that those students who did score high on only one form of processing obtained average to moderate levels of achievement, and that the resulting scores from both of these groups were approximately equal. All of their hypotheses were confirmed from the results of this study (Das, Kirby, 1977).

In light of the evidence resulting from the scientific studies of Das, Kirby, and others, it can be seen that differing levels of achievement are related to differential use of simultaneous and successive mental processing. These researchers have shown evidence that there is a significant relationship between the levels of mental processing and scholastic achievement, using subjects coming primarily from regular classrooms in urban areas. However, no research was found which looked at the interaction between mental processing and achievement using students residing in lower socioeconomic, rural areas, who had been referred for educational evaluation.

Rationale for the Use of the Sample Population Defined

There were several purposes for the selection of rural, lower socioeconomic, referred students as the population sample in the current study. In the United States approximately two thirds (67%) of all schools are located in rural areas. Out of these schools come approximately 32% of the school children of the United States (Helge, 1985). School psychologists cite various problems in serving the rural student, schools, and communities ranging from low financial resources to cultural and ethnic diversity as well as an overload of referred cases (Latham & Burnham, 1985). The underlying factor of this finding, however, is that even with the rural communities being understaffed and underserved by school psychologists, there have been approximately 1.8 million referred rural students who have been assessed and found to be educationally handicapped (Kramer & Peters, 1985).

Kaufman, one of several theorists who have hypothesized on the causes of low achievement rates, related that when looking variables such as sex, race, and socioeconomic status, SES was found to be the best predictor of intelligence and achievement level (Kaufman & Doppolt, 1976). Reschely (1982) presents a contention theory when he states that "there is a strong association between socioeconomic status and mild mental retardation. Children who are diagnosed as mildly retarded are much more likely to come from lower socioeconomic environments" (Reschely, in Reynolds & Gutkin, 1982, p. 220). The rural school districts have been generally found to be located in the areas where financial resources are low (Benson, 1985). Helge (1985) states that in schools in rural regions, poverty is at a disproportionately high rate, and she goes on to say that "mental health resources are typically innadequate in rural America, and rural schools are thought to have higher student dropout rates and lower academic achievement levels than non-rural schools" (Helge, 1985, p. 418).

Summary

All of the previously stated examples of problems in rural education settings point to the essential need to focus on the educational problems of the students in these areas. The current study will focus on students, referred for educational evaluation, who live in rural, lower socioeconomic areas of Oklahoma, which has a major portion of its schools located in rural areas. There is an obvious need, as previously cited by the literature, in these areas for help in identifying the causes of, and possible interventions for, the extreme rate of low achievement in rural community students. It is hoped that by determining if there are correlations between the two mental processing modes and different levels of achievement, in referred students from a rural, lower socioeconomic community, the current study will help to further research in this area, and further the steps taken by future researchers toward possible solutions to this problem.

CHAPTER III

METHODS AND PROCEDURES

Subjects

All of the students which were selected for participation were selected on the basis of being referred for evaluation and residing in a lower income, rural region of Oklahoma. There were a total of 30 students which were selected for participation in this study. The ages of the subjects ranged from 6 years 6 months to 11 years 10 months. The sample consisted of 22 males and 8 females.

To select subjects for participation in this particular study, the children had to be attending public school in their geographical region. The children, to be selected for participation, must also have had to been referred by their individual classroom teachers to the local Regional Educational Service Center (RESC) for a psychoeducational evaluation during the 1983-1984 school year. After the general guidelines were met and a list of potential subjects were made available, subject selection was begun. The children selected to participate in this study were between the ages of 6 years 0 months to 11 years 11 months (1st through 5th grades). A criterion in the selection process was that the children who were to be selected had been referred because of general low academic achievement or a delay specifically in reading or mathematics. A total of 30 students were selected for participation in this study who met the above criteria.

Procedures

Following selection of all of the participants who met all of the selection requirements, each of the participants were administered the Kaufman Assessment Battery for Children (K-ABC) in a private room at the location of the student's school. Approximately 45 to 50 minutes was required for the administration of the K-ABC. The K-ABC was administered by either one of the staff psychometrists with the respective RESC or one of four volunteer psychometrists. The names of the participants were randomly drawn and assigned to the respective psychometrist for testing. The psychometrist may or may not have known the subjects that they tested. There was no effort made to match any participant with any particular psychometrist.

The K-ABC was administered and scored by the psychometrists and was double checked for accuracy by another psychometrist. Once the K-ABC was administerd and scored, the scores obtained from the K-ABC for each student were grouped together. The sample subjects were then assigned numbers and the names were then destroyed to insure complete privacy of the individual participants.

Instrumentation

The assessment tool which was used for obtaining data for this study was the Kaufman Assessment Battery for Children (K-ABC).

Kaufman Assessment Battery for Children (K-ABC)

The Kaufman Assessment Battery For Children was the product of an effort put forth by Alan and Nadeen Kaufman (1983) who were in search of a better form of intelligence assessment. The K-ABC was published in 1983 and contains eight mental processing subtest scores which each yield a standard score with a mean of 10 and standard deviation of 3 at each age level. The K-ABC also gives scores in three "Global" areas of mental processing. These areas are sequential mental processing, simultaneous mental processing, and an overall combined mental processing composite score. These global areas all have a mean set at 100 and a standard deviation of 15.

The K-ABC also contains a separate achievement scale. Whereas the mental processing scales assess the student's problem solving skills in novel situations, the achievement scale assesses the student's factual knowledge and certain sets of skills which a student should acquire from school or through his/her environment. The achievement scale has a mean of 100 and a standard deviation of 15. It gives the examiner pertinent information and data which he/she could not have gotten just from looking at the mental processing composite scores. A combination of visual and verbal stimuli, verbal comprehension and non-verbal expression, and sequential and simultaneous information processing make up the tasks for the achievement scale of the K-ABC. Refer to Table 1 for a complete listing of the sixteen K-ABC subtests which measure sequential processing, simultaneous processing, and achievement level.

Norming of the K-ABC

Before the statistical treatment of the standardization data was conducted, different samples were analyzed to find out if different age groups differed from each other systematically on critical background variables (Kaufman & Kaufman, 1983). Kaufman and Kaufman (1983) found that "the similarity of these separate age groups was supported by the degree to which the different age levels matched the 1980 U.S. Census proportions on the various stratification variables" (Kaufman & Kaufman, 1983, p. 71). Kaufman (1983) wished to also show the age-by-age similarity on a separate measure of cognitive ability, the Peabody Picture Vocabulary Test-Revised (PPVT-R). The results indicated only minor fluctuations from age-to-age, with a non-significant F-value (0.77) obtained from performing an analysis of variance (Kaufman & Kaufman, 1983). As reported by Kaufman (1983) "Normalized standard scores with a mean of 100 and a standard deviation of 15 were developed for each achievement subtest within each age group, and normalized standard scores with a mean of 10 and a standard deviation of 3 (designated scaled scores) were developed, by age, for each mental processing subtest" (Kaufman & Kaufman, 1983, p. 72-73). Kaufman further stated that the estimation procedures that were used were reasonably accurate because of being based on standardization age group trends and the use of the same standardization scaling procedures. In the norming of the K-ABC there were a total of 807 black students and 1569 white students which comprised the norming sample (Kaufman & Kaufman, 1983).

Validity

Many studies were conducted by Kaufman and other researchers to determine the degree to which the K-ABC accomplished the tasks for which it was designed. The studies which were conducted offer evidence of validity on all three types (construct, predictive, and concurrent) of validity.

Construct Validity. The evidence of the construct validity of the K-ABC is organized around five areas which correspond to those described by Anastasi (1982) as contributing to a test's construct validation: developmental changes, internal consistency, factor analysis, convergent and divergent validation, and correlations with other tests.

Developmental Changes. Instruments which purport to measure intelligence or achievement or other functioning, that have a consistent relationship to chronological development, must show evidence of significant age differentiation to support claims of construct validity. Reynolds, Chatman, and Wilson (1983; cited in Kaufman and Kaufman, 1983) correlated the raw scores taken from the K-ABC subtests to chronological age. They found significant correlation ranging from .65 to .90 while correlating age with each of the K-ABC subtests. The results reported by Reynolds, Chatman, and Wilson (1983) compare with that of the WISC-R Performance and Verbal subtests which ranged from the lower .60's the the lower .80's. Reynolds, et al (1983) stated that from their findings, the K-ABC demonstrates construct validity as a developmental measure for boys and girls of different ethnic backgrounds, and the battery appears to lack any race or sex bias that would dictate any changes in test interpretation based on a child's particular background (Kaufman & Kaufman, 1983).

Internal Consistency. The K-ABC subtest scores were correlated with Total test scores so that the level of internal consistency was determined. The range on the Mental Processing Composite for 11 separate age groups was from .40 to .76 with a mean of .60, which indicates evidence of construct validity of the mental processing composite. From all of the subtests, which were correlated, the best measure found of Total Processing for the school-age child were the Matrix Analogies, Photo Series, and Triangles.

Internal consistency for the achievement scale on the K-

ABC was high, ranging from .69 to .89 with a mean of .82 (evidence again of construct validity). On the achievement scale the best measure of achievement was found to be the Reading/Understanding subtest.

Factor Analysis. Defining intelligence with the K-ABC involves distinguishing between two types of mental processing (simultaneous and sequential). Therefore, it was important to show that these two types of processing underlie the mental processing composite. It was also necessary to show factor analytic evidence of the achievement dimension. The two methods used for factor analysis on the K-ABC were principle factor analysis and confirmatory factor analysis.

Principle components analysis and principle factor analysis were conducted for the mental processing subtests alone and also for all K-ABC subtests at each age between 2 1/2 and 12 1/2, using data from 2,000 standardization sample cases (Kaufman & Kaufman, 1983). When the mental processing subtests were analyzed there was clear support of only two factors at each age level.

The best measures of the simultaneous processing group were Triangles and Photo Series subtests. The best measure of the sequential processing series were Word Order and Number Recall subtests. Simultaneous and sequential processing factors were correlated with standard scores to verify that the mental processing scales represent certain constructs. The coefficients that were found ranged from .84 to .96 (mean

.91) on the simultaneous processing scale offering further support of construct validity. On the sequential processing scale coefficients were found to range from .78 to .95 (mean .89) also offering support of construct validity. Coefficients of opposite names, as expected, ranged much lower, from .25 to .46 (mean .34) indicating the confirmation of the sequential/simultaneous dicotomy in all age groups (Kaufman & Kaufman, 1983).

In the confirmatory factor analysis process the tasks are predesignated as belonging to a certain dimension, and the factor analytic procedure will determine if the data supports the proposed organization of the tasks. The final factor solutions produce loadings on each factor for the variables that are believed to measure that particular dimension and all other variables are automatically assigned zero loadings. Chi-square is then computed for each analysis to determine whether or not the proposed factor is confirmed (Kaufman & Kaufman, 1983). Wilson, Reynolds, Chatman, and Kaufman, (1983) conducted confirmatory analysis of the K-ABC. As reported by Kaufman (1983), two factor solutions were analyzed for the mental processing subtests and three-factor solutions for all K-ABC subtests combined. Results indicated that the sequential-simultaneous-achievement grouping of K-ABC subtests was confirmed at all ages. Significant chi-square values were found to exist for all analyses and substantial factor loadings (in excess of .55) were found for the subtests on each factor (Kaufman & Kaufman, 1983). Both factor analysis methods attest to the construct validity of the K-ABC, particularily the confirmatory analysis because it provides the most information for evaluating the validity of the K-ABC scale structure (Kaufman & Kaufman, 1983).

<u>Convergent and Discriminant Validation</u>. In this area there was a need to show that the K-ABC correlates highly with like variables (Convergent validation) and correlates poorly with unlike variables or variables from which it was expected to differ. The K-ABC was correlated with a Processing Scale developed by Das, Kirby, and Jarman (1975, 1979) dealing with successive/simultaneous processing. Their theory was that the sequential processing scale would correlate highly with the successive factor put forth by Das, Kirby, and Jarmon and the sequential factor would correlate poorly with their simultaneous factor. They theorized the reverse for the simultaneous processing factor of the K-ABC. The Das, et al (1975, 1979) battery was a pertinent criterion for this analysis because of its foundation in Luria's theory and because of the considerable factor analytic support for the mental processing dicotomy that underlies this battery (Kaufman & Kaufman, 1983).

The results showed that the sequential processing scale subtests consistently correlated more highly with the successive Processing factor of Das-Kirby-Jarmon (.69) than it did with the simultaneous factor (.27). The reverse was also true for the simultaneous processing subtests of the K-ABC (.47 & .11). The results, therefore, show indication of support for the construct validity of both mental processing scales of the K-ABC (Kaufman & Kaufman, 1983).

Correlations With Other Tests. Since the Stanford-Binet and Wechsler Scales have been found to be widely accepted forms of intelligence assessments, the K-ABC was correlated with these tests to demonstrate further construct validity.

The correlation of the K-ABC Mental Processing Scale and the WISC-R Full Scale I.Q. was found to be .70. The K-ABC Achievement Scale also correlated more highly with the WISC-R Verbal I.Q. than with the Performance I.Q. (.78 achievement to verbal & .50 achievement to performance) which was expected "because of the linguistic, culture loaded, and school related features that characterize both the K-ABC achievement and the WISC-R verbal scales" (Kaufman & Kaufman, 1983, p. 111). The K-ABC Mental Processing Composite correlated almost equally well (.61 & .59) with both the WISC-R Verbal and Performance I.Q. Scales. The results of correlation of the K-ABC and the WISC-R offered support for construct validity of the K-ABC (Kaufman & Kaufman, 1983).

Six correlational studies were conducted correlating the K-ABC with the Stanford-Binet Intelligence Measure. Four groups consisted of normal samples, one group contained high-risk preschool students, and one group contained referred gifted students. The Stanford-Binet showed a correlation of .61 with the K-ABC Mental Processing Composite and the Stanford-Binet correlated at .78 with the K-ABC Achievement

Scale, with normal school-age children comprising the sample. When high-risk preschool students were compared, the correlation of the Stanford-Binet and the K-ABC Mental Processing Composite was .66, and .52 when comparing the Stanford-Binet and the K-ABC Achievement scale. The gifted students showed a correlation of .47 when comparing the Stanford-Binet and the K-ABC Composite, and .55 when comparing the Stanford-Binet to the K-ABC Achievement scale. When correlating the simultaneous processing, sequential processing, and non-verbal standard scores, there were correlations found with the Stanford-Binet ranging in the low .50's. The correlation found to be the most substantial was the correlation between the K-ABC Achievement Scale and the Stanford-Binet; the correlation was .78 for the 121 children sampled. The data supports overall validity of the K-ABC using the Stanford-Binet for a criterion (Kaufman & Kaufman, 1983).

Predictive Validity. The K-ABC Achievement Scale is designed to indicate performance and to predict the future performance of a child's academic competencies. The overall mental processing composite should also be a predictor of academic achievement (Kaufman & Kaufman, 1983).

Six studies were conducted to test the predictive validity of the K-ABC Scales, with other individual or group achievement tests as the criteria. The time intervals between the K-ABC administration and that of the criterion test ranged from six months to one year. There were three studies

(Murray & Bracken, study 28) which used the Peabody Individual Achievement Test (PIAT) as the criterion. The K-ABC Achievement Scale score showed a correlation range of .67 to .82 with PIAT Total in these studies and, therefore, was a good predictor of school achievement. The mental processing composite score correlated in the .50's with the PIAT for the normal and culturally different samples.

Two other studies (Childers, Durham, & Bolen, study 9, in Kaufman & Kaufman, 1983), (Lewis, Swerdlik, study 25, in Kaufman & Kaufman , 1983) which were conducted to determine predictive validity of the K-ABC were performed using achievement batteries which were group administered. The group administered tests were the Iowa Tests of Basic Skills (ITBS) and the California Achievement Test (CAT). Substantial correlation was found in correlationg the K-ABC Achievement Scale with these tests. The correlation of the K-ABC Achievement Scale to the ITBS was .89 and the correlation of the K-ABC Achievement Scale to the CAT was found to be .77. Correlation of the K-ABC mental processing composite was found to be .58 with the ITBS Composite and .65 with the CAT Total (Kaufman & Kaufman, 1983).

Concurrent Validity. Kaufman (1983) stated that like predictive validity, concurrent validity concerns the relationship of a test to meaningful criteria. Kaufman suggests that school achievement tests are the best measures of concurrent validity.

Kamphaus (1982) analyzed the data during standardization of the K-ABC along with the data obtained from the Passage Comprehension subtest with the Woodcock Reading Mastery Tests (WRMT) and the 40 written computation items on the KeyMath Diagnostic Arithmetic Test. The correlation of the achievement scale was .82 and the Mental Processing Composite indicated a correlation of .63 with Passage Comprehension. Correlation of the Sequential and Simultaneous processing scales was in the mid .50's. The coefficients for the Mental Processing Composite and KeyMath was .50.

Concurrent validity was also tested using the Wide Range Achievement Test (WRAT), (Zins & Barnett, study 43, in Kaufman & Kaufman, 1983), (Bolen, Childers, Durham, & Rouse, study 4, in Kaufman & Kaufman, 1983), and (Nelson, study 34, in Kaufman & Kaufman, 1983). The correlation was reported to range between .39 and .64 with the WRAT in the areas of Reading, Arithmetic, and Spelling.

Reliability

In determining the reliability of the K-ABC, a variation of the standard procedure for computing split-half reliability was used which takes advantage of the Rasch-Wright one parameter latent-trait model. The Rasch-Wright model tests for item bias and significant differences between difficulty estimates for two groups' scores on an item. The split-half reliability coefficients reflected good internal consistency for the K-ABC subtests across all age ranges

(Kaufman & Kaufman, 1983). The obtained mean value for 12 of the 16 subtests was found to be at .80 and above. There were no coefficients at any age which went below .70, and few even fell below .75. Internal consistency reliabilities for the Global scales of the K-ABC had a mean coefficient range from .86 (Simultaneous) to .93 (Achievement) for preschool children, and from .89 (Sequential) to .97 (Achievement) for school-age children. The mean values for the mental processing components and achievement exceeded .90 at both the preschool and school-age levels, indicating excellent internal cosistency for the global scales in the battery (Kaufman & Kaufman, 1983).

The test-retest stability of the preschool children fell in the range of .77 to .95. For the 5 to 8 year old children the test-retest stability coefficients fell within the range of .82 to .95 which reflects stability over time. In the age range of 9 1/2 to 12 years the test-retest stability coefficients fell within the range of .87 to .97, also reflecting good stability.

Intercorrelations. The degree of relationship among the components of a test battery plays an important role in determining the reliability of an instrument, and affects the interpretation of profile fluctuations (Kaufman & Kaufman, 1983, p.90). In the intercorrelation of the Global scales, it was found that there was only a moderate relationship between simultaneous and sequential processing. In this instance the mean correlation for preschool children was found to be .41

and the mean correlation for school-age children was found to be .50. The simultaneous and sequential scales both correlate more highly with achievement. The sequential processing degree of relationship with achievement was .46 for preschool children and .62 for school-age children. The simultaneous processing correlation with achievement was .64 for preschool children and .66 for the school-age children. The mental processing composite and its correlation with achievement was shown to have a substantial relationship (.70 to .79) between the ages of 3 to 12 1/2 years. There was a lower correlation score at age 2 1/2 in the mental processing composite and its correlation with achievement (.56). The authors stated that the lower relationship at age 2 1/2 undoubtedly relates to the limited definition of the processing construct on the K-ABC for very young children (Kaufman & Kaufman, 1983). The authors also point out the distinction between the two information processing scales. The correlation (.40 to .50) between the sequential processing and simultaneous processing scales are high enough to justify their combination into a Global measure of intelligence, but moderate enough to confirm their separate existence. According to Kaufman (1983) the finding that each scale, by itself, correlates well with achievement supports the important roles that both sequential and simultaneous processing play in a child's performance on tests of factual knowledge and school related skills (Kaufman & Kaufman, 1983, p. 91). The higher intercorrelations between the achievement scales and the mental processing scales reflect a meaningful relationship between the two (Kaufman & Kaufman, 1983).

CHAPTER IV

RESULTS

The statistical procedure which was chosen to analyze the data obtained from the samples drawn for this study is the Multiple Regression Method of Multivariate Statistical Analysis. The dependent variables in this study are the sequential and simultaneous mental processing scores of referred students from a lower socioeconomic, rural community. The independent variables of the study are the scholastic achievement subtest scores, of the referred students, which are obtained from the scholastic achievement section of the K-ABC. In the present study the multiple regression analysis technique was used to assess the relationship between sequential and simultaneous mental processing to the overall achievement scores, as well as assessing the relationship of sequential and simultaneous processing to each individual area of achievement. Multiple regression was used to test the hypothesis, that a relationship exists between sequential/simultaneous mental processing and achievement within the defined population.

The total number of subjects in the sample was somewhat small in relation to the number of variables, resulting in a subjects-to-variables ratio of 6:1. It would have been more desirable to have had a larger subjects-to-variables ratio to make the results more generalizable to the population. The small sample size places considerable limits on this generalizability.

Tabachnick & Fidell (1983) define the term outliers as being cases with such extreme values on one or a combination of variables that they unduly influence the size of correlation coefficients, the average value for a group, or the variability of scores within a group (Tabachnick & Fidell, 1983, p. 72). An investigation of the outliers indicated that none existed in the data set (See Table #2). An examination of the skewness of each variable was also conducted and the results indicated that no significant skewness was present among the variables.

Two multiple regression analyses were performed on the data utilizing the SPSSX REGRESSION computer package. The first multiple regression analysis was computed between the dependent variable sequential processing and the independent variables faces & places, arithmetic, riddles, reading/decoding, and reading/understanding. In this analysis a total of 30 cases were processed with 28 cases actually being used for the analysis. Two of the cases had at least one predictor variable missing and, therefore, had to be eliminated from the analysis. In the first analysis (see Table #3) the only significant predictor of sequential processing was arithmetic, which yielded an F-value of 7.044 ($p. < .05$). In the analysis, 21% of the observed variability in sequential mental processing can be explained by the independent variable arithmetic (R squared = 0.213). The adjusted R-squared value, which attempts to correct R-square to more closely reflect the goodness of fit of the model in the population, indicated a somewhat lower percentage of observed variability (18%) in sequential mental processing which can be explained by the independent variable arithmetic (Adjusted R-squared = .1829). The overall correlation of the dependent variable sequential processing with all 5 independent variables, with an F-value of 1.846, was found to be non-significant at the .05 level indicating no significant contribution from the variables beyond arithmetic.

The second multiple regression analysis (See Table #4) was computed between the dependent variable simultaneous processing and the independent variables faces & places, arithmetic, riddles, reading/decoding, and reading/understanding. Simultaneous processing was significantly correlated with the independent variables arithmetic and faces & places. Simultaneous processing correlated most highly with arithmetic which had an F-value of 17.843 ($p<.05$). Simultaneous processing was also found to be correlated with faces & places which had an F-value of 12.242 ($p<.05$). The results indicate that the variable faces and places contributed approximately 9% (R-squared change = .0878) of the observed variability beyond that of the independent variable arithmetic. In this analysis nearly 41% (R squared = 0.406) of the observed variability in simultaneous mental processing can be explained by the independent variable arithmetic. The adjusted R-squared value indicated a somewhat lower percentage (38%) of observed variability in simultaneous mental processing that can be explained by the independent variable arithmetic (adjusted R-squared = .3842). Of the 5 independent variables 49% of the observed variability in simultaneous mental processing can be explained by the two independent variables arithmetic and faces & places (R squared = 0.494). The adjusted R-squared value reduced the percentage, of the observed variability in simultaneous mental processing that can be explained by the 2 independent variables (arithmetic and faces & places), to 45% (adjusted R-squared = .4544). The overall correlation of the dependent variable simultaneous processing with all 5 independent variables (F-value = 5.215) was found to be non-significant at the .05 level, indicating no significant contribution from the variables beyond arithmetic and faces and places.

In the present study it was hypothesized that a significant relationship would be found among simultaneous mental processing and the 5 achievement scales: arithmetic, faces and places, reading/decoding, riddles, and reading/understanding. The results indicate significant correlation of simultaneous processing to arithmetic and faces and places, lending support for the hypothesis for these two variables. The correlation of simultaneous processing to the 3 remaining independent variables was non-significant and, therefore, the hypothesis was rejected for the 3 variables.

It was also hypothesized that a significant correlation would be found among sequential mental processing and the 5 achievement scales. The results indicate the correlation of sequential processing to arithmetic to be significant, lending support for the hypothesis for that variable. However, the hypothesis was rejected for the 4 remaining independent variables which had non-significant correlations with sequential processing.

CHAPTER V

DISCUSSION

This study examined relationships among mental processing and achievement using an instrument (K-ABC) which measures both of these areas. Also examined were the multiple correlations of the individual achievement subtests with each form of mental processing.

According to the results of the study a relationship was found to exist between sequential mental processing and arithmetic, indicating a better prediction of sequential processing from arithmetic than from the other achievement subtests. A significant relationship was found to exist between simultaneous mental processing and both "arithmetic" and "faces & places" subtests indicating that both of these subtests play an important role in the prediction of simultaneous processing, with arithmetic as the better predictor.

After reviewing the related literature it was expected and hypothesized that significant relationships between either form of mental processing and the five levels of achievement would be found. The study results indicated that the previously stated hypothesis was not rejected, because of the significant correlation of the achievement subtest "arithmetic" with both the sequential and simultaneous processing level. According to Kaufman (1983) the K-ABC subtest "arithmetic" utilizes both simultaneous and sequential processing in its assessment of the child's abilities, and "arithmetic" was found to be significantly correlated with both forms of mental processing in the current study. The K-ABC achievement subtest "faces & places", which is primarily a simultaneous ability, was only significantly correlated with simultaneous processing which supported the hypothesis. Significant correlations were not found, however, with the remaining K-ABC achievement subtests and simultaneous/sequential mental processing: the subtest "riddles" which utilizes primarily simultaneous abilities; the subtest "reading/decoding" which utilizes both simultaneous and sequential mental abilities; and the subtest "reading/understanding" which also utilizes both simultaneous and sequential abilities.

Taking into account the significant correlations which were found, one conclusion to the current study is that utilizing instruments/materials designed to test the child's concentration, identification, and computation skills (i.e. K-ABC "arithmetic" assessment) would better predict the child's sequential and simultaneous processing level. Also, assessing the child's alertness to the environment, the child's early environment, and general factual knowledge through tests such as the K-ABC "faces & places" would be a good indicator of the child's simultaneous processing level.

Recommendations

There are several improvements which could be made in the present study which might aid future researchers in better identifying the relationships which exist between mental processing and achievement level. The major improvement which can be seen is the need for a greater sample size. The sample size used for the present study was relatively small in nature with a 6:1 subjects to variables ratio. A larger sample size would be helpful in obtaining statistical results which might be more generalizable to the total defined population.

There are variations to the current study which might also prove to be useful to the future researcher in this area. One variation might be to conduct the experiment, utilizing the defined sample population, including other variables not used in the present study such as sex, age, or racial background.

Another variation might be to conduct a similar experiment using the defined sample population and utilizing several different assessment instruments, and possibly comparing different types of academic abilities, obtained from those instruments, with the simultaneous/sequential mental processing scores obtained from the K-ABC.

Another variation to the present study might be to test the relationships of sequential/simultaneous mental processing obtained from other assessment instruments and to the achievement areas ("arithmetic", "faces & places") which were found to have significant correlation in the current study.

Certainly a future study, or a variation of the present study, would be useful to future researchers in their attempts to identify patterns of correlations between the level of mental processing and academic achievement level within the defined sample population. It is hoped that studies such as the current one, as well as those which might stem from it, would aid future researchers to ultimately devise better methods of working with and teaching children who are referred for evaluation and coming from lower socioeconomic, rural backgrounds.

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APPENDIX

TABLE I

THE SIXTEEN SUBTESTS OF THE K-ABC

SUBTEST	SCALE MEASURED	DESCRIPTION
Hand Movements	Sequential Processing	Performing a series of hand movements in same sequence as examiner.
Number Recall	Sequential Processing	Repeating a series of digits in the same sequence as the examiner
Word Order	Sequential Processing	Touching a series of silhouettes of common objects in same series as examiner said them.
Magic Window	Simultaneous Processing	Identify a picture which the examiner exposes by moving it behind a narrow window.
Face Recognition	Simultaneous Processing	Select from a group of photos the faces shown on the previous page.
Gestalt Closure	Simultaneous Processing	Naming an object in an "inkblot" drawing.
Triangles	Simultaneous Processing	Assembling triangles into an abstract pattern to match a model.
Matrix Analogies	Simultaneous Processing	Select the meaningful picture or design which completes an analogy.
Spatial Memory	Simultaneous Processing	Recall the placement of pictures on a page that was exposed briefly.
Photo Series	Simultaneous Processing	Placing photos of an event in chronol. order.
Expressive Vocabulary	Achievement Scale	Name the object pictured in a photograph.
Faces & Places	Achievement Scale	Name the well-known person or place in photo
Arithmetic	Achievement Scale	Demonstrate knowledge of numbers and math concept and other math abilities
Riddles	Achievement Scale	Inferring the name of a concrete or abstract concept given traits.
Reading/ Decoding	Achievement Scale	Identifying letters and reading words.
Reading/ Understanding	Achievement Scale	Demonstrate reading comp by following commands given in sentences.

TABLE II

HISTOGRAM TO LOCATE OUTLIERS

N	EXP N		(* = 1 CASES, . : = NORMAL CURVE)
0	.02	OUT	
0	.04	3.00	
0	.11	2.57	
0	.25	2.33	
1	.51	2.00	:
1	.94	1.57	:
1	1.54	1.33	*.
5	2.26	1.00	*:***
2	2.97	.57	**.
5	3.51	.33	***:*
0	3.71	.00	.
2	3.51	-.33	** .
4	2.97	-.57	**:*
1	2.26	-1.00	*.
5	1.54	-1.33	*:***
0	.94	-1.57	.
1	.51	-2.00	:
0	.25	-2.33	
0	.11	-2.57	
0	.04	-3.00	
0	.02	OUT	

TABLE III

MULTIPLE REGRESSION SUMMARY STATISTICS OF THE INDEPENDENT VARIABLE ARITHMETIC WITH THE DEPENDENT VARIABLE SEQUENTIAL PROCESSING

Var.	Mult. R	R^2	Adj. R^2	F	Sig. F	R^2 Ch.	Sig. F Ch.
ARITH	.4617	.2132	.1829	7.045	.0130	.2132	.0130

TABLE IV

MULTIPLE REGRESSION SUMMARY STATISTICS OF THE INDEPENDENT VARIABLES ARITHMETIC AND FACES & PLACES WITH THE DEPENDENT VARIABLE SIMULTANEOUS PROCESSING

Var.	Mult. R	R^2	Adj. R^2	F	Sig. F	R^2 Ch.	Sig. F Ch
ARITH	.6380	.4070	.3842	17.844	.0000	.4070	.0000
F & P	.7034	.4948	.4544	12.242	.0000	.0878	.0470

VITA

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