



Field dependence-independence and reading achievement of sixth grade children
by Dorothy Fay Bush Schillings

A thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Education
Montana State University

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Abstract:

The problem of the study was composed of two parts: (1) could reading achievement scores be predicted from scores of a measure of field dependence-independence and (2) to determine if a composite of the independent variables (field dependence-independence, intelligence, gender, race, age, and socioeconomic status) might be used to classify individuals into selected reading groups.

Stepwise multiple regression was used to analyze the data for prediction. The F test was applied to determine if the was significant at the $P < .05$ level.

Discriminant function analysis techniques were used to determine composites of the independent variables to classify the cases in the study into reading group membership. The chi square statistic was used to test for the significance of the discriminating functions at the $P < .05$ level.

The conclusions of the study indicated that the measure of field dependence-independence used in the study was statistically significant at the $< .05$ level from the stepwise multiple regression analysis. However, the variance was so small and combined with other variables that the measure alone could not predict reading scores. Discriminant analysis revealed significant discriminant composites for identifying likely reading group membership for individuals. It was concluded that the measure of field dependence-independence utilized in the study could be helpful as a supplement to the assessment procedures used by educators in the development of programs to enhance the reading achievement of sixth grade children.

Recommendations included suggestions for studies in field settings applied to field dependence-independence and (1) information processing; (2) stability or change in individuals over the time spent in school; (3) black children, especially females, to determine possible school influences; (4) classroom influences such as classroom organizational patterns; (5) the study profiles of children; (6) different types of curriculum materials; (7) teacher awareness of information processing differences of individuals; (8) parent awareness and involvement; and (9) teacher education programs.

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OF SIXTH GRADE CHILDREN

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APPROVAL

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This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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ABSTRACT

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CHAPTER ONE

Introduction

Educators have long been aware of individual differences in children and that gaps in achievement widen, especially in reading (Chall, 1983), as students progress through elementary school (Daneman, Carpenter, and Just, 1982). Authorities (Bloom, 1976; Bruner, 1966; Carroll, 1963; and Lesser, 1971) considered those differences to be related to the failure of accommodating instructional programs to individual differences as the learning environment is structured and instructional methods and strategies are planned.

Sternberg and Powell (1983) suggested that if the variables which account for individual differences can be identified and if instruction is adapted to individual needs, then maximum individual achievement might be realized. Educators included many different variables such as achievement, intelligence, and age in planning for individual differences. However, cognitive styles which also vary with individuals, have been considered infrequently (Saracho, 1984).

Cognitive styles, a psychological term defined by investigators, referred to the relatively stable ways individuals tend to process information. The investigators used the term to describe how one perceives, remembers, thinks, and solves problems. Of the more than nineteen cognitive styles identified, the common element underlying all of them was that each represented a contrast between two ways of cognitive functioning influenced by different sets of interacting characteristics within individuals (Messick, 1976; 1979).

Field dependence-independence, a cognitive style investigated by Witkin and his associates for more than thirty years (Witkin, Moore, Goodenough, and Cox, 1977), has generated more than 3000 references (Kogan, 1980). Field dependence-independence was described as contrasting ways in which individuals do the following: (1) locate and use basic elements from materials that are already organized (2) structure information that is unorganized, and (3) provide a different structure from that suggested in the available information (Frank, 1983).

According to Witkin and Goodenough (1977), field dependent individuals differed from field independent individuals in how they structured information and in how they reacted to cues available to them in a task situation. Field dependent subjects often required outside help (teachers) to structure material that had little or no

structure. They were dominated by the most obvious cues in a task situation while they ignored cues that were important but not as obvious.

In contrast, field independent individuals functioned with little outside help in organizing and structuring tasks. They attended not only to the obvious cues but also the other less obvious ones that were available (Goodenough, 1976; Witkin and Goodenough, 1977). Witkin and Goodenough (1981; cited in Frank, 1983: 90) considered field independent individuals to be more "flexible information processors" than field dependent individuals.

Field dependence-independence was grounded in Gestalt psychology with its emphasis on mental organization (Witkin and Goodenough, 1981). An area of cognitive psychology, information processing theory, influenced the developers of reading models that emphasized basic thinking processes (Anderson and Pearson, 1984). It could be hypothesized that field dependence-independence might be related to the cognitive processes underlying reading comprehension. In information processing theories, people were viewed as having the capacity to transform, store, retrieve, and use information when it is needed. Thus, how "information from print is taken in and transformed to meaning" was described in information processing models of reading (Samuels and Kamil, 1984: 191).

The influence of an information processing approach to

the study of cognitive processes related to reading can be seen in the reading models developed during the 1970s and 1980s (Gough, 1972; Kintsch and van Dijk, 1978; LaBerge and Samuels, 1977; Rumelhart, 1977). Although all of these reading models were developed with an information processing base they differed in several important ways. Models were conceptualized according to how reading processes flowed through an information processing sequence.

If reading comprehension were an information processing activity as suggested by these models and since field dependence-independence, assessed by the Group Embedded Figures Test, was described as a measure of differences in how individuals process information, then it might be helpful for curriculum directors, reading specialists, classroom teachers, or others to be aware of these differences. The specialists might utilize information on each child's cognitive style, field dependence-independence, in the development of a most effective reading program for each individual.

Kirby (1984: 51) expressed the idea that as more elaborate models of human information processing, taking into account individual differences, were developed from cognitive psychology, such models needed to be applied in schools. He pointed out that curriculum specialists should work to add the analysis of cognitive processes to assessment procedures used in schools. After that,

instruction might be designed to include information concerning individuals' cognitive processes. Using that type of approach would provide "a more realistic and coherent framework" for the investigation of educational problems than an approach using only information gathered about individuals from the traditional psychometric perspective.

Mayer (1981) argued that the psychometric approach now used in schools in locating and measuring individual differences was inadequate since the processes underlying these differences were not described. In addition, Anastasi (1984: 181) stated:

Analyzing individual performance at the level of basic cognitive processes should eventually make it possible to pinpoint each person's sources of weakness and strength and thus enhance the diagnostic use of tests.

Lohman and Kyllonen (1983) commented that good psychological models of individual differences in school learning have not been generated. They pointed to recent developments in cognitive psychology for attempts to understand individual differences in cognitive processes and structures as those processes and structures relate to complex problem solving and school learning. This (Lohman and Kyllonen, 1983: 106) might help educators "to adapt instruction to the relatively stable characteristics of the learner or to directly train these characteristics." Wittrock (1978: 90) agreed and contended that "potentially

significant contributions ... to the individualization of instruction" might be made through research on cognitive style.

The present investigator first became interested in reading comprehension as a reasoning, thinking process while teaching in the elementary classroom. The interest continued with work in teacher training at the university level. In the elementary school, at the upper levels, the curriculum began to require reading tasks that demanded not only the ability to decode the material but also to organize and restructure it for comprehension. Due to these needs, numerous requests from classroom teachers for extension courses and for workshops concerned with reading comprehension were made to interested individuals at the university. It is hoped that the present study will point to an area of individual differences not widely examined by teachers and that it may offer aid in instructional planning to enhance the reading achievement of children.

Statement of the Problem

The problem of the study was to investigate the relationships between reading comprehension and field dependence-independence of sixth grade children. The problem had two components: (1) to study relationships between reading achievement and field dependence-independence, intelligence, age, gender, race, and socioeconomic status at the sixth grade level; and (2) to

examine the composites of the variables (field dependence-independence, intelligence, age, gender, race, and socioeconomic status) that show maximum differences and minimum overlap among reading achievement groups.

Need for the Study

The need for the study was derived from three viewpoints: (1) the continuing commitment of educators and the public to identify and provide for individual differences of children to assure their competency in reading; (2) suggestions from investigators from the fields of education and psychology concerning the need for a better understanding of how children process information; and (3) because of limited and confusing results revealed from an examination of studies on the relationship of field dependence-independence to the reading achievement of upper-elementary children.

Recognition of differences in individuals and the commitment to accommodate them has been accepted by educators and expected by the public regardless of these differences (Wardhaugh, 1969). Many different types of instructional materials and organizational plans for schools have been tried to meet these expectations (Fries, 1963; Smith, 1969). Gibson and Levin (1975) commented that in spite of more than forty years of concentrated effort problems still existed. One of the problems they cited is that as many as twenty-five percent of the children in

school read below their expected level. Guthrie (1984) reported that a study commissioned by corporations with sales of over \$100 million found deficiencies in reading of their employees that were severe enough to cause a loss of time and productivity.

Williams (1981) stated that since the 1950s courts and legislatures assume an active part in public education. He interpreted the court as saying each child comes to school with individual differences implying that teachers are obligated to develop reading instruction based on each child's needs. Pavlonnis reported (1985) that, in Montana, the courts ruled that juvenile delinquents were handicapped students. As such, school districts were required to provide an appropriate education or bear the expense of a suitable program wherever it could be found.

Educators, as well as the public, pointed to the seeming inability of schools to assure success in reading after the primary grades (Durkin, 1978-1979). The editors of Reading Research Quarterly (1982) stated that although reading achievement test scores from many systems compared favorably in the primary grades they began to fall in the upper-elementary grades. The concerns expressed by these authors implied that different approaches to reading instruction may be needed to assure the success of all children.

Durkin (1978-1979) stated that there is already a

considerable body of knowledge on decoding but little on the processes underlying the comprehension of written material. Travers (1982) added that little is known about how the reader organizes what he reads. Otto and White (1983) recommended research that focused on the reader since the question of what thinking processes the reader uses as he reads is not understood (Golinkoff, 1975-1976; Travers, 1982). However, the failure to consider how children process information could result in having them placed in a series of inappropriate and unsuccessful programs in school (Saracho, 1984).

Research on field dependence-independence and reading achievement has been limited and conflicting (Saracho, 1984; Spiro and Tirre, 1980). Only a few studies concerning sixth grade children, field dependence-independence and reading achievement were located. The studies differed in size of sample, test used to measure cognitive style, and the type of statistical analyses applied. Logan's (1983: 706) recommendation that "future investigations of pupils' cognitive styles and their relationships to reading development are warranted" might have been influenced by those reported differences.

General Questions to be Answered

The following questions will be investigated in the study:

1. What is the relationship between reading

achievement and field dependence-independence, intelligence, age, gender, race, and socioeconomic status?

- a. How strong is the relationship?
- b. How important are the various independent variables to the relationships?
- c. What is the relationship between reading achievement and field dependence-independence with the effect of the other independent variables removed?

2. What are the dimensions along which the reading groups differ?

- a. Which independent variables contribute to the differences among groups on the dimensions?
- b. What is the degree to which members of the reading groups may be accurately classified?

General Procedures

The general procedures followed in this study were:

1. Completed an extensive literature search related to the theoretical basis and research. An ERIC search was conducted in the spring of 1984 for the years from 1963-1984. The descriptors used were: field-dependence-independence, cognitive style, sixth grade, reading achievement. A manual search through April, 1985 supplemented the ERIC search.

2. Identified the variables of the study and selected the statistical analyses.

3. Selected a school and obtained permission to

conduct the study.

4. Developed precautions to assure anonymity of the children.

5. Arranged a testing schedule and tested the children.

6. Tabulated, coded, checked, analyzed, and corrected the data.

7. Drew conclusions and made recommendations.

Limitations of the Study

Limitations of the study are:

1. The sample was limited to the children from one school composed of nine classrooms of sixth grade students situated in a small southern city where a university is located.

2. Data utilized in the study were limited to the following variables: (1) reading achievement, (2) field dependence-independence, (3) intelligence, (4) race, (5) sex, (6) age, and (7) socioeconomic status.

3. Some data obtained for the study were dependent on information maintained and collated by personnel from the school district.

4. The references used in the study were limited to those available at Auburn University and Montana State University or those obtained through the interlibrary loan at Montana State University.

Definitions of Terms

The following terms were used throughout the study:

Embedded Figures Test (EFT). Individual measure of field dependence-independence. It is a twelve item verbal-manual test which requires the subject to "locate and trace a previously seen simple figure within a larger complex figure" from a card set (Sweetland and Keyser, 1983).

Cognitive Style. A person's characteristic and consistent manner of processing information (Messick, 1976).

Construct. A particular form of a concept, an idea or perception resulting from an orderly arrangement of facts or impressions. A constructed variable is in contrast to an observed variable (Messick, 1976).

Field Dependence-Independence (FDI). Cognitive style process variables representing restructuring skills described as contrasting ways individuals (1) locate and use basic elements from organized material, (2) structure information that is unorganized, and (3) provide a different structure from that suggested by the materials utilized. Field dependents are less autonomous and need outside help in structuring or organizing tasks. Field independents are more self-reliant and more likely to impose structure themselves. This cognitive style is associated with thinking and problem solving (Frank, 1983; Witkin and Goodenough, 1981).

Group Embedded Figures Test (GEFT). A paper-pencil

test used to assess field dependence-independence developed by P. K. Oltman, E. Raskin, and H. A. Witkin (1971). The test contains eighteen items. The subject is required to locate and outline in pencil a simple figure in a complex design. The test was developed for group use and for ages ten to adult. It is hand scored from a key furnished by the publishers.

Groups I, II, III, and IV. Groups designated by the investigator from reading achievement test scores. This allowed the investigator to identify the composites of the independent variables that show the maximum differences among group means of composite scores and the minimum overlap in the distribution of these scores (Thorndike, 1978). Group I, zero to the twenty-fifth percentile; Group II, the twenty-sixth percentile to the fiftieth percentile; Group III, the fifty-first percentile to the seventy-fifth percentile; Group IV, the seventy-sixth to the one hundredth percentile.

Race. Designated black or non-black in the study.

Reading Achievement. Assessment of reading comprehension measured by the California Achievement Tests, Form C, Level 16 (CTB/ McGraw-Hill, 1981).

Reading Comprehension. "...[S]tudents' understanding, recall, and integration of information stated in or inferable from specific text passages. (Tierney and Cunningham, 1984: 610)." Measured by the California

Achievement Tests, Form C, Level 16 (Monterey, CA: CTB/McGraw-Hill).

Rod and Frame Test (RFT). Forerunner of the Embedded Figures Test and the Group Embedded Figures Test. It required the subject, seated in a darkened room, to adjust a luminous rod to a vertical position within a tilted luminous frame. The aim was to identify differences of individuals in their perceptions of space orientation so that their personality differences could be investigated (LaVoie, 1984).

Short Form Test of Academic Aptitude (SFTAA). A revised form of the California Short Form Test of Mental Maturity. The test contains four sections (Vocabulary, Analogies, Sequencies, and Memory). The scores from the four areas yield composites of language and nonlanguage aptitudes. It can be used from grades 1.5-12. The test was standardized on the same norms as the California Achievement Tests (Aiken, 1979). The Kuder-Richardson - 20 reliability coefficients range from .65 to .91 for Vocabulary, Analogies, Sequencies, and Memory, from .84 to .93 for Language and Nonlanguage, and from .90 to .96 for Total (Shoemaker, 1972).

Socioeconomic Status (SES). A person's rank in relation to certain demographic factors used as indicator to assess "life chances" in contrast to prestige ratings. There are many approaches and no single generally accepted

socioeconomic status classification scheme in use by social scientists. Most of the scales and indices included occupation as part of the measure, but other factors such as income, housing, and education as well as other variables were also included. A basic assumption underlying the selection of items used for measuring socioeconomic status was that the status of the family was indicated by the status of the income earners (Nam and Powers, 1983). The factors used as indicators of and influences on life chance in the present study included; (1) home ownership, (2) if the parents live in the home, (3) number of years of schooling of the parents, and (4) occupation of parents.

The first procedure in the development of the study was to conduct an extensive review of the literature. The review was undertaken to establish the theoretical background for the study and to investigate the research related to field dependence-independence and reading achievement. This follows in Chapter Two.

CHAPTER TWO

Review of the Literature

In this chapter the investigator reviewed the field dependent-independent cognitive style with developments in the study of reading and how those developments converged through expansions in psychology and education to form the background for the present investigation. The theoretical framework underlying the study was based in several related disciplines: (1) the early influences of investigations from experimental psychology and psychometrics; (2) the organization of thinking and problem solving rooted in Gestalt psychology which influenced Witkin (1977) in his studies of field dependence-independence; and (3) information processing theories from cognitive psychology expressed in recently developed models of reading comprehension. Specifically, the review examined the pervasive role of individual differences; how individual differences have been studied in the past, field dependence-independence as a means of identifying individual differences in certain information processing characteristics; and research on field dependence-independence and reading

that suggested the problem of the study.

Early Experimental Psychologists and Individual Differences

According to Glaser (1983: xi) the study of "individual differences in cognition is as old as the beginnings of scientific psychology and ... as new as modern cognitive psychology." He pointed out that although mental processes as individual differences were acknowledged as fundamental they were not analyzed separately by the early experimental psychologists. Those investigators were interested in discovering general laws of nature which could be applied to everyone rather than differences in individuals (Glaser, 1977; Tyler, 1965). Their work provided the foundation leading to the mental testing movement.

Individual differences in mental processes were recognized as early as 1816 by Friedrich Bessel, an astronomer. While examining a history of the Greenwich Astronomical Laboratory, he uncovered a report of the dismissal of a young assistant who reported the time of transit of stars across a line in a telescope to be one second after that reported by his mentor. This led to Bessel's investigation of reaction times of fellow astronomers and the discovery that differences of individuals in the time they reacted to a visual stimulus did exist. The work was important because it indicated that at least one mental characteristic could be measured (Tyler, 1965).

Sir Francis Galton's work on determining the characteristics of geniuses was reported in 1869. Its problems of measurement led to his development of tests of mental abilities. He established the Anthropomorphic Laboratory in London and used the tests in investigations from 1884 to 1890 causing Carroll (1965) to credit him with the invention of the mental test. The idea of differences in heredity posed by Francis Galton and the development of correlation in statistics created by Galton and systematized by Karl Pearson were then available for use in the investigations of others that followed. Although Galton conceptualized correlation and regression he applied it only to the studies of inherited traits, but not in the analysis of mental test results. Carroll (1978: 6) stated that no important information concerning individual differences came from this work on mental tests except that such differences tended "to be distributed according to the Gaussian law of error."

Wilham Wundt, a philosopher-physiologist who called himself a psychologist, was the first to use the term "experimental psychology". He worked to advance psychology as a science and began a laboratory at Leipzig in 1879 where many students came to study elements of the mind by introspection. Although he was interested in child development and the higher mental processes among other topics, he thought they could not be studied experimentally

(Hearst, 1979). He was not interested in individual differences and either ignored them or treated them as error (Anastasi, 1965).

Several of Wundt's students became leaders in the field of experimental psychology. Among them was his self-appointed assistant James McKeen Cattell, who was interested in and studied individual differences. Cattell's interest led to his investigations of basic reading processes and work on mental tests and measurement. On his way back to the United States he stopped for a time at Galton's laboratory in London and on his return to this country incorporated the notion of standard tests into his ideas of mental processes. He introduced the term "mental test" in his writings in 1890 (Venezky, 1984). Also, he worked to establish laboratories for experimental psychology and was involved in the mental testing movement. "The newly established science of experimental psychology and the newer testing movement merged in Cattell's work" according to Anastasi (1968: 8).

The Testing Movement and Individual Differences

Glaser (1977) and others (Good and Stipek, 1983) explained that providing for individual differences in classroom instruction has been a continuing concern for educators since the beginning of the twentieth century. As school attendance increased so did the demand for means to measure individual differences (Tyler, 1965). Two early

investigators, Hermann Ebbinghaus and Alfred Binet, were commissioned to work on school problems.

Ebbinghaus (1897; cited in Tyler, 1965) investigated memory using nonsense syllables with himself as the only subject. He also worked on a school problem at the request of school officials in Breslau (Tyler, 1965). The problem was to determine the time of day that children were least efficient. He constructed three tests: rapid addition and multiplication, memory for digits, and a completion type. The tests were administered to the children before each period. The completion test was similar to the cloze test used today in that it required the child to fill in blanks deleted from a sentence or paragraph. The child was then required to decide on a word as a best fit for the blank from the context of the passage. The completion test discriminated better than the other tests among the poor, good, and average students. The fatigue problem was forgotten. From this study he deduced that the completion test pointed to the importance of a "combining function" in mental ability (Watson, 1963: 289).

Alfred Binet and his associates worked through many approaches in order to measure intelligence. This led to the conviction that intelligence could be measured best through "direct though crude measurement of complex intellectual functions (Anastasi, 1968: 10)." The opportunity to apply those ideas came through the request of

the Minister of Public Instruction who appointed a committee to study the problem of mentally retarded children in the Paris schools. In work for the French government to identify those children who could profit from schooling, Theodore Simon and Binet developed a scale for measuring intelligence in 1905. The scale was revised by Terman at Stanford in 1916 and became known as the Stanford-Binet test, the first standardized test of individual intelligence.

As Anastasi (1968) stated, the Binet tests and all revisions are individual tests. Group tests came about as the need became apparent for ways to classify men when the country became involved in World War I. A committee appointed by the American Psychological Association and directed by Robert M. Yerkes developed the first group intelligence tests. Those tests, Army Alpha and Army Beta, were based upon group tests donated by Arthur S. Otis who was Terman's student at Stanford (Anastasi, 1968). In World War II, more specialized tests were developed to meet the demand for tests as predictors of differences in the aptitude of people such as pilots and navigators needed for special jobs. The tests indicated that intelligence could be considered multidimensional rather than unidimensional as was thought earlier. After World War I the tests were released for everyone to use.

Although E. L. Thorndike wrote the first textbook on

educational measurement in 1904, it was not until after World War I that testing groups in education was begun (Goslin, 1963). Through statistical methods, test theory, and factor analysis (Spearman 1927; Thurstone, 1938; and Guilford, 1967, 1982) attempts were made to "define and organize" the information that was gathered. Individual difference factors measured through standardized tests (Glaser, 1983) were investigated. The practical outcome of their work was the development of multiple aptitude batteries.

Large school surveys were undertaken and some interest was directed toward individual differences, but the main application of the tests in the schools was for dividing classes into homogeneous groups. This practice continued despite the indicators and arguments that individual differences were so specific that it is impossible to achieve true homogeneous grouping (Carroll, 1982).

Traditionally, individual differences considered in school practice were related to intelligence and aptitude. Those tests predicted outcomes in education. They were not designed to: (1) "...determine the different way in which different students learn best, (2) measure the basic processes that underlie various learning, (3) nor assess prerequisite performance capabilities required for learning a new task", according to Glaser (1977: 310).

Two developments during the 1940s and 1950s occurred

which influenced the construction of mental tests: (1) factor analysis and (2) growth in statistical theory of mental tests. Factor analysis showed that intelligence is multifaceted while statistical theory development allowed "new ways of constructing mental tests and studying their measurement characteristics (Carroll, 1982: 59)." Even though progress was made in mental test theory related to test scores, little progress has occurred in identifying those underlying characteristics that the scores measure. Glaser (1977: 310) pointed out that the psychometricians made a great impact on education in that "the major activity in educational psychology revolved around measurement and psychometric practice." Early investigators either ignored individual differences or were not concerned with individual differences related to learning and cognitive processes. Those developments led to the construction of learning theories not related to individual differences.

In educational practice, Sternberg (1984) stated that since the development of the Binet tests there has been a strong link between the testing movement and education. He pointed out that the testing now used in the schools cannot yield the information that educators need to make the most informed decisions for instructional practice. The tests (mental measurement and achievement tests) do not provide information necessary for a program that emphasizes learning processes. He suggested that a combination of

the psychometric approach, some Piagetian ideas (not directly related to this study), along with an information processing approach should be used together since each emphasizes different aspects, all of which are needed for adaptive instruction.

Carroll (1982) stated that the latest theories concerned with mental testing were derived from information processing theory from cognitive psychology. Mental tasks including those found on mental tests of ability were thought to involve mental processes as depicted in information processing models (Carroll, 1982) and related investigations conducted by E. Hunt, Frost, and Lunneborg (1973) and Sternberg (1977). E. Hunt, Frost, and Lunneborg (1973, cited in Carroll, 1982: 76) thought that individuals differed in "speed, probability of transfer between different memory stores, and capacity of memory stores" which they considered were involved in the performance of any mental task, including mental tests. Sternberg (1982: 226) worked to "decompose performance on tasks into elementary information-processing components, and then to show the interrelation among the components used to solve various tasks requiring intelligent performance". According to Carroll (1982), the importance of the above work was that much more exact information could be obtained concerning cognitive abilities measured by standardized mental tests.

Cognitive Psychology and Information Processing

Cognitive psychology was generally defined as the study of human higher mental processes (memory, perception, learning, thinking, reasoning, language, and understanding) through analysis by scientific methods (Lachman, Lachman, and Butterfield, 1979; Mayer, 1981). Cognitive psychology had its roots in the work of the early experimental psychologists who studied the mind through self analysis (Leahey, 1981) and the Gestaltist who were interested in perceptual organization. Since the 1960s, some modern cognitive psychologists used information processing models to describe how the mind functions. Theoretical information processing models of how humans receive, act on, store, and retrieve information from their mental framework was described as similar to the way information is processed through a computer program (Mayer, 1981; Wagner and Sternberg, 1984).

Through models the developers expressed the idea that everyone has an information processing system (IPS) composed of parts through which information flows toward some response or output. The parts are short term sensory store (STSS), short term memory (STM), and long term memory (LTM).

Short term sensory store, STSS (also labeled sensory register, sensory buffer) was the point where information entered the system through one of the senses. It was

thought that STSS accommodated each of the senses, although few investigations were attempted with any except the auditory and visual senses. The greater part of the research involved the visual sense. In STSS, the incoming information was held briefly exactly as presented, but faded within a half second unless attended.

Short term memory (STM) was the storage area for information attended on from the short term sensory store (STSS), held for a short time (thirty seconds), and limited to seven items which would decay unless rehearsed. STM was designated by some investigators as the store for all that one could be aware of at one time. Working memory (WM) was attached to STM by some developers. Also called intermediate memory, it was described as the store where conscious mental operations were performed. If the information held in STM or WM were acted on, it was then transferred to long term memory (LTM).

Long term memory (LTM), the third storage structure, had unlimited capacity. The information there did not decay, but parts might be lost because retrieval paths could be blocked by new information entering the system (Mayer, 1981).

Those storage components of the information processing system were designated memory structures to distinguish them from another component called memory processes (Klatzky, 1980; Matlin, 1983; Mayer, 1981). Memory

processes (control processes) were the processes used by the system to act on information held in the structures (stores). The memory processes constructed by Mayer, (1981) were not all inclusive (See Klatzky, 1980; Lachman, Lachman, and Butterfield, 1979). They are listed below:

Attention. Transferring information from STSS to STM.

Rehersal. Keeping information active in consciousness in STM

Chunking. Techniques for clustering information in STM.

Operations in WM. Manipulating information in working memory.

Encoding. Transferring information from STM to LTM.

Searching LTM. Finding a target in LTM (Mayer, 1981: 25).

The structures and processes described in information processing models were depicted in flow diagrams developed by different theorists. The three structures (storage areas) were represented as boxes with one structure per box. The flow and direction of the control processes were symbolized by arrows. The following diagram (Figure I) was based on those developed by Klatzky (1980), Lachman, Lachman, and Butterfield (1979), Matlin (1983), and Mayer (1981).

The Expansion of Cognitive Psychology

As previously noted, cognitive psychology had its roots in the early work of the structuralists. Due to the

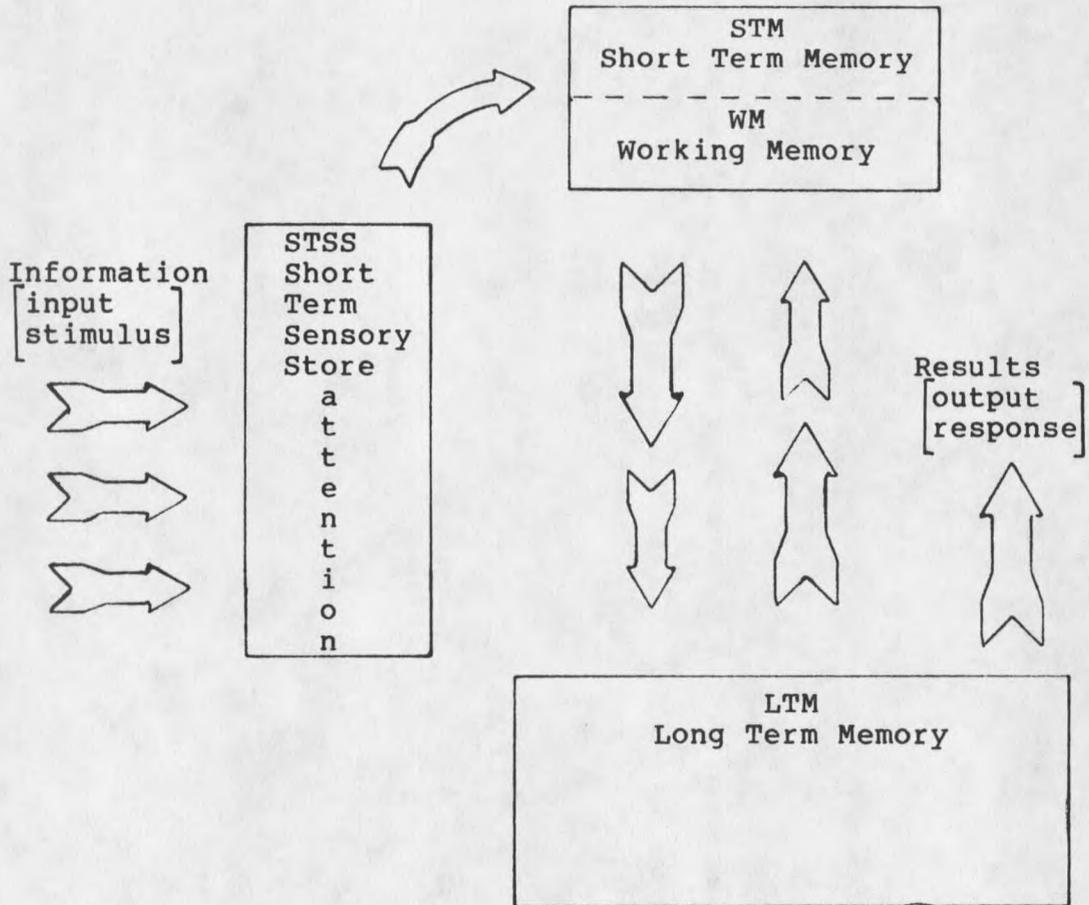
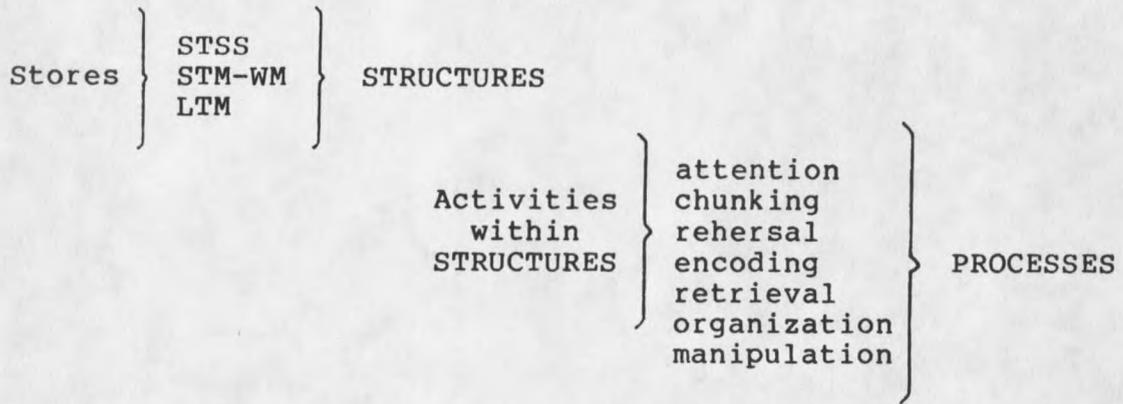


Figure I. Model of a human information processing system based on those developed by Klatzky (1980, 1984); Lachman, Lachman, and Butterfield (1979); Matlin (1983); and Mayer (1981)

reaction of the behaviorists against structuralism under the leadership of John Watson in the United States, behaviorism became dominant in psychology from the 1920s to the 1950s. In contrast to the structuralists, the behaviorists contended that since mental processes could not be observed directly they could not be studied scientifically. At about the same time, in Europe, another reaction to the structuralist developed from the Gestalt group. Gestaltists did study mental processes but did not have available to them the rigorous methods of analysis that they needed.

Important occurrences that had an impact on the development of cognitive psychology during and since the 1950s included : (1) The use of computers by psychologist (Newell, Shaw, and Simon, 1958) to examine problems in human behavior through computer analogies. That resulted in renewed interest in the study of mental processes since those processes could then be specified on a computer program; (2) the work of Noam Chomsky (1957) in linguistics where he examined language from a cognitive perspective; and (3) the developmental studies of Jean Piaget who focused on the cognitive processes that describe developmental changes in children (Mayer, 1981).

Traditional psychologists also presented new ideas. Bruner, Goodnow, and Austin (1956) in their work on strategies involved in learning concepts offered a cognitive interpretation. Miller (1956) in his article, "The Magic

Number Seven, Plus or Minus Two" encouraged the development of an information processing model for the study of cognitive processes. Miller, Galanter, and Pribram (1960) authored a book where the human was viewed as an information processor instead of just a responder to stimuli. These writers provided an alternative to the S-R behaviorists (Mayer, 1981).

In 1967, Neisser's book Cognitive Psychology appeared, in which he posed an information processing model of mental processes. The book was important because it showed that mental processes could be studied from a cognitive psychological base. It provided new analytic procedures that could be adapted for cognitive research in psychology (Mayer, 1981).

Information Processing and Individual Differences

Developers of information processing approaches assumed a general information processing system (IPS) for all people. They thought that individuals might differ in the structures and processes associated with the system. The structures and processes of the system were part of the IPS, but differences could occur among individuals in the size of each memory store and the character of the process of the system. Examples of the differences include variations in retrieval speed in long term memory (LTM), storage capacity in short term memory (STM), or attention in short term sensory store (STSS), which result in the

transfer of more information to short term memory (STM) before it fades.

Snow and Lohman (1984) concluded from their Aptitude Treatment Interaction (ATI) studies that not only qualitative differences could occur as mentioned above but also sequence and route variations might occur within individuals. The most important parts of the cognitive system were labeled assembly and control processes. These processes were designated higher order processes. They involved organization, reorganization, and monitoring processes of the dynamic cognitive system that caused it to adapt or learn within a task. It was thought that the assembly and control processes would be important as sources of ability-learning correlations in education (Snow and Lohman, 1984).

Knowledge was used, as well as processes, in the organization that was required for the individual to perform a task. Different tasks required different organizations. Individuals differed in how they assembled and controlled the processes that were necessary. Less successful participants demonstrated some degree of mismatching in the organizing components they assembled. The implication for instruction for individual differences along those organizing components was alternative teaching. Since the "able students prefer to exercise their own particular organization of abilities (Snow and Lohman, 1984: 351)."

instructional attention needed by the less successful learner would be detrimental to the successful one. If the instructional environment was not structured to accommodate those differences the students would not be able to perform cognitively in using their own personal assembly functions. In order to structure the environment to accommodate those differences, the planners of the environments needed means to measure cognitive processes (Snow and Lohman, 1984).

Measurement

Lyman (1978) stated that there are three types of tests in general use in schools today: intelligence tests, aptitude tests, and achievement tests. Intelligence tests (sometimes called mental maturity tests, mental ability, or scholastic aptitude tests) have been used mostly to predict school achievement. Aptitude tests, also used for prediction, depended partly on achievement since reading was required to complete them. Achievement tests measured the amount of knowledge one had acquired. Anastasi (1983: 8) explained that those tests could be used as "predictors in the sense of assessing relevant prerequisites but not in the sense of future stability." She further stated that the tests were "descriptive" of an attribute of behavior and should be used only to "assess the current status" of individuals. None of the tests measured the underlying cognitive processes of individuals.

Another approach to measurement was that of Jean Piaget on the description of the development of children's thought processes assessed through specific tasks. The Piaget tasks were designed to assess "the development of specific concepts or cognitive schemata rather than broad abilities (Anastasi, 1983: 12-13)." Recently, the tasks were organized into standardized scales in experimental form. Although the Piaget tasks were more difficult and required more time to administer, they provided different information from that acquired from intelligence, aptitude, and achievement tests.

Cognitive psychologists applied information processing concepts to determine the processes underlying problem solving and to explore what intelligence tests measure. Investigators used puzzles, chess, word problems from algebra, problems in logic, and the spelling of English words (Simon and Hayes, 1976; cited in Anastasi, 1983) to determine individual differences in methods of problem solving.

In exploring what intelligence tests measured, researchers investigated separate areas. Carroll (1976) classified cognitive processes and structures related to factors identified by factor analysis from intelligence tests. E. Hunt and associates (E. Hunt, 1976; E. Hunt, Frost, and Lunneberg, 1973) used factor analysis to examine relationships between information processing laboratory

tasks they devised and scores on psychometric tests. Simon and Hayes (1976) used simulations of human problem solving related to number series completion tests and the Raven Progressive Matrices. Klahr (1976) developed simulation models to explain intellectual development as Piaget described in the transition of individuals from one developmental stage to another.

Sternberg (1982) proposed a framework for theory and research on problem solving and reasoning based on psychological constructs (components) and analyzed through an information processing approach. In the framework components were classified into three levels of generality with five kinds of functioning. The framework could be ... "applied to diagnostic and prescriptive problems in educational theory and practice..." according to Sternberg (1982: 234).

In light of the research reported above, Anastasi (1983) commented that the investigations should lead to a better understanding of what intelligence tests measure. This in turn should help to identify each person's weaknesses and strengths so that programs could be designed to meet individual needs.

Cognitive Styles

Cognitive styles, another parameter of individual differences, were designated by Messick (1984) as information processing constructs. He further classified

cognitive styles as organizing and controlling variables with implications for education. The measurement of individual differences in achievement in the content areas resulted in the description of psychological dimensions in content terms such as numerical ability. However, if emphases were placed on psychological dimensions of how an individual performed a task, the performance was described in terms of cognitive style.

Overview of Cognitive Style

Vernon (1973) speculated that the term cognitive style evolved from three sources. They were (1) "Perception: Approach to Personality" (Blake and Ramsey, 1951); (2) Klein (1954), when he discussed "perceptual attitudes" that represented a "style of organization"; and (3) Gardner (1953) who categorized behavior. Nine categories from these sources, conceptualized by Messick (1970) were:

1. Field independence-dependence (Witkin, Lewis, Hertzman, Mackover, Meissner, and Wapner, 1954).
2. Reflection-impulsivity (Kagan, Rosman, Day, Albert, and Phillips, 1964).
3. Conceptual differentiation (Gardner, 1953).
4. Scanning (Gardner and Moriarity, 1968).
5. Leveling and sharpening (Gardner, Jackson, and Messick, 1960).
6. Constricted-flexible control (Smith and Klein, 1953).

7. Tolerance for incongruous or unrealistic experiences (Klein and Schlesinger, 1951).

8. Cognitive complexity (Kelly, 1955).

9. Breadth of categorizing (Pettigrew, 1958).

Messick (1976) modified and added to his list for a total of nineteen cognitive styles. Other writers named more and different ways of categorizing cognitive styles (Vernon, 1973; Goldstein and Blackmon, 1978; and Guilford, 1980).

Cognitive Style Defined. Cognitive style was defined by investigators in the following ways:

1. ... information processing habits ... characteristic modes of operation which, although not necessarily independent of content, tend to function across a variety of content areas (Messick, 1976: 190).

2. ... dimensions of individual differences involving the form of cognitive functioning with impressions in a wide array of content areas including perceptual, intellectual, social, interpersonal, and personality defensive processes (Goodenough, 1976: 675).

3. The mode in which a person organizes and classifies his perception of the environment in order to impose order upon a confusing series of events (Wolman, 1973: 67).

4. ... superordinate construct which accounts for individual differences in a variety of cognitive, perceptual, and personality variables (Vernon, 1973: 141).

5. ... individual variation in modes of perceiving, remembering, and thinking or as a distinctive way of apprehending, storing, transforming, and utilizing information (Kogan, 1971: 244).

6. ... stable individual performances in

modes of perceptual organization of the external environment (Kagan, Moss, and Sigel, 1963: 74).

Specific Cognitive Styles: Definitions and Common Elements

From the thousands of studies (Vernon, 1973; Goldstein and Blackmon, 1978), three prominent approaches to the study of cognitive styles emerged (Kagan and Kogan, 1970; Messick, 1970; Goldstein and Blackmon, 1978). They were the investigations of Witkin and his associates (1954, 1962, 1977) on field independence-dependence; Kagan and others (1963) on reflection-impulsivity; and Klein (1954) on cognitive controls. Several constructs were developed from each of these cognitive styles (Kogan, 1971; Goldstein and Blackmon, 1978; Blackmon and Goldstein, 1982). Since each investigator defined styles based on theoretical interest, the constructs are listed, defined, and relationships are noted in the following:

1. Field independence-dependence (Witkin, Lewis, Hertzman, Machover, Meisner, and Wapner, 1954). This cognitive style refers to the organizing and restructuring processes individuals utilize when solving a task (reading) and to the attention and use given to salient cues. Field dependent individuals tend to rely on others (teachers) for help in organizing or restructuring information. They attend to the most obvious cues but may ignore other important information. Field independent individuals impose structure on unorganized information and use all cues

that are relevant, both salient cues and not so obvious cues.

Field dependence-independence in this study was measured by how an individual extracted an embedded figure from a complex, confusing field on the Group Embedded Figures Test (Goodenough and Witkin, 1979).

2. Reflection-impulsivity were terms used by Kagan, Rosman, Day, Albert, Phillips (1964) to refer to the time and accuracy involved when a subject had been shown a picture and asked to choose a like picture from several that closely resembled the one shown. The reflective subject took more time and was more accurate in his selections. The impulsive subject tended to respond quickly and with errors.

3. Conceptual differentiation (Gardner, 1953), also labeled equivalence range, described how individuals functioned on sorting tasks. What individuals were willing to "accept as similar or identical" in free sorting tasks (Gardner, 1953: 229) were described. An individual high in conceptual differentiation and narrow in equivalence range used many categories in a free sorting task (Goldstein and Blackmon, 1978).

4. Scanning (Gardner and Moriarity, 1968). The investigations concerning scanning were made to examine the intensity of attention to a task (Kogan, 1971) in the "extent to which an individual checks the judgments he makes

(Goldstein and Blackmon, 1978: 468)."

5. Leveling and sharpening (Gardner, Jackson, and Messick, 1960). Those elements were used to refer to the degree of assimilation between events already perceived and stored in memory and a new event. Levelers had a high degree of assimilation (Goldstein and Blackmon, 1978).

6. Constricted and flexible control (Smith and Klein, 1953). Those styles were used to identify differences of individuals in how they responded to distracting stimuli (Goldstein and Blackmon, 1978).

7. Tolerance within individuals for incongruous or unrealistic experiences (Klein and Schlesinger, 1951) concerned individual differences in the willingness to accept perceptions which varied with conventional experiences (Kogan, 1971).

8. Cognitive complexity (Kelly, 1955) was defined as an information processing construct. The number of constructs a subject used in organizing or representing his environment was an index of his cognitive complexity. The more dimensions he used the greater his cognitive complexity.

9. Breadth of categorizing was the outgrowth of the work of Bruner, Goodenow, and Austin (1956) on thinking, in which strategies of concept attainment were explained in terms of "preferred modes of risk regulation". Pettigrew (1958) developed a paper-pencil questionnaire for assessing

category width (the C-W Scale) where the subject decided which of two types of errors he minimized. The risk of including an event when it did not belong was favored by a broad categorizer. The risk of omitting from the category something that belonged was preferred by the narrow categorizer (Kogan, 1971).

Common characteristics were noted among approaches to cognitive style even when definitions differed (Brody, 1972). Individual differences in styles of thinking were a starting point instead of emphasis on other personality factors (motivation, emotion, or biological processes). How an individual thought rather than what (content) he thought was investigated. Cognitive styles were commonly related to other personality characteristics of individuals, yet style characteristics were considered independent of situational influences (Goldstein and Blackmon, 1978).

Related Concepts

Other investigators who used related constructs were Tolman, cognitive maps; Bartlett and Piaget, schemata; and Lewin, differentiation and hierarchical organization (Goldstein and Blackmon, 1978). The present review was limited to those styles identified as constructs related to how individuals structure thought or process information.

Other Cognitive Styles

Other investigators who made contributions to the field were:

1. Pettigrew (1958) who was influenced by the work of Bruner and his associates (Bruner, Goodnow, and Austin, 1956) who studied consistencies within individuals in which they consider events likely to occur. Pettigrew developed a test of the phenomenon category width, the C-W Scale to discriminate between risk takers and non-risk takers. The subject in a task must decide which type of error to minimize. The broad categorizer preferred an inclusion error, that is, the possibility that elements in a category may not belong in it. The narrow categorizer, on the other hand, risked an exclusion error, an error in which elements omitted from the category should be included (Kogan, 1971).

Another concept investigated by Gardner (1953), termed equivalence range, subsequently relabeled conceptual differentiation, was considered an alternative form of category width. The constructs dealt with sorting tasks. Individuals varied in the number of groupings they formed when asked to sort objects into the most appropriate groups. Kogan (1971) indicated that inaccurate sorters occurred more frequently in less intelligent more poorly adjusted children.

2. Harvey, Hunt, and Schroder (1961) investigated integrative complexity, a cognitive style in which man was

viewed as an information processor concerned with the ability of people to:

... organize the differentiation dimensions within a hierarchical system. Based on their ability to differentiate and integrate information, from the concrete to the abstract. Abstract individuals perform more effectively than concrete subjects in complex situations (Goldstein and Blackmon, 1978).

Cognitive Styles, Learning Styles, Abilities, and Strategies

Researchers conceptualized different perspectives of cognitive styles (Messick, 1984). However, their views contained common overlapping elements. Messick (1984: 61) stated them "as characteristic self-consistencies in information processing" Cognitive style and learning style were used by some authors interchangeably, but they represented different constructs derived from different disciplines. Distinctions were made between styles and abilities as well as between styles and strategies.

Cognitive styles differed from abilities in several ways. According to Messick (1984: 64), abilities were considered to be unipolar and cognitive styles, bipolar. That is, abilities ranged from very little to a great deal of the same facility. An example is reading ability. In contrast, cognitive styles described characteristics of individuals that ranged from one extreme to another extreme, each describing different ways of functioning. Field dependence-independence described contrasting ways

in which individuals function. Field independent individuals impose their own structure on a task and recognize salient cues as well as other important cues that might be more obscured yet important to the completion of the task. In contrast, field dependent individuals need outside help to structure or to discover less salient, important cues needed to complete a task. When measured, abilities implied competence and maximum performance with emphasis on accuracy and correct responses. Cognitive styles were assessed by either typical or contrasted performance.

The terms cognitive styles and cognitive strategies were often used synonymously, however Messick (1984) considered a distinct difference between them. Cognitive styles were activated spontaneously "without conscious consideration or choice across a wide variety of situations" according to Messick (1984: 61). Strategies, on the other hand, were considered as decisions among alternative approaches which varied as a function of the situation. It was thought that strategy formation and strategy choice might be more amenable to change through training under various learning conditions than cognitive styles.

Schmeck (1983) defined learning styles as learning strategies. He measured learning style by a self assessment inventory. Gregoric (1979) determined that learning was based on concrete or abstract experiences and

that it occurred randomly or sequentially. Learning styles (concrete random, concrete sequential, abstract random, or abstract sequential) were determined by observations and interviews. Dunn and Dunn (1980) considered learning style as the preferred way one reacted to the school environment. It was assessed through a self report inventory.

The articles on learning styles contained common elements. All were measured with a self report inventory. None of the investigators reported a theoretical base for his or her work.

Criticisms

Goldstein and Blackmon (1978) pointed to the difficulties in extracting general principles from the literature on cognitive styles because investigators disagreed on approaches and measuring instruments. Level of subjects varied from study to study making studies hard to replicate. Definitions were not consistent across investigators which caused confusion in the interpretation of different studies (Guilford, 1980).

Recommendations

Several recommendations by different writers were suggested but only those that pertained closely to this investigation follow. Kagan (1966) suggested the need for a system of levels of theory and research and the development

of studies to relate the variables used by one researcher to those of others. Vernon (1973) recommended a multivariate statistical approach to the analysis of data on cognitive styles, since new techniques have been developed which can be applied with greater results.

Trends

Kogan (1983) reviewed cognitive style after a twelve year span and stated that of the nine cognitive styles which had appeared in his last review only two were reported. The two that appeared in the current review were field dependence-independence and impulsive versus reflective styles. He attributed that to investigators who had withdrawn from studies associated with certain styles and the fact there were no successors to prominent investigators of other styles. He predicted the momentum for field dependence-independence to continue due to the interest of researchers in several different areas of psychology, including educational psychology, and because of the interest of a small group of committed researchers who worked to understand the competence-performance distinction.

Cognitive Style: Reviews

Since there are so many studies related to cognitive style and such a variety of concepts associated with the term, used by so many investigators, writers have reviewed the concept in a variety of ways. Vernon (1973) provided an

historical review. Wardell and Royce (1978) used a multifactor focus, grouping cognitive styles into types. Goldstein and Blackmon (1978) reviewed many styles briefly plus five styles in detail by developing a continuum of difference in degree of emphasis on content to structure of personality.

Vernon: Historical. Vernon (1973) traced the origin of style from the constitutional types (theory of temperaments; choleric, sanguine, phlegmatic, and melancholic) of Galen in Rome and through Jung's classifications of psychoanalyzed patients (extraversion-introversion); Meuman's (1907) diffusive versus fixative attention; and Rorschach's (1921) type classifications. Vernon suggested a number of "precursors" to cognitive style. Among these were the work of Lewin, who emphasized the field in which personality operated, followed by Carl Roger's theories of psychotherapy dealing with reorganizing the client's perceptions, and Kelly's stress on the way people "construe their world". Others Vernon cited were Goldstein and Scheerer (1941), who worked with concrete and abstract types and their reactions to sorting; Hanfman (1941), who used a conceptual instead of perceptual approach to the Vygotsky Blocks; and to Bruner, Goodnow, and Austin's (1956) strategies of thinking. Vernon gave greater emphasis to Gardner, Kagan, and Witkin. Their work follows in greater detail.

A multi-factor focus. Wardell and Royce (1978: 475) defined cognitive styles as personality integrators or moderator variables which determined the number of consistent influences on how cognitive and affective processing related to individual behavior. Cognitive style was identified as one of six subsystems of an individual's personality. The other subsystems were: sensory, motor, cognitive, affective, and values. The cognitive style subsystem was then organized into cognitive, affective, and cognitive-affective types of stylistic constructs. Cognitive styles and affective styles related to functional consistencies in relationships between both styles and ability factors or affective traits, respectively. Cognitive-affective styles, on the other hand, were consistent ways in which styles simultaneously integrated both ability and affective traits. Thus, an individual with many combinations of traits, who faced a complex situation might employ many ways of responding.

Wardell and Royce (1978) then proposed a hierarchy of styles: rational, empirical, and metaphoric. Under that hierarchy they listed eight cognitive styles (cognitive complexity, conceptual differentiation, category width or equivalence range, conceptual integration, reflective-impulsive, abstract versus concrete, leveling versus sharpening). Three general styles (cognitive, affective, and cognitive-affective) were clustered with each of the

higher order styles. The purpose for these developments was to provide a theoretical statement from which further empirical and theoretical developments might occur.

Goldstein and Blackmon: Five cognitive styles. From a brief review of several major investigators and their cognitive style constructs, Goldstein and Blackmon (1978) examined five cognitive styles in more detail. They classified the five representative styles along a continuum of attitudes from those high in content to those high in structure. Content referred to what an individual thought in contrast to structure which referred to how one thought. An example of a style high in content was that investigated by Adorno, Frenkel-Brunswik, Levinson, and Sanford (1950) on anti-semitism, ethnocentrism, and economic conservatism. Witkin's construct, field dependence-independence, was considered an example of a cognitive style high in structure.

Influential Cognitive Styles

Other investigators of cognitive styles, the constructs they identified, the instruments used to measure the constructs, and the psychological base of each follow.

Impulsive-Reflective cognitive style. Kagan and Kogan (1970) stated that their investigations began as accidental discoveries which resulted in empirical work with a trial and error quality. In other words, they had no theoretical

base. Only recently have they gained some insight into the processes underlying an analytic attitude and devised some direct, experimental tests of their "hunches".

Kagan and others (1964) seemed to associate the constructs they investigated with developmental theory. He stated that the child's initial perceptions of the world are global, but with time become more articulated and differentiated. He also stated that this age difference is a matter of "maturational capability", as well as an "acquired habit." He defined cognitive styles as "... stable individual preferences in mode of perceptual organization and conceptual organization of the external environment (Kagan and Kogan, 1970: 73)." The reflection-impulsive dimensions of cognitive style were described (Kagan, Rosman, Day, Albert, and Phillips, 1964) as speed in which someone reaches decisions under conditions of uncertainty. Subjects who chose slowly and without error were designated, reflective. Conversely, those who chose quickly and with error, impulsive.

The measuring instrument used to determine the reflective-impulsive constructs was the Matching Familiar Figures Test (MFFT). Subjects were presented with a picture and asked to match this picture with one from a group of highly similar comparison pictures. Those who responded rapidly, with errors were designated impulsive and those who respond slowly and accurately were reflective.

Cognitive Controls. Cognitive control dimensions of personality were represented in the wide range of behaviors through which an individual encounters reality may be "encompassed by relatively few dimensions of organization" (Gardner, Holzman, Klein, Lenton, and Spence, 1959). These dimensions are related to modes of coping with tasks in certain situational frameworks. They are manifested through perceptual functions with organizing tendencies. They are termed adaptive controls. The behavioral consequences are the adaptive solutions. The theoretical substructure of cognitive controls are found in personality theory, partly in psychophysics and Gestalt theory, but especially in the psychoanalytic personality theory of Freud (Goldstein and Blackmon, 1978).

Gardner and Long (1962), quoted in Goldstein and Blackmon (1978), stated that cognitive controls are viewed as enduring and like defense mechanisms, thought to emerge in the course of development from the interaction of genetic and environmental influences. The terms used have evolved from perceptual attitudes to be replaced by cognitive attitudes and cognitive system principles, then by cognitive controls and cognitive control principles. Goldstein and Blackmon (1978) stated that the idea of a delaying controlling function, which was involved, was suggested by the adaptation of the last two principles.

Cognitive controls and cognitive styles are related but

different concepts according to Gardner, Jackson, and Messick (1960). Cognitive controls referred to the specific dimensions of leveling-sharpening, scanning, field articulation, conceptual differentiation, and constricted-flexible control. Cognitive style referred to the way these dimensions were structured within individuals (Goldstein and Blackmon, 1978). However, Kagan and Kogan (1970) pointed out that Gardner and his associates did not always use these definitions.

Various tests were developed to assess the constructs. Santostefano and Paley (1964) developed tests for children. The constructs investigated with children and the tests used to measure them are listed below:

1. Scanning-focusing was the extent to which an individual checks the judgments he makes. Gardiner and others (1959) pointed out that individuals who were initially labeled focusers were really scanners who attended broadly. In later studies the term focusing was not used. The construct scanning, was conceptualized as an estimation task based on judgments the subject made as a result of the intensity of his attention to the task.

The Circles Test (Santostefano and Paley, 1964) was developed for use with children. It was a measure of scanning, using a size estimation task.

2. Constricted-flexible control was a construct used to describe how a subject reacted to intrusive or

contradictory information. Flexible subjects withheld attention from intrusive information so were not distracted by it. Constricted individuals selectively withheld information, and as a result their performance on a task was disrupted.

The Fruit Distraction Test is used to assess this construct (Santostefano and Paley, 1964).

Field Dependent-Independent cognitive style. Witkin and others (1977) maintained that the theoretical base of field independence-dependence evolved from Gestalt psychology. Goldstein and Blackmon (1978) reported that the Gestalt concept of "silent organization" or "cognitive structures that guide behavior" were cognitive processes that remained independent of content and related to Witkin's constructs. Witkin and others (1977) described the field independent-dependent cognitive style as constructs related to individual differences in how subjects perceive, think, solve problems, and learn "cast in process terms". From investigations of field independence-dependence "suggestions are emerging" for ways of teaching students to use problem-solving strategies which are most appropriate for a task. That might involve shifting to strategies more suitable for the assigned task rather than relying on an individual's identified cognitive style.

Cognitive styles were designated pervasive dimensions. That is, they were holistic and as a feature of personality

and cognition assessed by nonverbal (perceptual) tasks. In using those nonverbal tasks, individuals who were not proficient readers were not penalized. In contrast, success on some assessment procedures depended heavily on verbal skills.

They were stable over time. This does not mean that they were unchangeable, but generally, a person who demonstrated a particular style on one occasion demonstrated the same style later.

Such cognitive styles were "bipolar". That was an important consideration which distinguished cognitive styles from intelligence or other ability dimensions where having more of an ability is better than having less of it. For example, a higher score on an intelligence test is better than or more desirable than a low one. On the other hand, with field dependence-independence each pole has adaptive value under specified circumstances, and so may be judged positive in relation to the circumstances, according to Witkin and others (1977).

Tests used to measure field dependence-independence.

Cox and Gall (1981) reported twenty seven measures of field dependence-independence in use or that were used by researchers. The tests included instruments constructed by other investigators as well as the ones developed by Witkin and his associates. Tests that have been used most frequently by researchers were the Rod and Frame Test, the

Embedded Figures Test, and the Group Embedded Figures Test. The Rod and Frame Test and the Embedded Figures Test must be administered individually. The Group Embedded Figures Test, first published in 1971, is group administered (Goldstein and Blackmon, 1977). The Rod and Frame Test and Embedded Figures Test are both instruments that must be administered individually. The Group Embedded Figures Test, first published in 1971, is group administered (Witkin and others, 1971).

The Rod and Frame Test (RFT) was used to assess the orientation of individuals on their differences in the perception of the upright. A luminous, adjustable rod in a luminous, adjustable frame was manipulated by subjects in complete darkness to bring the rod into a true vertical position independent of the orientation of the frame. Subjects who accomplished this were termed field independent since they were able to focus on the rod, independent of the frame (field) (LaVoie, 1984).

The Embedded Figures Test (EFT) was composed of eight simple and twenty-four complex figures. Each of the eight simple figures is obscured within the twenty-four complex figures. The subject, working alone with the examiner, was required to locate the simple figures in two sets (twelve cards per set) of complex figures. The figures Witkin selected for the test were from a set originally developed by Gottschaldt (1926, cited in Goldstein and Blackmon,

1978).

The Group Embedded Figures Test is a paper and pencil exercise that was first published in 1971. In the test a subject located a figure hidden in a complex, distracting background. The field independent person was able to extract the figure quickly and accurately from the embedding context while the field dependent person was distracted by the embedding context. The Group Embedded Figures Test is available for administration to groups from ages ten and older (Witkin, Oltman, Raskin, and Karp, 1971).

Field Dependence-Independence and Information Processing

Messick designated field dependence-independence an information processing construct in 1970. Davis and Cochran (1982) stated that the reasons field dependence-independence as information processing had implications for research were: (1) a cognitive view of learning and memory research that evolved over the last ten to twenty years provided a theoretical and methodological perspective for studying the construct and (2) individual difference in this construct may help to further understanding in the nature of cognition, possibly in school tasks including reading. The information processing view of cognitive functioning has been "reflected by a number of information processing models of cognition (Davis and Cochran, 1982: 3)." Examples of the models follow (p.59).

Educational Implications

Messick (1984) listed several potential contributions from the study of cognitive styles for education. Presentations of teachers might be structured to develop, compensate for, or capitalize upon student characteristics to achieve maximum subject matter learning. Curriculum materials as well as procedures might be developed in terms of style by varying degrees of structure and the amount of group interaction. Increasing student awareness of cognitive styles might serve to give them alternative thinking strategies and increase the number of strategies available for the student to use in different situations. If a goal of schools is to develop thinking skills, process goals might be established and process outcomes evaluated. For example, the development of thinking and enhancement of the numbers of procedural alternatives available to students could be provided.

Several reasons for the lack of application of knowledge concerning cognitive styles to classroom practice might lie with how the study of cognitive styles developed and the measurement of them. The study of cognitive styles developed through psychologists whose work was done in laboratories and clinics. Measurement techniques were constructed for use there and have usually required individualized measurement. Recently, measuring instruments have been constructed for use with groups, for

example, the Group Embedded Figures Test used to determine field dependence-independence. Also, Messick (1984) commented that the research base concerning cognitive style compared to the research base associated with educational applications of ability has only been developed within the last forty or fewer years. Only recently have those developments begun to move from the research of the laboratory to applied research for the classroom.

Reading Comprehension

Venezky (1984) stated that the interest in reading comprehension is relatively recent, within the last twenty to thirty years. He cited the work of Romanes in 1884 as the first study of reading comprehension. However, in spite of the early start, only occasional research was conducted on comprehension until the 1960s. This was attributed partly to the work of Hermann Ebbinghaus who by his study of memory using nonsense syllables influenced researchers interested in verbal learning to study serial learning of nonsense syllables and lists of words.

Venezky (1984: 13) stated that "research ... was so sparse up to the 1950s that even the phrase reading comprehension was seldom found." He cited a textbook published in 1952 and used in courses for the psychology and teaching of reading. There the term appeared only occasionally in connection with teaching methods and testing. Yet, whole chapters were included in the book on

eye movements and word perception. Instruction in the schools centered on oral reading in the early 1900s until testing became prominent and there was a change in instructional practices to a more meaning centered curriculum from 1915 to 1920. Another influence was the belief that the comprehension of reading material depended for the most part on the difficulty of the vocabulary used in the material. Venezky (1984) argued that the research failed to fit into prevailing educational practices or to launch new ones.

Early Research on Reading

Early research on reading paralleled the history of cognitive psychology (Venezky, 1984) from Wundt's laboratory in the late 1800s to the reading research conducted today. Most of the reading problems considered important today were studied by early researchers by the early 1900s. The work of Henderson (1903), Bartlett (1932), and Thorndike (1917) made contributions to research on comprehension. Memory organization and prior experience were investigated by Bartlett and Henderson. Through his work, Thorndike contended that reading was an active reasoning process, similar to problem solving. Henderson, an educational psychologist, showed the importance of conceptual organization in memory and the influence of prior experience on it. Bartlett (1932), in a study on remembering, arrived at results similar to those of Henderson. He

conceptualized schema as active organization of past reactions, or of past experiences. Schemata constructed from past experiences had sensory experience at the lowest level and other experiences (art, literature) at a higher level. Bartlett considered remembering a constructive process involving schemata that might not be closely connected. Schema theories of today have some basis in Bartlett's work (Venezky, 1984).

Reading Processes and Information Processing Models

According to Samuels and Kamil (1984) there were no strong precedents for conceptualizing reading processes into reading models until the mid-1950s and 1960s. Several developments contributed to model construction from 1965 to the present. They included: (1) the renewed interest in the study of mental processes by cognitive psychologists; (2) psycholinguistic studies that gave impetus to the study of basic processes in reading; and (3) an accumulating body of evidence concerning basic mental processes. Singer and Ruddell (1971: xii) suggested that "... models are not only useful for decision making in teaching but also for guiding research"

The reading models that were developed during the 1950s and 1960s, because of the influence of behaviorism, emphasized "how stimuli, such as printed words and word-recognition responses, became associated (Samuels and Kamil, 1984: 188, 190)." Researchers were concerned with

information that was observed directly and was external to the individual. In contrast, the developers of models after the advent of cognitive psychology in the late 1960s and since, were interested in how processes such as memory and attention affected reading. Their models of the reading process reflected the thinking of information processing theorists where:

... the human ... is viewed as a communication channel with a capacity for taking in information from sensory organs, such as eyes and ears, and then transforming, storing, retrieving, and finally using this information when it is needed (Samuels and Kamil, 1984: 190).

The model builders usually depicted information processing flow diagrams in which information from print is taken into the system, stored, acted on, and comprehended. The models generally represented the flow of information as: (1) data driven or bottom up processing, (2) conceptually driven or top down processing, and (3) interactive processing in which both data driven and conceptually driven processes were used.

In an example of a data driven model, Gough (1972) described how information from print was processed. First the print was visualized through iconic representation (eye fixation) and letters were discriminated. Mapping occurred where the reader moved from the recognition of a word to the meaning of the word. A lexical search was made in short term memory where words accumulated until syntactic and semantic information were understood. The

information moved on to another place, (PWSGWTAU) the "Place Where Sentences Go When They Are Understood". Then different information might enter the system.

In this view, there was a text based emphasis on comprehension where the reader progressed through a series of stages. The stages involved the detection of features of letters, recognition of letters, identification of strings of letters as words, analyzing words for meaning, and finally, connecting sentences for meaning. Different approaches suggested factors other than text that might influence reading, such as the role of making inferences, prior knowledge, and the selection of the important elements of text necessary for understanding (Samuels and Kamil, 1984).

Goodman's model (1971), the most influential one on reading instruction (Samuels and Kamil, 1984), used oral reading data to support it. Goodman (1971) viewed reading as a psycholinguistic guessing game, a selective process, in which the reader made:

... partial use of available minimal language cues selected from perceptual input on the basis of the reader's expectation. As this partial information is processed, tentative decisions are made to be confirmed, rejected or refined as reading progresses (Goodman, 1971: 260).

In this model the reader relied more on syntactic and semantic rather than graphic information (Samuels and Kamil, 1984) for meaning. However, in the selection process, the reader did pick up graphic cues and then formed an image

that was partly what he saw and partly what he expected to see (Goodman, 1971). The information derived from this process was stored in short term memory (STM), then the process continued.

According to Mitchell (1982) neither the data driven nor the conceptually driven models exemplified by Gough, (1972) and Goodman (1971) seemed to be completely satisfactory. He argued for both text and reader expectation as influences. In interactive models of the reading process both data driven (bottom-up) and conceptually driven (top-down) processes were engaged simultaneously.

Rumelhart (1977) proposed a model that emphasized "flexible processing with multiple information sources depending on contextual circumstances (Samuels and Kamil, 1984: 187)." Mitchell described the model in the following manner: (1) information was seen and stored in a Visual Information Store (VIS); (2) visual features moved to the pattern synthesizer, the model's central component, where different sources of information were used to interpret the text; (3) that information moved to the message center where each knowledge source was used to formulate hypotheses, those were checked against information in other parts of the system and if compatible, strengthened, if not weakened. After repeated checking, done simultaneously, a final set of hypotheses was accepted as the interpretation of the text.

Schemata, the "building blocks of cognition" (Rumelhart, 1981: 4) were elements upon which "all information processing depends." Schemata were used to: (1) process sensory data, (2) retrieve information from memory, (3) organize actions, (4) determine goals, (5) allocate resources, and (6) guide "the flow of processing in the system."

An exhaustive exposition of schemata has not been conceptualized. They are viewed as active processes to determine best fit among data and to "invoke patterns" in information. Rumelhart and Ortony (1977: 13) posited four characteristics for schemata: (1) they contain variables; (2) they can be embedded within each other; (3) they represent knowledge at all levels of abstraction; and (4) they represent knowledge not definitions.

The process of understanding text involved discovering schemata to account for the text and evaluating those schemata against that text toward an interpretation. The interpretation the reader arrived at may not be the one the author intended. One reason this might occur could be because the reader does not have the correct schemata and as a result could not understand the intended meaning. In another instance the reader could have the appropriate schemata, but cues given by the author could be inappropriate. The reader would not understand the passage, but with more cues could derive meaning. Finally, the

reader could devise a consistent interpretation that might not be the one intended by the author. In this case the reader would comprehend the text but misunderstand the author. Rumelhart (1981: 4) commented that the ideas have not yet "... proved their usefulness but they offer promise for problems involved when psychological theories are applied to educational problems."

Kemmil and MacGinitie (1981) stated that it was important for a successful reader to develop hypothesis testing facility. In order to accomplish this the reader needed to be able to use an appropriate set of schemata as a basis for focusing on and recalling information that was central to the theme of the text. Mature readers were able to distinguish salient elements from text from about sixth or seventh grade levels. Due to encoding and retrieval processing, important elements were recalled from text. Differences occurred because while encoding some individuals processed more or used text elements to fill out slots in schema. Material was important if it filled the available slots, but was not used if it did not fit the schema. In efforts at retrieval, a memory search moved from knowledge in existing schemata to information stored when text was read. Information important to the knowledge frame would be accessible while unimportant information would not. Another retrieval effort might involve inferential reconstruction. If the reader failed to recall text,

reconstructing the text based on details which would usually fit the slots in the knowledge frame might facilitate recall.

Kemmil and MacGinitie (1981) argued for the importance of the use of appropriate schemata as the basis for focusing on and recalling information. A way to examine that ability was to investigate how individuals extracted pertinent clues from text. Adult readers could distinguish important elements in text, but it was not until the sixth or seventh grade that children approached adult patterns. The processes operating when the important elements from text were recalled included encoding and retrieval and they seemed to be independent of each other.

Reading and Field Dependence-Independence: Individual Differences and Information Processing

According to Daneman, Carpenter and Just (1982), information processing models of human cognitive functioning presented individual differences in two ways. Such models were structured for single subjects or as general models that applied to all subjects. Investigators interested in developing computer simulations developed models or programs that model the behavior of a single individual in a single task environment (Newell and Simon, 1972; cited in Daneman, Carpenter and Just, 1982: 85). The general model developers constructed procedures to control for inter-subject variability in the methods of testing the

models. Daneman, Carpenter and Just (1982: 85) commented that the need to control this variability pointed to "... the pervasiveness and importance of individual differences in cognitive processing."

Currently, (Spiro and Myers, 1984) the most dominant view of information processing in reading is the interactive model (Rumelhart, 1981). From this base researchers have hypothesized separate reasons for differences in readers' comprehension. Processing differences listed by Daneman, Carpenter, and Just (1982) included differences in word encoding and retrieval, working memory, and integrative processes. Davis and Cochran (1982) proposed that examining attention, encoding in short term memory, and retrieval, as well as, storage in long term memory might enhance the understanding of information processing characteristics of field independent and field dependent learners. In the evolution of ideas concerning field dependence-independence, Witkin and associates (1979) concluded that individuals differed in their ability to restructure information in perceptual and cognitive modes. The differences involved: (1) breaking down a complex stimulus into its component elements; (2) providing structure for an ambiguous stimulus complex; and (3) providing a different structure from that inherent in the stimulus complex.

Attention, as the entry point of information processing

models, could have relevance for field dependence-independence (Davis and Cochran, 1982) through the cue salience hypothesis. The cue salience hypothesis (Goodenough, 1976) suggested that field dependent subjects attended only to the most noticeable or salient features of a stimulus and tended to ignore many features that might not have been as obvious yet had relevance for interpretation.

Studies cited by Davis and Cochran (1982) as evidence for individual differences in attention processes included: (1) subjects who were asked to attend to a relevant stimulus in auditory and visual modes with competing and irrelevant stimuli (Avolio, Barrett, and Sterns, 1981); (2) eye movement patterns with a changing visual display (Shiner, McDowell, Rackoff, and Rockwell, 1978); (3) signal detection in high task demand situations (Forbes and Barrett, 1978); (4) selective attention detected by eye movements during performance on the Rod and Frame Test (a test of field dependence-independence) where subjects must attend to the relevant parts of the visual field; and (5) pace in presentation of stimuli in auditory and visual selecting attention tasks (Avolio, Alexander, Barrett, and Sterns, 1979). Davis and Cochran (1982) interpreted those studies as evidence for individual differences in attentional processes associated with information processing models.

Encoding, another process associated with information processing models, could be a source of differences. Davis

and Cochran (1982) presented studies of encoding-specificity, digit span, and working memory tasks to support this deduction. Differences in versatility and quality of recall related to encoding information were reported. Digit span tasks assumed to be related to processing in short term memory indicated differences in subjects. Working memory, the central computing space where information is held and acted on before moving to long term memory, was manipulated through high and low information load tasks that were examined for errors. Inference and recognition performance were also investigated and the results indicated, differences of individuals in encoding processes (Davis and Cochran, 1982).

Goodenough (1976) reported little evidence for relationships between the performance of field dependent and field independent individuals on associative learning and memory tasks. More recent research (Davis and Frank, 1979; Stasz, Shavelson, Cox, and Moore, 1976) seemed to indicate that organizational processes contributed to memory differences in subjects (Davis and Cochran, 1982). Glynn (1983) stated that component comprehension processes competed for limited space in the readers' working memories. Those processes included recognizing words and retrieving meanings, identifying and organizing important text ideas, and integrating those ideas with prior knowledge from long term memory.

It was thought that readers coped with limited processing capacities by attending selectively, organizing information hierarchically, and practicing the processes until they became automatic. Information attended to was stored temporarily through rehearsal while the reader operated on it. In studies involving recall in prose passages (Annis, 1979; Satterly and Telfer, 1979; Spiro and Tirre, 1980), organizational processes were implied (Davis and Cochran, 1982). Although the precise processes, storage or retrieval, were not identified, the results of the studies consistently indicated individual differences in organizational processes.

Reading was defined as more than the ability to identify and decode words. Early writers conceptualized it as an activity involving reasoning (Thorndike, 1917, 1971) and thinking (Huey, 1908). Matlin (1983) pointed out that cognition involves mental activities which includes reasoning and thinking. Reading was conceptualized as involving cognitive processes (Goodfriend, 1983) with information processing models to describe them (Goodman, 1971; Gough, 1972; Rumelhart, 1981). By logic (Goodfriend, 1983), with the supporting argument, reading comprehension could involve some of the same information processing variables assessed and identified through field dependence-independence measures.

Reading and Field Dependence-Independence Research

Kogan (1980: 70) concluded that "... there is good reason to believe that field-independence ... is associated with certain verbal abilities, possibly including reading." Yet, in the more than 3000 references related to field dependence-independence, relatively few indicated concern with reading problems or achievement (Kogan, 1980; Shaha and Wittrock, 1983). One reason this might have occurred is that Witkin and others (1977) stated that the construct was related to the reasoning required in mathematics rather than the type of skills required in verbal activity such as vocabulary and comprehension. A second reason which suggested "field dependence-independence has apparently never been in vogue with reading researchers and reading has not been a favored concern of field dependence-independence investigators" was posed by Rasinski (1983: 5).

Recently, Witkin and others (1979, cited in Kogan, 1980) related field dependence-independence to restructuring processes. If field dependence-independence and reading involved processes associated with information processing models then it could be hypothesized that they might be related.

Research concerned with field dependence-independence and reading was first conducted in the 1960s and has continued to the present. Goldstein and Blackmon (1978)

reported that the findings from the literature were difficult to interpret for several reasons. The reasons were that the investigators used small samples, subjects from different age groups (Hansen and Stansfield, 1981), different types of learning tasks, and many different measures of field dependence-independence (Goldstein and Blackmon, 1978). Also, research has been conflicting on the significance of the relationship between field dependence-independence and reading achievement. Some research reported a significant relationship while others found no relationship between reading achievement and reading comprehension (Pitts and Thompson, 1982).

Research on field dependence-independence and reading achievement reported in this review included brief summaries of studies of young children and adolescence with a more detailed examination of studies of children in the middle grades, especially the sixth grade since this grade is the focus of the study.

Gill, Headtner, and Lough (1968) studied achievement and field dependence-independence of nursery school and kindergarten children using a modified Rod and Frame Test and the Metropolitan Achievement Test. They reported that the modified Rod and Frame Test was a moderate predictor of achievement. Watson (1970) concluded that boys who were field independent were better readers than those who were field dependent in grades one, two, and three.

Smith (1973) reported a significant relationship between scores on the Children's Embedded Figures Test and reading for details with intelligence controlled for females and the total sample of precocious kindergarten readers. The findings were not significant for boys. The hypothesis that more children who were field independent would be early readers was not supported. Pitts and Thompson (1982) found a statistically significant relationship between cognitive styles, including field dependence-independence, and reading comprehension of second, third, and fourth graders. Robeck (1982) reported the greatest amount of unique variance to silent comprehension was contributed by field dependence-independence. In three studies (Gluck, 1973; Schwartz, 1973; Watson, 1970) of first, second, and third grade children where the Children's Embedded Figures Test, a measure of field dependence-independence and a reading achievement test were used. Evidence from these studies indicated "... some relationship between reading achievement and cognitive style (Robeck, 1982: 100)." The common element that might be relevant to both field dependence-independence and reading achievement was the process of disembedding critical points from a structured field and reorganizing them into a new structure. That element seemed to be important in decoding tasks as well as some tasks in comprehension. Robeck (1982) concluded that successful reading could depend on the match between the

cognitive processes of children and the type of reading program offered to them. Saracho (1984) from a study of first and third grade children thought that their differing cognitive styles might affect academic achievement differently at different grade levels.

Witkin (cited in O'Tuel and Wicker, 1979) reported no relationship between fielddependence-independence and achievement at the college level and a moderate relationship at the high school level. In an early study conducted by Stuart (1967) with forty males and forty females from seventh and eighth grades a strong positive relationship was found between the Embedded Figures Test and reading achievement measured by the Metropolitan Reading Achievement Test. Peterson and Magaro (1969) discovered that field dependence-independence measured by the Embedded Figures Test was significantly related to reading achievement with intelligence partialled out. The subjects who participated in the study were ten retarded and ten normal high school students. Satterly and Telfer (1979) in a study involving fifteen year old subjects, stated that the ability of field dependents to deal with formal structure is limited. They suggested that field dependents might be helped by advance organizers if teachers emphasized them. Wilcox, Richards, and Merrill (1977), in a study of high school students, used various forms of text to read and answer questions of the application type based on the text. They found that the

field independent students were significantly better at answering the questions than the field dependents.

Several investigators reported studies of field dependence-independence and reading achievement in the middle grades. Scores from samples of children from different types of populations (learning disabled, black inner city, predominantly white suburban, and boys only) were reported. Some studies included subjects from several grade levels while others included children from only one grade.

Guyer and Friedman (1975) studied learning disabled and normal boys who varied in age from eight to thirteen on a variety of measures. The learning disabled children were found to be more field dependent as well as poorer readers. In an investigation of black, inner-city sixth grade children in a free breakfast and lunch program, Barra (1973) reported no significant differences among four cognitive styles, including field dependence-independence, and reading achievement. Tamor (1980) concentrated on white, upper-middle class, second, third, and fifth graders in a study of field dependence-independence along with three other cognitive styles and their influence on reading performance. The strongest influence of cognitive styles on performance was at the third and fifth grade levels. Cognitive styles had a significant influence on reading as measured in the study. Field independence was associated with more mature

readers. In a study (Lane, 1976) of highly gifted and highly achieving children from ages seven through twelve, the predicted relationship between field independence and high reading achievement was not sustained with sex, age, a cultural factor, and a verbal comprehension factor partialled out.

The results from a Pitts and Thompson (1984) investigation of cognitive styles, including field dependence-independence as mediating variables in inferential comprehension of 128 fourth, fifth, and sixth graders indicated a statistically significant canonical correlation. Wineman (1971) investigated cognitive style and reading achievement of 270 fourth, fifth, and sixth graders. A significant relationship was reported at the fourth grade, no relationship at the fifth grade, and a significant relationship for girls but not for boys at the sixth grade.

Cohn (1968) studied 123 sixth grade students on field dependence-independence, measured by the Embedded Figures Test, and reading achievement and reported a significant and positive relationship. Daku (1978) found no significant relationship between field dependence and reading achievement of sixth graders with intelligence controlled. He commented that the researcher who showed relationships did not control for intelligence. Tormey-Miller (1981) reported no relationship between field dependence-

independence and reading achievement of twenty-six children at the sixth grade level. Yet, Guildemeister and Friedman (1980) found that twenty skilled readers scored higher on a measure of field dependence-independence than twenty unskilled readers who were in the sixth grade.

Reviewers commented that it is difficult to generalize concerning the results of research on field dependence due to the variety of instruments used to measure the construct and reading achievement, the different ages studied, and the many designs and statistical analyses used.

Even though the data base is not large it seems promising enough for researchers to continue to investigate because of the importance it could have for school practice. Different directions have been suggested through theoretical developments in cognitive information processing theory related to how people process information and the view that reading is an information processing activity represented by reading models developed since the mid-seventies.

CHAPTER THREE

Procedures

As stated in Chapter One the problem of the study had two parts: (1) to study relationships between reading achievement and field dependence-independence, intelligence, age, gender, race, and socioeconomic status at the sixth grade level; (2) to examine composites of the independent variables among reading achievement groups on the basis of field dependence-independence, intelligence, age, sex, race, and socio-economic status in combinations and alone.

The first part of the problem was analyzed using stepwise multiple regression techniques to investigate the following questions:

1. What is the relationship between reading achievement and field dependence-independence, intelligence, age, gender, culture, and socioeconomic status?
 - a. How strong is the relationship?
 - b. How important are the various independent variables to the relationship?
 - c. What is the relationship between reading achievement and field dependence-independence with the

effect of the other independent variables statistically removed.

A discriminant analysis was used to analyze the second part of the problem. The following questions were investigated:

1. What are the dimensions along which the reading groups differ?
 - a. Which variables contribute to the differences among groups on the dimensions?
 - b. What is the degree to which members of each of the reading groups may be accurately classified?

The following general procedures were used. The population was described and steps in the selection of the sample were explained. The variables pertinent to the study were identified. The data collection plan was constructed. It included: (1) obtaining permission for the study, (2) gaining the cooperation of the principal and teachers of the school, (3) providing the process to assure the privacy of the individuals who participated in the study, and (4) establishing the testing schedule. Statistical hypotheses were developed which were appropriate to analyze the problem. Stepwise multiple regression and discriminant analysis were identified as the appropriate statistical techniques for use in the analysis of the data. The precautions which were taken to enhance the accuracy of the computation process were explained.

Population Description and Selection of the Sample

The participants in the study were sixth graders from a school located in a small city in a southeastern state. About sixty percent of the economy of the state is industrialized (Statistical Abstracts of the United States, 1984). The population is made up of approximately twenty five percent black inhabitants (Statistical Abstracts of the United States, 1984) who along with the white population have "deep genealogical roots in the state (Encyclopaedia Britannica, 1985: 197)." The city, where a university is established, is located in an agricultural area adjacent to a manufacturing center. The university is the main employer in the city, although businesses located in a small industrial park hire workers from the area. The area included a small number of people, mostly faculty members, from other parts of the country and the world.

The school system located in the city included: (1) a comprehensive high school (grades nine-twelve); (2) a junior high school (grades seven-eight); (3) a school for sixth grades; (4) a school for fourth and fifth grades; (5) and three primary schools (kindergarten-third grades). The three primary schools were neighborhood schools. The other schools were scattered throughout the city. Buses and private vehicles were used to transport the children to school.

The school where the data were gathered served only

sixth graders who were transported there from all areas of the city. It was selected for several reasons: (1) a large sample was needed due to the number of variables included in the study; (2) the number of children who attended would assure a large enough sample to meet the requirements of the statistical analysis (Tabachnick and Fidell, 1983); (3) the fact that the children were all in one school would eliminate the need to control for variability between schools (4) the instrument used to measure field dependence-independence, the Group Embedded Figures Test, is not recommended for children below ten years of age (Witkin, Oltman, Raskin, and Karp, 1971); (5) by the sixth grade level the school curriculum generally has included an emphasis on reading comprehension since that is usually the final level where reading instruction is conducted; and (6) using only one grade level narrowed the age range of the children.

The population included all of the sixth graders in the school system (241) who were present at school on the three days of testing. The group size accommodated multiple regression and discriminant analysis, the statistical analyses of the study, which required a large number of cases. Tabachnick and Fidell (1983) and Klecka (1984) stated that discriminant analysis could be thought of as multivariate multiple regression. If regression is to be used, a case (data collected from an individual) to

variables ratio must be considered if the findings are to be meaningful. The minimum requirement suggested was four to five times the number of cases than independent variables. "Ideally, one would have twenty times more cases than variables (Tabachnick and Fidell, 1983: 91)." Thus, with seven variables the ideal requirement would be seven times twenty which equals 140 cases. That sample size is relevant if there is skewness in the dependent variable, for a smaller effect size, and if there might be considerable measurement error from unreliable variables. Tabachnick and Fidell (1983: 300) also stated that "overfitting can occur with ... direct discriminant analysis if the number of cases does not notably exceed the number of variables." All of the children were tested because of the possibility of discovering missing data on individuals and the possibility of finding extreme scores in the sample.

Variables Described

There are two main variables of interest in the study and five other variables reported in the literature which may influence one or the other main variables. The dependent variable is reading achievement and the independent variables are field dependence-independence, age, gender, race, socio-economic status, and intelligence.

The dependent variable, reading achievement, was measured by the California Achievement Tests, Form C, Level 16. The test is a general achievement test and is

administered each year to all sixth grade students in the state because of a mandate from the State Department of Education. Reading achievement was composed of three sections, Reading Vocabulary, Reading Comprehension and Total Reading. The vocabulary tests measured word categories, synonyms, antonyms, and multimeaning words and their definitions. The reading comprehension tests measured skill in literal, interpretive, and critical comprehension. Literal comprehension was defined as the recall of facts. Interpretive comprehension included inferred meanings, character analysis, and figurative language. Critical comprehension involved determining the author's attitude or position and detecting techniques of persuasion. A total score, found by adding the scores obtained from Reading Vocabulary section and the Reading Comprehension section, was also reported.

Field dependence-independence was determined by the Group Embedded Figures Test (GEFT). The test, developed by Witkin, Oltman, Raskin, and Karp (1971), is a perceptual test used to assess information processing characteristics of individuals. The Group Embedded Figures Test is an adaptation of the individually administered Embedded Figures Test (EFT) to be used with large numbers of subjects. The GEFT has three sections: section one contains seven very easy items and is used for practice; sections two and three contain nine items each and are more difficult than those in

the first section.

The reliability and validity of the test were reported by Witkin and associates (1971). Through correlations between the first and second sections of the test by the Spearman-Brown prophecy formula, a reliability estimate of .82 for both males and females was reported. The validity of the test was assessed through a comparison with its forerunner, the individually administered Embedded Figures Test (EFT). The correlations between the GEFT and the EFT were "reasonably high", $-.82$ for males and $-.63$ for females. The r 's should be negative, according to Witkin and others (1971: 29) because the tests were scored "in reverse fashion". Others (Lis and Powers, 1979; Shade, 1982) reported similar reliability and validity correlations for children. Lis and Powers reported a long term coefficient of stability of $.80$ for boys and $.71$ for girls and an internal consistency of $.83$ for boys and $.98$ for girls. Shade (1982) used the Spearman-Brown prophesy formula and found a reliability coefficient of $.74$ for the "Euro-American" sample and $R = .87$ for an "Afro-American" sample. Shade (1982) also found reliability coefficients for gender. She found $R = .91$ for boys and $R = .81$ for girls. Shade concluded (1982: 91) "that the GEFT is a highly reliable instrument with a high degree of internal consistency."

Intelligence was measured by the Short Form Test of Academic Aptitude (Sullivan, Clark, and Tiegs, 1970) which

was considered by Aiken (1979) to be a multilevel group intelligence test. The test was administered, scored, and reported to the investigator by staff members of the school system. It was included because intelligence was reported as a variable in some studies but not in others. However, intelligence tests have been used to "predict learning in school settings (Spiro and Meyers, 1984: 473)" from Binet's time to the present.

Ages of the children ranged from eleven to thirteen years. Since that range was so broad and the cognitive processing that is associated with field dependence-independence (Witkin and others, 1971) and reading comprehension may be age related (Wigfield and Asher, 1984), the age variable was included.

Race, gender, and socioeconomic status (SES) were included because research indicated that these variables might be related to the other variables of the study. The variables of race and gender were dichotomized into: (1) black and non-black for race and (2) male and female for gender. Socioeconomic status was examined through several items. They were: (1) housing (owns, rents, federally subsidized) and (2) parents (live in the home, schooling, occupation). Race was included because more than thirty percent of the sample was black and findings from studies that included blacks in their samples suggested that differences might occur between blacks and non-blacks in

field dependence-independence (Shade 1982, 1984). Shade (1982: 23) reasoned that Afro-Americans process information differently from other groups, however the research reported in the area is "extremely small and is found largely in unpublished dissertations."

Data Collection

Preparations for data collection were made a year before the data were gathered and proceeded through several stages. They included: (1) deciding on the information needed, the design, and the type of sampling procedure necessary for the study; (2) finding a school that best fit the design of the study; (3) obtaining permission from the school system to conduct the study; (4) securing the cooperation of the principal and teachers of the school in gathering the data from their school; (5) working with the superintendent, principal, and central office personnel on a schedule for testing, (6) constructing a plan to assure the privacy of the students; (7) testing; and (8) developing and implementing procedures after the testing.

After the school was located the superintendent of the system was contacted and permission was granted to conduct the study contingent on permission by the school board. Final permission was obtained. The superintendent contacted the principal and explained the request for the study. This was followed by a visit by the investigator to the principal to describe the study and to set meetings with

teachers to explain the study and to ask for their cooperation.

The achievement testing schedule for the next year was determined and the testing for field dependence-independence was scheduled for the week after the achievement tests. The schedule for administering the Group Embedded Figures Test was set for afternoons of the Tuesday, Wednesday, and Thursday following the week of achievement testing. Three classes were tested each day and the day and times for testing were randomly selected. The privacy of the children was assured by attaching removable stickers to the test booklet where the children wrote their names. The testing procedure from the test manual of the Group Embedded Figures Test was followed by the investigator for each class with the teacher present. After the testing was completed the test booklets were sealed in the presence of the teacher and taken to the central office where they were coded by number, the other data were recorded, the privacy stickers with the children's names on them were removed, and the data and test booklets were returned to the investigator.

Statistical Hypotheses

The following null hypotheses were tested:

$H_{01} = 0$. There is no significant relationship between the dependent variable (reading achievement), and

the independent variables (field dependence-independence, intelligence, age, gender, race, and socioeconomic status.

$H_{02} := 0$. The regression coefficient of the independent variable field dependence-independence = 0, that is, there is no significant relationship between the dependent variable, reading achievement and the independent variable, field dependence-independence.

$H_{03} := 0$. The regression coefficient of the independent variable, intelligence = 0, that is, there is no significant relationship between the dependent variable, reading achievement and the independent variable, intelligence.

$H_{04} := 0$. The regression coefficient of the independent variable age = 0, that is, there is no significant relationship between the dependent variable, reading achievement, and the independent variable, age.

$H_{05} := 0$. The regression coefficient of the independent variable, gender = 0, that is, there is no significant relationship between the dependent variable, reading achievement and the independent variable, gender.

$H_{06} := 0$. The regression coefficient of the independent variable race = 0, that is, there is no significant relationship between the dependent variable, reading achievement, and the independent variable, race.

$H_{07} := 0$. The regression coefficient of the independent variable, socioeconomic status = 0, that is,

there is no significant relationship between the dependent variable, reading achievement and the independent variable, socioeconomic status.

$H_{0g} = 0$. There are no distinct variables (field dependence-independence, intelligence, gender, race, or SES) which can be used to distinguish among reading achievement groups (Group I, Group II, Group III, and Group IV).

Analysis of Data

Stepwise multiple regression and discriminant analysis techniques were used to analyze the data. Multiple regression analysis allowed the investigator to assess the degree of relationship between the dependent variable and several independent variables. Regression analysis was used because it does not require that the independent variables be uncorrelated (orthogonality). That is, the relationship between the dependent variable and the independent variables can be assessed when the variables are correlated. The investigator had reason to believe that the variables were correlated because of findings of research reported in the Review of the Literature. Another reason for using regression analysis was the nature of the problem. The problem of the study involved children in a classroom setting. This situation cannot be "meaningfully reduced to orthogonal designs in a laboratory setting (Tabachnick and Fidell, 1983: 86)."

The procedure for the stepwise multiple regression

analysis was established by the following multiple regression model:

$$Y' = A + B_1 X_1 + B_2 X_2 + \dots + B_6 X_6$$

Where:

Y' = reading achievement

A = value of Y' when all the X's are zero

B = parameter coefficient of the independent variables or best fitting weights

X₁ ... X₆ represent the independent variables available to predict Y' where:

X₁ = field dependence-independence

X₂ = intelligence

X₃ = age

X₄ = gender; male - female

X₅ = race; black - non-black

X₆ = socioeconomic status; home ownership, parents live in home, parents years of schooling, parents occupation

Stepwise multiple regression techniques were used to identify the greatest number of related variables.

Discriminant analysis allowed the investigator to find functions (composites) of variables that showed maximum differences and minimum overlap among groups. Discriminant analysis may be used for classification or prediction. Since stepwise multiple regression provided prediction, discriminant analysis was used for classification. For example, in the present study the following information was available for each child: scores

from the Group Embedded Figures Test and an intelligence test, age, gender, race, and socioeconomic status. Discriminant analysis selected the best combination of these variables to provide information concerning individuals who were classified into reading achievement groups (Group I, zero to the twenty-fifth percentile; Group II, the twenty-sixth percentile to the fiftieth percentile; Group III, the fifty-first to the seventy-fifth percentile; or Group IV, the seventy-sixth percentile to the one hundredth percentile). According to Tabachnick and Fidell (1983), if there are more than two groups and if classification of cases is desired, discriminant analysis is appropriate. Therefore, discriminant analysis was appropriate because there were more than two groups (four) in the dependent variable. Neither option, the use of more than two groups nor classification, is available with other multiple regression techniques.

A cross-validation procedure was followed to assess the adequacy of classification. Twenty-five percent of the total sample was set aside for the cross-validation sample. The cross-validation sample contained a stratified random sample of blacks and nonblacks as well as males and females based on the numbers in the total sample. The same discriminant analysis techniques were applied to the cross-validation sample as the standardization sample. The patterns of group membership in the standardization sample

were then compared to the patterns found in the cross-validation sample (Tabachnick and Fidell, 1983; Thorndike, 1978).

The region of rejection used in the study was set at the .05 level of significance. The probability was .05 of committing a Type I error. A Type I error is committed when an hypothesis that is assumed to be true (null hypothesis) is rejected.

Precautions Taken for Accuracy

The test booklets for the Group Embedded Figures Test were checked twice and recorded on the data sheet supplied by the school system. It was rechecked before the data were entered into the computer. It is assumed that the data supplied by the school system are accurate. The investigator was not allowed to check these data immediately following the testing because of the concern for the privacy of the individuals who participated in the study. A computer printout of the raw data was checked against the data sheet used to enter the data into the computer before statistical analysis. The data were rechecked in the data files entered into the computer and corrections were made.

The Honeywell DPSC3, Level 66 main frame computer with the CP6 operating system, was used to process the data. SPSS^x Stepwise Multiple Regression and Discriminant Analysis programs were used for the analysis of the data.

CHAPTER FOUR

Data Analysis

The data were analyzed through stepwise multiple regression and discriminant analysis techniques. Stepwise multiple regression was used to determine the best linear combination of independent variables to predict the dependent variable as stated in hypotheses one through seven. The classification of groups from the application of discriminant function analysis were given as they applied to hypothesis eight. Descriptive data are presented followed by the results of the stepwise multiple regression and discriminant analysis.

Questions of causality were not answered since the results from stepwise multiple regression and discriminant analysis cannot be used to explain what causes prediction or differential group membership (Tabachnick and Fidell, 1983). Causality can only be established through experimental designs in controlled situations.

Descriptive Data

The information displayed in Table 1 is a summary of

Table 1. Summary of Means and Standard Deviations from the California Achievement Tests, Form C, Level 16 (CAT): Group Embedded Figures Test (GEFT); and Short Form Test of Academic Aptitude (SFTAA) by Race and Gender

		N	Mean	Standard Deviation
CAT	Total Group	205	49.78	15.38
	Males	95	49.68	15.96
	Females	110	49.86	14.92
	Black males	29	37.03	15.92
	Black females	37	35.81	12.69
	Non-black males	66	55.24	12.51
	Non-black females	73	56.98	10.18
GEFT	Total	239	7.21	5.58
	Males	117	7.54	5.14
	Females	122	6.89	5.98
	Black males	35	4.29	4.61
	Black females	40	2.73	3.57
	Non-black males	82	8.94	4.74
	Non-black females	82	8.93	5.87
SFTAA	Total	199	106.80	16.41
	Males	94	107.47	16.35
	Females	105	106.21	16.53
	Black males	27	92.74	12.79
	Black females	34	90.65	11.88
	Non-black males	67	113.40	13.70
	Non-black females	71	113.66	12.87

the means and standard deviations of the scores from the reading achievement, field dependence-independence, and intelligence measures of thirty-five black males, thirty-nine black females, eighty-two non-black males, and eighty-four non-black females.

The total number of participants is composed of 51.4 percent females and 48.6 percent males. Blacks make up 35.7 percent of the sample. The remainder, 64.3 percent, are are classified as non-black. The ages of the children ranged from eleven to thirteen. The eleven year group was composed of 46.8 percent of the total number of children, the twelve year group contained 48.4 percent, and the thirteen year group accounted for 4.8 percent.

Most of the families of the children either owned their homes (65.2%) or rented (29.0%) a place to live. Federal housing provided for 5.8 percent of the children.

Fathers were in the home of 94.8 percent of the children and mothers in 97.1 percent of the cases.

Schooling of parents is displayed (Table 2) below.

Table 2. Percent of Parents and the Number of Years of School Completed

Years in school	Mothers	Fathers
	Percent	Percent
College:		
4 years or more	37.7	63.5
1-3 years	24.6	5.8
High school:		
4 years	16.4	13.5
1-3 years	14.7	5.8
Elementary school:		
0-8 years	5.5	11.5

A greater percentage of the fathers completed four or more years of college than the mothers. However, a greater percent of the mothers attended high school and at least

three years of college. More mothers than fathers completed elementary school.

Nam and Powers (1983) developed a scale for occupation status scores that represented the "life chance" for an individual. The scores range from 0-100. The higher the score the greater the chance for success. Types of occupations represented by higher scores were professional and technical jobs. The lower scores represented laborers and service work. The authors suggested that investigators examine the "natural groupings" which occur. Natural groupings were defined as the groups that were formed where a natural break occurred in the scores. Natural groupings are displayed in Table 3.

Table 3. Percentage of Parents in Natural Groupings of Occupation Status Scores

Scores	Percent
Natural groupings:	
Fathers	
0-29	22.6
61-80	25.5
82-99	50.9
Mothers	
0-29	47.8
34-65	19.4
76-99	32.8

The scores from the "natural groupings" of occupation status tended to be higher for the fathers than the mothers. More than fifty percent of the fathers' scores fell within the 82-99 grouping. Only about thirty-three percent of the

mothers' scores were in the highest grouping (76-99). The scores displayed in Table 3 form a part of the group of variables which were designated socioeconomic status. They represented the fathers' occupations (FO) and mothers' occupations (MO).

Stepwise Multiple Regression

Stepwise multiple regression techniques allowed the selection of an optimum number of predictor variables which made the greatest contribution to the stability of the regression equation by dropping the variables which made the least contribution in the multiple regression (Thorndike, 1978). The aim in the analysis was to identify those independent variables that best predicted the dependent variable and to eliminate those independent variables that did not provide predictive value (Tabachnick and Fidell, 1983).

The following null hypotheses were tested through stepwise multiple regression techniques.

$H_{01} := 0$. There is no significant relationship between the dependent variable (reading achievement), and the independent variables (field dependence-independence, age, intelligence, gender, race, and socioeconomic status).

Table 4. Stepwise Multiple Regression and Significance for Reading Achievement by the Independent Variables: Field Dependence-Independence, Intelligence, Age, Race, Gender, and Socioeconomic Status

Independent Variables	R ²	R ² Change	P
FDI*	.6641	.0077	< .001
IQ	.6104	.6104	< .001
Age	.6498	.0074	< .001
Race	.6333	.0229	< .001
Gender*			
Socioeconomic Status**			
Hsing*			
Fin*			
Min		.0091	< .001
Fsch*			
Msch*			
Fo*			
Mo		.0065	< .001

* Variables entered in the second block of the stepwise regression: results shown beside FDI

** Housing (Hsing), Father in the home (Fin), Mother in the home (Min), Fathers' schooling (Fsch), Mothers' schooling (Msch), Fathers' occupation (Fo), Mothers' occupation (Mo)

The R² change between reading achievement and the independent variables IQ, RACE, MIN, AGE, and MO was significantly greater than zero. As a result, hypothesis one was rejected. The results tested indicated a significant relationship between reading achievement and the independent variables IQ, RACE, MIN, AGE, and MO.

H₀₂: = 0. The regression coefficient of the independent variable field dependence-independence = 0, that is, there is no significant relationship between the dependent variable, reading achievement and the independent variable, field dependence-independence.

Table 5. Stepwise Multiple Regression Results Involving Reading Achievement and Field Dependence-Independence

Independent Variable	R ²	R ² Change	F	P
FDI				
GNDR				
HSING				
FO				
FIN				
MSCH				
FSCH	.6641	.0077	37.56	< .001

Field dependence-independence (FDI), gender (GNDR), housing (HSING), fathers' occupation (FO), father in the home (FIN), mothers' schooling (MSCH), and fathers' schooling (FSCH) accounted for the results displayed

The R² between reading achievement and field dependence-independence was significantly greater than zero. As a result, hypothesis two was rejected. The results of the tested hypothesis indicated a statistically significant relationship between reading achievement and field dependence-independence.

H₀₃: = 0. The regression coefficient of the independent variable intelligence = 0, that is, there is no significant relationship between the dependent variable, reading achievement and the independent variable, intelligence.

Table 6. Stepwise Multiple Regression Results Involving Reading Achievement and Intelligence

Independent Variable	R ²	R ² Change	F	P
SFTAA	.6104	.6104	374.47	< .001

The R² (.6104), the initial step in the stepwise

regression model, between reading achievement scores and intelligence scores was significantly greater than zero. As a result, hypothesis three was rejected. The results of the tested hypothesis indicated a statistically significant relationship between reading achievement and intelligence.

$H_{04} = 0$. The regression coefficient of the independent variable age = 0, that is, there is no significant relationship between the dependent variable, reading achievement and the independent variable age.

Table 7. Stepwise Multiple Regression Results Involving Reading Achievement and Age

Independent Variable	R^2	R^2 Change	F	P
Age	.6498	.0074	109.47	< .001

The $R^2 = (.6498)$ between reading achievement scores by age was significantly greater than zero. As a result, hypothesis four was rejected. The results of the tested hypothesis indicated that there was a statistically significant relationship between reading achievement and age.

$H_{05} = 0$. The regression coefficient of the independent variable gender = 0, that is, there is no significant relationship between the dependent variable, reading achievement and the independent variable, gender.

Table 8. Stepwise Multiple Regression Results Involving Reading Achievement and Gender

Independent Variable	R ²	R ² Change	F	P
GNDR*				
FDI				
HSING				
FO				
FIN				
MSCH				
FSCH	.6641	.0077	37.56	< .001

* Gender (GNDR), field dependence-independence (FDI), housing (HSING), fathers' occupation (FO), father in the home (FIN), mothers' schooling (MSCH), fathers' schooling (FSCH) accounted for the results displayed

The R² between reading achievement and gender was significantly greater than zero. As a result, hypothesis two was rejected. The results of the tested hypothesis indicated a statistically significant relationship between reading achievement and gender.

H₀₆ := 0. The regression coefficient of the independent variable race = 0, that is, there is no significant relationship between the dependent variable, reading achievement and the independent variable, race.

Table 9. Stepwise Multiple Regression Results Involving Reading Achievement and Race

Independent Variable	R ²	R ² Change	F	P
Race	.6333	.0229	205.55	< .001

The R² (.6388) between reading achievement scores and race was significantly greater than zero. Because of that

finding, hypothesis six was rejected. The results of the tested hypothesis indicated a statistically significant relationship between race and reading achievement.

$H_{07} = 0$. The regression coefficient of the independent variable socioeconomic status = 0, that is, there is no significant relationship between the dependent variable, reading achievement and the independent variable, socioeconomic status.

Table 10. Stepwise Multiple Regression Results Involving Reading Achievement and Socioeconomic Status

Independent Variable	R ²	R ² Change	F	P
Socioeconomic status				
MIN	.6424	.0091	141.91	< .001
MO	.6563	.0065	89.75	< .001
MSCH				
HSING				
FIN				
FO				
FSCH*	.6641	.0077	37.56	< .001

* Mothers' schooling (MSCH), housing (HSING), father in the home (FIN), fathers' occupation (FO), fathers' schooling (FSCH), along with field dependence-independence and gender accounted for the results displayed

The R² between some socioeconomic status measures (MIN, .6424; MO, .6563) was significantly greater than zero. As a result, hypothesis seven was rejected. The results of the tested hypothesis indicated a statistically significant relationship between reading achievement and socioeconomic status.

Stepwise regression techniques were used to investigate

the following questions:

1. What is the relationship between reading achievement and field dependence-independence, intelligence, age, gender, race, and socioeconomic status?

a. How strong is the relationship?

b. How important are the various independent variables to the relationship?

c. What is the relationship between reading achievement and field dependence-independence with the effect of the other independent variables removed?

The following discussion concerns question one. The stepwise regression procedure produced those variables that were the most significant ones for predicting reading achievement scores. All of the independent variables were statistically significant ($< .01$) for predicting reading achievement scores derived by stepwise multiple regression analysis. Intelligence, race, mother in the home, age, and mothers' occupation accounted for a total R^2 of .6563 as the first block of variables through the stepwise multiple regression equation. All of the other variables combined (field dependence-independence, gender, housing, fathers' occupation, fathers in the home, mothers' schooling, and fathers' schooling) indicated a small ($R^2 = .0077$) but statistically significant relationship with reading achievement.

The variable which made the strongest contribution, R^2

= .6104, to the prediction of reading scores was intelligence. The remaining variables combined which were significant to the prediction equation contributed $R^2 = .0459$. The analysis indicated that the most important variable for predicting reading scores was intelligence as measured by the Short Form Test of Academic Aptitude.

There was a small, statistically significant relationship between reading achievement and field dependence-independence with the effect of the other independent variables controlled.

Discriminant Analysis

The problem of classifying individuals (characterized by description vectors) into preset groups as: Group I (0 to twenty-fifth percentile of reading achievement scores); Group II (twenty-sixth to the fiftieth percentile); Group III (fifty-first to the seventy-fifth percentile); and Group IV (seventy-sixth to the one hundredth percentile), was accomplished through discriminant analysis. Discriminant analysis allowed the investigator to describe a set of linear combinations of the variables whose values are as close as possible within groups and as far as possible between groups (Lebart, Morineau, Warwick, 1984: 70). The objective of the investigator was to find all of the linear combinations among the variables that had (1) a maximum between group variance (in order to maximize the differences between groups) and (2) a minimum within group

variance (in order to minimize the spread of the groups). In other words, the reason for using discriminant analysis was to interpret the discriminating space in terms of the variables that made the greatest contribution to the separation of Groups I, II, III, and IV (Tabachnick and Fidell, 1983). The linear combinations were the linear discriminant functions.

The following hypothesis was investigated.

$H_{08} = 0$. There are no distinct variables (field dependence-independence, intelligence, gender, race, or socioeconomic status) which can be used to distinguish among reading achievement groups (Group I, Group II, Group III, and Group IV).

Table 11. Discriminant Function Analysis for Reading Achievement Groups

Discriminant Functions	Percent of Variance	Chi Squared	D. F.	P
1	97.04	305.11	39	.001
2	2.08	44.80	24	.006
3	.88	14.29	11	.22

The chi-square test statistics of discriminant functions one and two were significantly greater than zero. As a result, hypothesis eight was rejected. The results of the tested hypothesis indicated a significant difference in the composites that best distinguished the individuals classified among the four reading groups.

Discriminant function analysis was used to analyze the

second part of the problem. The following questions were answered:

1. What are the dimensions along which the reading groups differ?

a. Which variables contribute to the differences among groups on the composites?

b. What is the degree to which members of each of the reading groups may be accurately classified?

The dimensions along which the reading groups differed were described through three discriminant functions. The discriminating variables were ordered by the function with the largest correlation and the magnitude of that correlation. The first discriminant function accounted for 97.04 percent of the variance within groups. The variables included in the first discriminant function were reading percentile rankings, mothers' schooling, and field dependence-independence. The second discriminant function accounted for 2.08 percent of the variance within groups. The variables included in the second discriminant function were race, housing, fathers' schooling, intelligence, and gender. Both the first and second discriminant functions were statistically significant ($\text{Chi}^2 < .05$). The third discriminant function accounted for .88 percent of the variance within groups, however the variance was not significant ($\text{Chi}^2 .22$). The variables included in the third discriminant function were age and the socioeconomic

variables mother in the home, father in the home, fathers' occupation, and mothers' occupation.

Examination of the group centroids (means) showed that differences on the composites distinguished among groups. Canonical correlations of .9759 for the first discriminant function and .5479 for the second discriminant function provided a high degree and moderate degree of association among discriminant function scores and group membership (Tabachnick and Fidell, 1983).

Discriminant analysis of the cross-validation sample (twenty-five percent of the total sample) yielded the following results.

Table 12. Discriminant Function Analysis for Reading Achievement Groups: Cross-Validation Sample

Discriminant Function	Percent of Variance	Chi ²	D. F.	P
1	82.56	95.28	33	.001
2	16.20	35.38	20	.018
3	1.24	4.79	9	.85

Composites of the first discriminant function are reading achievement groups, intelligence (not included in the sample composites), fathers' schooling (not included in the sample composites), and field dependence-independence. Composites of the second discriminant function included age and race. The third discriminant function included mothers' occupation, mothers' schooling, housing, gender, and fathers' occupation, however the correlation was not

significant. Although there are differences in the discriminant functions of the samples, field dependence-independence and reading achievement groups were the only variables included as composites of the first discriminant function of both samples.

Findings

The findings from the analysis of the data by stepwise regression analysis indicated that intelligence was the strongest predictor of reading achievement scores. The remaining independent variables added a small but statistically significant contribution to predicting reading achievement scores. The Group Embedded Figures Test would add to the assessment procedures already in use by school systems to predict reading achievement scores.

The findings from the discriminant analysis indicated that field dependence-independence was a discriminating variable in classifying children into different reading groups. Children who scored lower on the Group Embedded Figures Test tended to be classified into Group I (zero to the twenty-fifth percentile). Children who scored higher on the Group Embedded Figures Test tended to be classified into Group IV (seventy-sixth to the one hundredth percentile).

According to research reported in Chapter Two, children who score lower on the Group Embedded Figures Test are field dependent. Others researchers suggested that field dependent individuals need help in structuring material,

restructuring material that is organized, and in determining salient cues. and that those information processing components are considered to be important in reading comprehension. The discriminant analysis supports those findings since the individuals who were classified into Group I (zero to the twenty-fifth percentile) were field dependent and those classified into Group IV (seventy-sixth to the one hundredth percentile) were field independent.

From the multiple regression analysis, the correlation and significance of the relationship of the variables were included as part of the stepwise multiple regression options in SPSS^x. The analysis indicated that the correlations among: (1) reading achievement and intelligence was .78, (2) field dependence-independence and reading achievement (.50), and (3) field dependence and intelligence (.54). Those correlations could indicate that the tests used to measure intelligence, reading achievement, and field dependence-independence might contain overlapping elements that are measuring the same thing. The subtests of the California Achievement Tests contain a vocabulary section. The Short Form Test of Academic Aptitude also contains a vocabulary section. They both contain sections that measure reasoning processes. The Group Embedded Figures Test was described as a measure of information processing. The overlap, if true, might cause a distorted picture to appear in the statistical analysis.

Crosstabs, a subprogram of SPSS^X, when accessed, displays frequency distribution tables of selected discrete variables. The frequency distribution tables which were run included crosstabulations of reading Groups I, II, III, and IV by gender, controlling for race. Information from the crosstabulation procedure is displayed in Tables 13 and 14.

Table 13. Crosstabulation of Reading Groups by Gender Controlling for Race: Black

Groups	Black	
	Males	Females
I	38.7%	61.3%
II	42.9%	57.1%
III	71.4%	28.6%
IV	42.9%	57.1%

Group I was composed of 47.0 percent of the total number of black children; Group II, 31.8 percent; Group III, 10.6 percent; and Group V, 10.6 percent.

Table 14. Crosstabulations of Reading Groups by Gender Controlling for Race: Nonblack

Groups	Nonblack	
	Males	Females
I	66.7%	33.3%
II	41.2%	58.8%
III	54.8%	45.2%
IV	44.7%	55.3%

Group I was composed of 4.3 percent of the total number of the nonblack children; Group II, 12.2 percent; Group III,

22.3 percent; and Group IV, 61.2 percent.

Chapter Five, the final chapter of this study follows. In it the investigator presented the summary, conclusions, and recommendations. The findings reported in this chapter are incorporated into Chapter Five.

CHAPTER FIVE

Summary, Conclusions, and Recommendations

Summary

Educators have realized for some time that individuals differ in various ways and that differences in school achievement widen as the children progress through school. If variables which account for individual differences can be identified then instructional programs, plans, and strategies might be designed to accommodate those differences so that maximum individual achievement might be accomplished.

Cognitive styles, which are differences in the ways individuals process information, have been considered infrequently in educational planning. It was suggested that field dependence-independence, a cognitive style which has been investigated, primarily by psychologists for over twenty years, could have relevance for educators.

Field dependence-independence was described as contrasting ways in which individuals: (1) locate and use basic elements from organized materials; (2) structure unorganized materials; and (3) provide different structure

from that suggested by the available materials. Field dependent individuals need help in structuring materials while field independent individuals function with little or no outside help and are considered to be more flexible information processors.

Field dependence-independence was rooted in Gestalt psychology with its emphasis on mental organization. Information processing theory, from cognitive psychology, influenced the developers of reading models that emphasized basic reading processes. It could be hypothesized that field dependence-independence might be related to the cognitive processes underlying reading comprehension.

Reading models were developed, mostly since the 1970s, with an information processing base. They were conceptualized as how reading processes flowed through an information processing sequence.

If reading comprehension were an information processing activity as suggested by the models, it might be helpful for educators to be aware of the differences. The educators might include information on each child's cognitive style (field dependence-independence) in the development of a most effective reading program for each individual since writers suggested that the educational diagnostic procedures now in use are inadequate because they do not take into account cognitive processes and cognitive structures.

The need for the study was derived from three

viewpoints; (1) the continuing commitment of educators and the public to identify and provide for individual differences of children to assure their competency in reading; (2) suggestions from the fields of education and psychology concerning the need for a better understanding of how children process information; and (3) because of the limited and confusing results revealed from an examination of studies on the relationship of field dependence-independence to the reading achievement of sixth grade children.

The problem of the study was: (1) to investigate relationships between reading achievement and field dependence-independence of sixth grade children along with other variables (age, intelligence, race, gender and socioeconomic status) that might influence the relationships; and (2) to examine composites of the independent variables (field dependence-independence, intelligence, age, gender, race, and socioeconomic status) that showed maximum differences and minimum overlap among designated reading achievement groups.

All of the sixth graders in the school system (241) who were present on the three days of testing were included in the study. The following data were collected: (1) reading achievement scores from the California Achievement Tests, Form C, Level 16; (2) field dependence-independence score from the Group Embedded Figures Test; intelligence scores

from the Short Form Test of Academic Aptitude; and (3) information on age, gender, race, and socioeconomic status.

Stepwise multiple regression and discriminant analysis techniques were utilized to analyze the data to determine the variables which were the best predictors of reading achievement scores. Intelligence scores were the best predictors of reading achievement scores. The remainder of the independent variables made a small, statistically significant contribution to the prediction of reading scores.

Discriminant function analysis described the composites of the dimension along which the four reading groups differed. The composites of the first discriminant function accounted for 97.04 percent of the variance within groups. The composites of the first discriminant function were reading achievement score, field dependence-independence, and mothers' schooling. The findings were interpreted as providing evidence for the inclusion of the Group Embedded Figures Test in assessment procedures to aid educators in determining the individual needs of children so that appropriate instructional plans and strategies might be devised to assure success in reading.

Conclusions

Stepwise multiple regression results formed the basis for conclusions involving prediction. Results from the

discriminant analysis formed the basis for conclusions involving classification.

Conclusions based on the information collected and the analysis of the data are as follows:

1. Reading achievement scores, measured by the California Achievement Tests can be predicted to a small degree by field dependence-independence, measured by the Group Embedded Figures Test.

2. The strongest predictor of reading achievement scores measured by the California Achievement Tests was intelligence measured by the Short Form Test of Academic Aptitude.

3. There are dimensions along which the reading groups differed. Reading achievement, mothers' schooling, and field dependence-independence were the variables which were included in the first discriminant function of the standard sample. Those composites accounted for 97.04 percent of the variance among the groups. In the cross-validation sample, the first discriminant function was composed of reading achievement, intelligence, fathers' schooling, and field dependence-independence. Those composites accounted for 82.56 percent of the variance among groups. Reading achievement and field dependence-independence were the only variables to appear in the first discriminant function of both samples. Since reading achievement and field dependence-independence held as

discriminating variables across samples, that fact seems to justify the conclusion that they could be used as factors to discriminate among individuals in reading achievement.

4. Differences in field dependence-independence varied with reading groups. Children who were more field dependent tended to be classified in Group I (zero to the twenty-fifth percentile). Children who were more field independent tended to be classified in Group IV (seventy-sixth to the one hundredth percentile).

5. More black children than nonblack children tended to fall into Group I. More nonblack children than black children tended to fall into Group IV.

6. Certain socioeconomic variables make a small contribution as predictors of reading achievement and as composites of discriminant functions.

7. Gender does seem to be of use in distinguishing among reading groups since it was one of the factors of the second discriminant function.

7. Age, in the range designated in this study, can be used as a predictor for reading achievement, although it was not significant as factor of the composites of the discriminant functions.

Recommendations

Based on the analysis of the data and the conclusions drawn, the investigator recommended:

1. Further studies to examine the subsets of tests

(California Achievement Tests, Short Form Test of Academic Aptitude) as they relate to information processing (structuring information, restructuring, cue selection) measured through the Group Embedded Figures Test.

2. Follow-through studies of the same children should be conducted to determine if the characteristics they exhibited related to field dependence-independence in the sixth grade hold throughout schooling. Follow-through studies might be conducted at two year intervals.

3. In depth studies need to be conducted to determine if the results related to black children (black females in particular) hold in other studies. Are black children more field dependent? Are black females more field dependent than black males? Are there cultural factors that influence black children's performances on the measure of field dependence-independence? Are there social expectations that exert different influences on black male children and black female children? What role does the school play in these differences? Do the black children who enter school tend to be more field dependent?

4. Classroom influences need to be examined. Do different types of classroom organization make a difference in field dependence-independence and achievement?

5. Profiles of field dependent children as well as field independent children are needed to answer the following questions. How do field dependent children work

through a situation? How are they different from field independent children?

6. Curriculum directors and coordinators should conduct studies within school systems for:

a. The examination of materials that teachers are required to use and if these materials contain subject matter to enhance the information processing skills of children.

b. Involve teachers in adapting materials to the differing information processing modes of children.

c. Adapt plans and strategies to include information processing components such as, structuring unorganized material, restructuring material that is already organized, or selecting appropriate cues.

7. School systems should develop pilot studies to examine the influence of parent involvement when the staff of the school system school works with families to develop information processing skills. How would these activities affect children's achievement? Would these types of activities affect public opinion of schools?

8. Studies at the university level should examine the field dependence-independence of prospective teachers. If differences exist, adapt instruction. Develop components of the teacher education program to include attention to information processing skills as they relate to the type of instruction planned for children.

Data derived from the present study were interpreted as support for the potentially important role which field dependence-independence should play in the understanding of reading processes involved in reading comprehension leading to the enhancement of reading success for all children. These findings would be helpful if educators utilized them in assessment procedures since they are related to reasoning, thinking, information processing modes that influence reading comprehension. The development of instructional methods and materials designed to include this information would add to the enhancement of success in reading.

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