THESIS

This is to certify that the

thesis entitled

The INTERACTION of Problem-Solving Response Time, Time Given to Problem-Solve, AND Reflection-Impulsivity IN THIRD GRADE LEARNERS

presented by

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has been accepted towards fulfillment
of the requirements for

PhD degree in Educational Psychology

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Major professor

Date 7/11/84

O-7639

THE INTERACTION OF PROBLEM-SOLVING RESPONSE TIME, TIME GIVEN TO PROBLEM-SOLVE AND REFLECTION-IMPULSIVITY IN THIRD-GRADE LEARNERS

By

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A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Educational Psychology

1984

ABSTRACT

THE INTERACTION OF PROBLEM-SOLVING RESPONSE TIME,
TIME GIVEN TO PROBLEM-SOLVE,
AND REFLECTION-IMPULSIVITY
IN THIRD-GRADE LEARNERS

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This dissertation investigates the relationship between instructional problem-solving response time, time given to problem solve, and the learner's reflection-impulsivity cognitive style. The issue of primary interest concerns whether a learner's reflection-impulsivity relates significantly with response time on classroom-type math problems. The Matching Familiar Figures Test was used to assess the sample of ninety-four third-grade learners on reflection-impulsivity. Math problems from the Michigan Educational Assessment Program were used as problems in the three treatment conditions (five-second, ten-second, variable-second). Data were collected on the latency time (time taken to problem solve and respond) in relationship to the time given to respond (treatment conditions). The accuracy of responses (correct, incorrect answer) were also recorded as dependent measures. Results showed no significant differences between impulsive and reflective learners on the time taken to problem solve and respond under the three treatment conditions. In addition, no differences were

found when controlling for ability. Modest differences were found, however, between reflective-impulsive learners on the accuracy of responses.

DEDICATION

This dissertation is dedicated to the memory

of my grandparents,

William and Elizabeth Davis Thomas

Stacey and Bertha Meeks Mosley

ACKNOWLEDGMENTS

Sincere gratitude is given to my chairperson, Dr. Lawrence Lezotte, for his ceaseless encouragement, wisdom, and guidance. Special thanks is also extended to my committee members, Dr. Christopher Clark, Dr. Gloria Smith, and Dr. Donald Hamachek, for their knowledge and assistance.

Appreciation is extended to the staff and students of the school used in this study. In addition, gratitude is extended to Ed Beddinghaus and Elayne Bleill, to Andrea Phillips for her editing and typing skills, as well as to Shalah Mehdizaden and Kahlil Ansaei, the research assistants who aided in this project.

The warmest of thanks is extended to my family: my parents, Dr. and Mrs. A. Mosley; my sisters, Elizabeth, Vicki, Teresa, and their families Peter, Lisa and Leslie, Michael, Drew and Simone, for their eternal love and support. A very special thanks to lovely friends who supported me throughout my doctoral program, especially my mentors, Drs. Phillip and Jacqueline Bowman. Finally a special heartfelt thanks to my husband, Derek Howard, for his love and strength.

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CHAPTER I

INTRODUCTION

The integration of research on individual difference variables and instructional process variables provides for a research basis which may have a potentially powerful impact on psychological theory and instructional practice. These two areas have concurrently advanced trends for instruction of the learner as well as understanding theory. Therefore, no site is more appropriate for conducting such research in this area than the classroom.

Cognitive Style and Time to Problem-Solve

Research on the learning process has combined the study of student entry variables, such as cognitive ability or style; process variables, for example instructional techniques; with product variables, like ability or problem-solving performance. Models using these variables include the process-product model (Medley, 1979; Dunkin & Biddle, 1974), mastery models (Bloom, 1974; Carroll, 1963), and the interactive model (Peterson, 1977). Recent literature has shown that cognitive style can be used as a student entry variable in studying the learning process. These dimensions of cognitive style include field dependence and independence, (Witkin, Dyk, Faterson, Goodenough & Karp, 1962),

scanning-focusing (Bruner, Goodnow, & Austin, 1956), conceptual tempo: reflection-impulsivity (Kagan, Moss, & Sigel, 1963), and leveling-sharpening (Gardner, Holzman, Klein, Linton, & Spencer, 1959). Reflection-impulsivity in particular has captured much attention as one dimension that relates directly to individual problem-solving behavior. Reflection-impulsivity is the combination of one's manner of processing information quickly or slowly (latency), and the errors that result from this process in making appropriate choices. This interaction has been extensively measured with the Matching Familiar Figures Test (MFFT) (Kagan, 1965).

As an entry variable, cognitive style can play a mediating role in the learning process. This study is intended to investigate the role of cognitive style with instructional time in the learning process. Other variables studied in the learning process include both time given to problem-solve and time taken to problem-solve.

Time and Learning

Little attention has been given to the investigation of a learner's cognitive style and the time the learner needs to problem-solve. One question concerning this notion could be: Is this finite problem-solving time influenced by the environment, or is it inherent to the reflection-impulsivity cognitive style of the learner?

If it is innate, to what does one attribute the variance of problem-solving time across tasks? In some classrooms, one witnesses the impulsive nature of many learners when teachers ask questions. This idea raises questions concerning the relationship between latency, response, and response time, or time given to answer a question. Does the learner gauge him/herself within the time frame provided for answering the question? In contrast, does the learner serve as a base measure for the teacher, who then delegates the amount of time for the learner to answer (based upon the time the learner needed previously)?

The research on response time, problem solving, and cognitive style can be interpreted and logically studied to determine the interaction of the variables. It is hoped that this investigation can complete that task.

The Research Problem

The problem examined in this study involves three issues: 1) the problem-solving process; 2) the use of problem-solving time; and 3) individual differences. The interactional influence of problem-solving time, the learner's cognitive style on question-answer responses, and time taken to respond are more specifically at issue here.

The ability to problem-solve is a result of cognitive abilities. The study of learning and problem-solving

behavior has ranged from the examination of encoding (Siegler, 1978) and information processing (Klahr & Wallace, 1976), to instructional concerns of problem-solving hierarchies (Gagne, 1977) and time-to-learn models (Frederick & Walberg, 1980). In addition, teacher use of instructional techniques is partially dependent upon his or her assessment of the student as a problem solver and on the student's mode of thinking. This study focuses on the problem-solving process, investigating how learners respond under time limits.

Time as an element in instruction brings to bear such issues as problem-solving time or wait time. In this context, one may consider the teacher's pacing of problem-solving situations in relationship to a learner's reflectiveness or impulsiveness. The focus here was how learners used time dependent upon the amount allocated.

The reflective-impulsive dimension of cognitive style reveals that an individual mode of thinking and responding can influence performance of a variety of tasks. Individual modes of problem-solving may be related to the learner's style of reflection-impulsivity. Reflection-impulsivity may be found to influence the learner's approach and response to the problem. Regardless of these diverse perspectives, the direct interaction of reflection-impulsivity cognitive style and problem-solving responding in learning situations remains an issue in educational and psychological literature.

Definition of Terms

Time allowed to problem-solve and respond: In this study, time given to problem-solve and to give an answer to the problem served as treatment levels. Three levels were used: 1) five seconds, 2) ten seconds, and 3) a random treatment where different times were allowed.

Reflection-impulsivity cognitive style: This definition is based on Kagan's (1965b) research and theoretical perspective. It is the manner in which individuals cognitively process and respond and the errors that occur from this process. Individuals may respond using little latency time (quick) and commit many errors (impulsive); or few errors (fast-accurate); or use much latency time (slow) and commit few errors (reflective), or many errors (slow inaccurate).

In this study, errors were transformed to the number of correct responses in the data analysis section.

Purpose and Need

The purpose of this research is to investigate the interaction of time given to problem-solve and respond, reflection-impulsivity, the time taken to respond, and accuracy of the response in third-grade learners.

The issues addressed in this study are: 1) the interaction between problem-solving time given and the accuracy of problem-solving performance in reflective-impulsive learners; 2) the interaction between learner problem-solving

time taken and past allocated time experiences; and 3) a comparison of reflective-impulsive learners and their performance across problem-solving task situations. A theoretical question to be considered concerns itself with whether time given to problem-solve depends upon past learner performance, or whether the learner's problem-solving time depends upon past instructional time experience.

In investigating these issues one finds that reflective-impulsive performance in learners and the time allowed for problem-solving are germane to psychology and education. If results indicate there is an interaction between problem-solving performance and time allowed for problem solving, instructional methods and learning situations could be affected. In addition, influences could occur in other systems.

The educational evaluation system and psychological assessment depend heavily upon problem-solving performance. Knowledge concerning problem-solving behavior in learners, therefore, is important in these areas as well. Furthermore, time is an inherent dimension in education and cognitive psychology. School learning, or structured learning, is established within time constraints.

Because of these instructional issues, one sees that research of this type is important to the understanding of processes in classroom learning. Currently, the view of cognitive style and instructional logistics of classroom

learning are juxtaposed. There is little integration of cognitive characteristics and actual instructional methods or teacher behaviors. By taking a total view of such cognitive and instructional components, one may develop a more integrated perspective of the actual influence of cognitive variables and classroom experiences on problem-solving behavior.

CHAPTER II

LITERATURE REVIEW

The literature review gives theoretical and empirical perspectives on four conceptual areas: 1) aptitude treatment interaction research; 2) research on cognitive style; 3) issues related to problem-solving time; and 4) the psychoeducational implications germane to these topics.

Research on Learning and Teaching

As mentioned previously in this dissertation, research on teaching and learning has produced much in the form of theories and data about how learners learn, and what influences that learning. Some models view learning as linear (process-product), with direct input (teacher) and output (student achievement). More specifically, theoretical and empirical perspectives on learning and teaching may fall into two camps. One says that teaching is the major influence on student achievement. A case in point is research indicating that direct instruction is the one most useful approach for facilitating math achievement (Medley, 1979; Gage, 1978; Rosenshine, 1979). A second notion, supported by the aptitude treatment interaction camp, says that the effectiveness of direct instruction may depend on differences in student aptitude. Other

schools of thought consider time as a crucial variable in the learning process. Carroll (1963) perceives learning as a linear process that is influenced by variables other than teacher-related ones. One major question is how much time is needed and used in the learning process.

To try to understand learning behaviors, ethnography views the learning process as a whole. Ethnographic-oriented research investigates the underlying variables and behaviors in a naturalistic form. Observation serves as a mode to assess the teaching-learning relationship. One other model that has produced much research and which offers a mechanism for investigating both the relationship and effect of variables on learning is the aptitude treatment interaction model.

Aptitude Treatment Interaction Research

Aptitude treatment interaction studies (ATI), of which this research is one, investigate the relationship between individual traits (aptitude) and conditions interacting differentially with that trait. Cronbach and Snow (1977) purported that ATI research attempts to identify generalizations correlating treatment variables to measureable individual characteristics. The impetus for ATI research developed from the philosophy that many learning experiences in educational settings were not necessarily appropriate for all learners. Learning time for students

of varying aptitudes, instructional methods for students of varying achievements levels, and teacher style with students of varying psychological traits were topics for research developed in the 1960's and 1970's.

ATI research combines correlational with experimental methods and modes of analysis (Cronbach, 1957, 1975). One investigates the differences between treatment effects or policy effects and the association between characteristics of the subjects. This produces richer or more intricate results because the researcher is free to analyze trends and similarities as well as differences.

One interaction that may materialize points to the different effects of the treatment variable on the performance of the subjects under study. An interaction occurs when one treatment produces differential results from subjects than another treatment. For example, Treatment A influences Subject B in Manner X, while Treatment A influences Subject C in Manner Y. Treatment B may influence these subjects in a different way. These influences can produce extremely different, almost opposite, effects (disordinal interaction, see Figure 2.1), or produce slightly different effects (ordinal interaction, see Figure 2.2), or produce no effect (parallel graph interaction, see Figure 2.3) on the subjects.

Interactional graphs may show that two methods of instruction are both vulnerable to individual differences

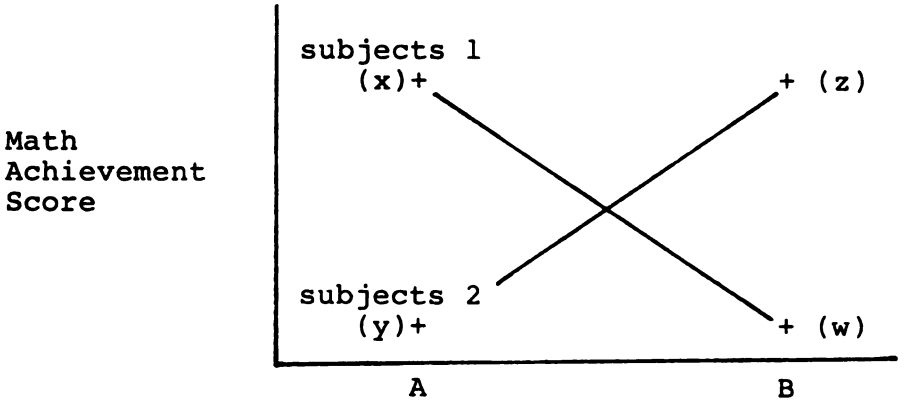

Figure 2.1

Disordinal Interaction

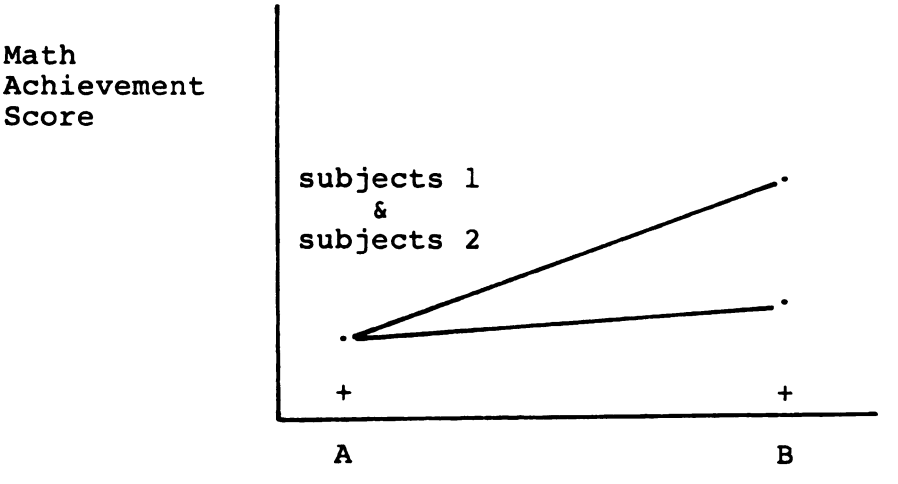

Figure 2.2

Ordinal Interaction

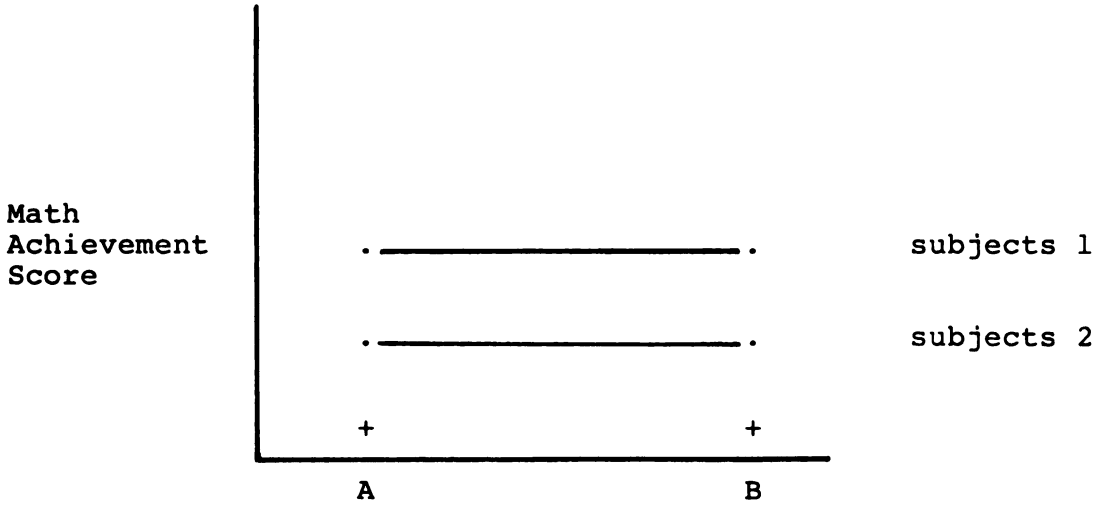

Figure 2.3

No Interaction

in aptitude, but one treatment is better for all learners (parallel lines). Some disordinal interactions also indicate that both methods are vulnerable to individual differences but intersect near the extreme of the aptitude, proving to be better for one group than the other. Interactions intersecting near the median show no preference for either group of learners. These statistical interactions key the researcher into not only differential effects, but also the different predictive validities of the treatments. These interactional patterns have been operationalized through research studies.

The underlying notion for some ATI studies is that instructional/learning conditions may need to be altered,

depending upon the traits of the individual learner. It is assumed that the individual traits are fixed. Some psychological theory says that traits change with learning experiences. Viewing learners as having fixed traits provides the foundation for research investigating the affect of certain instructional methods on these emotional and cognitive traits.

Student anxiety, for example, has been studied at some level with instructional methods (Peterson, 1977; Cronbach & Snow, 1977; Dowaliby & Schumer, 1973). These studies measure anxiety level in students and evaluate achievement of anxiety groups under various instructional situations. Findings suggest that constructive, independent students profit from less directive instruction. Defensive, anxious students tend to require more supportive, external structuring (Cronbach & Snow, 1977). Students with high levels of anxiety perform better in teacher-centered learning situations, while students experiencing low levels of anxiety do better in student-centered environments (Dowaliby & Schumer, 1973). Peterson (1977) replicated the Dowaliby and Schumer (1973) study with a college sample. Results of this work indicated that student performance was influenced by a combination of anxiety and ability (Peterson, 1979).

Other socioemotional variables have been considered to interact with achievement or problem-solving behavior

(learning outcomes). Domino (1968) determined that achievement is better when the instructor encourages the student's natural style. The study of the aptitude variable "conformity-independence" has produced interesting results. In this study teachers were interviewed to determine their attitudes toward class expectations. Instructors encouraging independence obtained high achievement from students high in independence and low on conformity. The conforming situation yielded the better performance from students low in independence and conformity. A follow-up study by Domino (1971) showed an interactional effect on every outcome except conformity. Those high in independence did best under the independent instruction style, while those high in conformity fared better under conforming circumstances.

ATI studies on cognitive traits have produced similar interactional results. These studies generally define cognitive style as "habitual patterns or preferred strategies of information processing" (Cronbach, 1977). Styles are distinguished from traits and abilities. Among those cognitive styles used in ATI research are conceptual levels and field independence.

Conceptual levels are generally assessed by a projective sentence-completion test. Individual responses can be characterized as differentiated and integrated, or diffuse and stereotypical. Respondents scoring high tend

to be mature in personal interactions and to think abstractly, flexibly, and creatively. Those scoring low lack these characteristics. Hunt, Joyce, Greenwood, Noy, and Weil (1974) purport that individuals with these low scores require a more structured environment. Further, Hunt and Hardt (1967) studied a sample of Upward Bound students on conceptual levels and perceived college outcome. A structured program of change in self-esteem and a change in perceived possibility of being a college graduate were introduced. The flexible program produced better results for the group with a high conceptual level, while the group with the low conceptual level fared better in the structured program.

McLaughlan (1973) assessed the effect of lecture and discovery methods of instruction for an art class of students with both high and low conceptual levels. The lecture format consisted of taped orations; the discovery format consisted of individual methods of learning. Results indicate that main effects favored the lecture format for high conceptual level subjects, producing an ordinal interaction.

Another study by Hunt et al. (1974) indicated that low-conceptual-level students exhibit better learning gains in direct teaching situations. Those scoring high perform better and have more self-control.

Siegel and Siegel (1965) investigated instructional

methods and conceptual orientation in a college biology course. Instructional methods were: 1) proctor in room/no proctor; 2) factual quiz/conceptual quiz; and 3) personal contact with TV/no contact with TV. Prior measures were taken on ACT scores, prior knowledge, motivation, and conceptual thinking. The outcome measure was the course final exam. Conceptually oriented subjects, high in ability and prior knowledge, performed best under quiz situations that emphasized conceptual objectives. Factually oriented students performed best on factual quizzes. This interaction was weaker for subjects low in ability and/or prior knowledge. The presence of a proctor accentuated the interaction.

Achievement has been related to cognitive strategies as well as to conceptual levels. Research indicates that achievement interacts with cognitive strategy and instruction.

Peterson (1982) studied the interaction between student aptitudes and cognitive processes during a direct instruction situation. Peterson states that ATI approaches and the process approach to studying the effects of instructional methods overlooked the impact of cognitive processes during the learning-teaching interaction. It was her belief that cognitive processes mediate between student differences and teaching behavior to precipitate differential achievement levels and attitudes. Students who reported the use of specific cognitive strategies (e.g., repeating,

reviewing, etc.) also had higher achievement scores on seat work and on achievement tests.

Another major focus of ATI research--and one that links the educational and psychological study of learners--is the study of instruction and an individual's learner ability.

Historically, past educators and psychologists studied the relationship of ability and learning capacity. Carroll (1963), Guilford (1967), and Wechsler (1950) all attempted to formulate theories about how ability or intelligence correlated with or influenced learning and cognitive performance. Yet there was debate over the relationship between ability and performance. Woodrow (1946) stated that ability was not parallel with intelligence. The notion that individuals had a unitary general learning ability was rejected. Some evidence in the 1970's suggested that classroom learning tasks were correlated with each other, as well as with other tested aptitudes (Fleishman, 1972). These results raised questions about the role of instruction in an individual's learning process. One primary concern in the 1960's and 1970's was that all individuals should be able to learn the same amount or learn in a similar fashion. It was hoped that programmed instruction would enable the "lows" on the learning continuum to learn as much as the "highs." The research in this area (Cronbach, 1977) cast doubt on the validity of the "mastery learning

concept" because one could not totally eliminate the consideration of individual differences (Cronbach, 1977).

Aptitude was perceived as still playing a role in the learning process. Many of these mastery-type studies failed to consider not only individual differences in aptitude but also differences in tasks and instruction.

Wispe (1951) studied the difference in student activity level and enjoyment under directive and permissive class atmospheres. The directive method involved the formal presentation of subject matter, while the permissive method used an informal, student-oriented format. Under the directive method, students with low SAT scores and low pretest scores obtained a high achievement level. No differences materialized for students with high SAT scores.

Guetzkow, Kelly, and McKeachie (1954), Flanders (1965), and Herman, Potterfield, Dayton, and Amershek (1969) all studied student achievement in some form with type of instruction. Tutorial, recitation, discussion, directive-permissive, teacher-centered and pupil-centered methods were found to have no interaction. When ability was considered, some differences materialized, e.g., high students performed better in permissive situations. Peterson's (1979) follow-up study of the ninth-grade level on conformance and achievement found that low and high structure and participation related to student achievement. During her five-week study at the University of Wisconsin, Peterson

found that on a multiple-chance test, college students high on AC (Achievement via conformance) performed better in low-structure treatments. College students low on AC performed better in high-structure treatments. The overall optimum treatment for high-AC college students was low structure/high participation, whereas ninth-graders performed best under the low structure/high participation or high structure/high participation.

Gabel (1981) investigated the interaction between types of instruction (factor-label method, use of analogies, use of diagrams, and proportionality), and problem-solving ability in four science-concept areas (mole concept, gas laws, stoichiometry, and molarity). The students had different verbal-visual preferences, different levels of math anxiety and proportional reasoning ability. Results indicated that students of low math anxiety and high proportional reasoning ability scored higher on the problems. ATI results indicated that students of high math anxiety and no visual preference, or low proportional reasoning, benefited from instructional methods with nonmathematical support material. It was also found that successful students (those understanding the chemical principles) tended to use mnemonic notation and organizing skills as well.

Those interested in ATI research were not only interested in instruction, aptitude, and socioemotional variables, but also actual problem-solving processes. Rosenshine

(1979) and Fisher (1980) focused on time spent solving problems, while Skinner (1968) focused on the problem-solving process and reinforcement. Cognitive psychologists view problem-solving as an active and internal process where information is "attended, analyzed, compared, synthesized, rehearsed, encoded, elaborated, while being learned" (Anderson, 1980). Brown (1978) advanced this concept by indicating that processing includes a mental directive procedure including identifying the problem, characterizing of the problem, planning, strategizing, monitoring, and evaluating.

Data reported by Peterson (1982) in this area indicate that students with high levels of class attendance show increased seat-work achievement scores. Students who understood lessons correlated positively with seat-work achievement, and achievement test scores even when controlling for ability. Students who used specific cognitive strategies showed higher achievement scores. These strategies included repetition, review, and use of prior related knowledge. Students who used general cognitive strategies (e.g., studied hard) had lower achievement scores. Peterson left the reader with fascinating interpretations. Peterson concluded that cognitive processes define ability and produce achievement. Even though ability is positively correlated with achievement, cognitive processing is related to both ability and achievement. Students with higher ability are more likely to attend to lessons, employ cognitive

strategies, use prior knowledge, report problem-solving strategies, and the like.

Ross (1980) studied the interaction of four achievement styles with task demands in groups of learners. Ross assessed subjects on achievement via conformance and independence (Ac Ai). A self-perception inventory was also administered to determine self-perceived attributes. Homogeneous and heterogeneous groups of low and high achievement via conformance and independence subjects were formed. In these groups, problem-solving tasks were administered, and group members were evaluated on leadership qualities and other attributes. Data indicated an interaction between Ac-Ai and attitudes. Subjects high on Ac and Ai (HH) reported favorable feelings toward work in small groups. They perceived themselves as useful to task and group maintenance. Students high on conformance (HL) perceived homogeneous groups positively. These students found their tendency for task orientation to be supported in the homogeneous groups.

Aptitude treatment interaction research has provided a mechanism for the investigation of instruction and the learning process. In addition, the relationship between the learning process and student entry variables can be studied. The interaction of these two sets of variables is crucial for the development of instruction, as well as theoretical perspectives in education. ATI research

relates directly with this dissertation study. The aptitudes or entry variables examined are reflection-impulsivity, while the treatments are the three different time constraints. An elaboration of the theory on reflection-impulsive cognitive style will clarify this interaction.

Cognitive Style: Reflection-impulsivity

The literature in this area of cognition ranges from theories and research on the origin and definition of cognitive style, to psychological and educational aspects of cognitive style. Early research on cognitive style concentrated on perceptual tests and studied situational factors contributing to various perceptual functions and stages (Lewin, 1951; Werner, 1948; Witkin & Lewis, 1954; Gardner et al., 1959; Smith & Klein, 1953; Kelly, 1955). For example, both Witkin (1954) and Gardner (1959) studied field articulation, while Kelly (1955) addressed subordinate and superordinate issues of perception. The tests used most often to derive this information were the Rod-Frame test, Body-articulation test and Embedded-figure test. These tests each dealt with an object in a complex field, which affected the way a person perceived the object. The tests were effective in eliciting a consistent mode of perceptual performance from the subjects. These studies were designed to derive a tool for measuring cognitive style. These researchers perceived cognitive style as

the consistent mode of functioning found within the individual (Witkin, 1967). Later research expanded, deviating from pure perceptual and psychological constructs into educational constructs as well.

Cognitive-style and cognitive-control dimensions have been defined as leveling-sharpening, field dependence-field independence, narrow-broad equivalence range, flexible-constructed, form boundedness-form lability, reflection-impulsivity, and conceptual tempo (Hamilton, 1976; Kagan, 1970). It was hypothesized that cognitive style developed from the interaction between various psychological systems and the environment (Gardner et al., 1959). It was viewed as a part of other cognitive systems.

For example, cognitive style is observed within different modes of cognitive acquisition, information processing, retention, and perception (Kobasigawa, 1974; McClusky & Wright, 1975; Zelniker & Jeffrey, 1976).

The reflection-impulsivity dimension of cognitive style was extensively studied by Kagan (1963, 1970). Reflection-impulsivity is defined as the manner in which an individual assimilates and communicates information. The individual may respond quickly with ltitle time between processing and reporting, or the individual may respond only after a longer period of time (more process time).

Studies on reflection-impulsivity cognitive style have investigated the affect on or interaction with academic

achievement, I.Q., and other measures of school performance. Problem-solving, an achievement-related ability, has been related to impulsivity and reflection in children. Zelniker and Jeffrey (1976) discovered that impulsive children were more accurate in global aspects of problem-solving (had higher error scores on detailed components). In addition, reflective children were more accurate on detailed aspects (more errors on global aspects). In this same study, Zelniker and Jeffrey also investigated memory capacity and various styles of analyzing exhibited by impulsive-reflective children. They found that impulsive children analyze in large units, while reflective children analyze in small proportions. The rate of decay in long-term memory was the same for both impulsive and reflective children. Recall in impulsive and reflective children only differed by the type of information being stored and recalled. Recall may have also been affected by how information was presented to the children, in small pieces or large chunks. Zelniker's results seem to indicate that the differences between impulsive and reflective children lies in the manner in which information is synthesized. The holistic approach of impulsive children may relate to their global analysis style. In some areas of academic study, this global approach may be of benefit. In addition, reflection-impulsive styles may produce different performances in technical courses versus art or visually-oriented

courses because they relate with different styles of storage and retrieval.

Frierson (1974) also investigated achievement and reflection-impulsivity cognitive style. He investigated the relationship of socioeconomic status (SES) and impulsive-reflective cognitive style with school achievement and I.Q. score. Frierson found that SES and conceptual tempo were associated with academic achievement in low SES children (fast accurate children demonstrated higher performance). Frierson purported that reflective children tend to be from high SES groups, and impulsive children from lower SES levels.

Greer and Blank (1977) found conceptual tempo to be related to problem-solving measures. Reflective children spent more time on problems and longer periods before giving solutions. In addition, the reflective children asked more questions. The training program used in this study was successful in increasing the child's total amount of time spent on a problem and time before giving a solution. It also increased the number of questions asked. Greer and Blank interpreted this to mean that programs of this type show promise in bringing about effective problem-solving abilities in children.

In this same framework, Ault (1973), based upon Zelniker (1976) and Kagan (1963), studied problem-solving style and reflection-impulsivity. Ault found that impulsive

children tend to ask "less mature" questions than reflective children. This could have an effect upon the learning process. The Greer-Blank training study did not share information on the type of questions the subjects asked; however, it seemed the subjects were trained to ask more detailed questions or questions that zeroed in on main points. Greer and Blank may need to do a follow-up study to investigate whether these questioning skills were retained over time.

McKinney has done further research on cognitive style and achievement. McKinney (1975) generally found that reflection-impulsive cognitive-style behaviors influenced problem-solving behavior and strategy of elementary school children. The reflective children progressed from trial-and-error behavior, grouping, and categorizing to abstract thinking and focusing strategy. McKinney stated that impulsive children did not progress in strategy between nine and eleven years of age as reflective children. This writer would not interpret this statement to mean that impulsive children were developmentally or academically inferior to reflective children. This writer believes that different styles do not indicate quality.

Research has also focused on how reflective-impulsive individuals perform in problem-solving and decision-making situations.

The study mentioned earlier by Greer and Blank (1977)

investigatd the interaction of reflection-impulsivity and problem-solving strategies of fifth-graders. Three programmed instruction situations were developed to: 1) encourage problem solving; 2) not facilitate problem solving; and 3) facilitate a regular classroom instructional situation. It was determined that reflection-impulsivity influenced the amount of time spent as well as quantity and quality of questions asked. The programmed instruction treatment used increased time spent by students on solving criterion problems. The ATI data also indicated that a more externally controlled timing program may prove helpful in increasing problem-solving time of impulsive children.

More research on the reflection-impulsive style and time in problem solving has shown that the reflective six- and eight-year-olds took longer to decide between alternatives on four of seven latency situations as opposed to impulsive six- and eight-year-olds (Mann, 1973). The quality of these decisions, however, did not differ.

Haskins and McKinney (1976) investigated the relationship between reflection-impulsivity, problem solving, and academic achievement. Data showed a correlation between Matching Familiar Figures test errors and problem-solving accuracy. Haskins and McKinney suggest that attention be focused on the learner's ability to process information, not the tempo of responding.

Witt and Cunningham (1979) reviewed the notion of cognitive speech and problem solving. It is stated that speech of organization, information processing, and retrieval speed play a crucial role in subsequent academic achievement. Birren (1974) added that this rate of processing and responding changes with age.

Loper, Hallahan, and McKinney (1982) said that other factors should be considered when examining cognitive style and problem-solving behavior. Motivational factors were alluded to as influences on impulsive-reflective behavior. When reinforced, both global and analytical responses can be elicited from reflective and impulsive individuals.

The application of research results on reflection-impulsive cognitive style and problem solving, achievement, socioemotional variables, cognitive development, and time spent on problems influences the actual classroom learning experience.

Reflection-Impulsivity Cognitive Style in Education

The concepts and definitions of cognitive styles may not differ from psychological to educational settings, but the perspectives from which cognitive styles are viewed may differ. Some psychological perspectives tend to see cognitive style as a personality trait or a consistent mode of functioning (Coop & Sigel, 1971), while educational

perspectives see cognitive style as less concrete and stable. A review of educationally oriented cognitive-style theories and studies may clarify this point.

Coop and Sigel (1971) posed many questions relating the cognitive style of individual students to learning and instructional methods. Scott and Sigel (1965) stated that the cognitive styles of students are related to teaching methods used in the classroom. After teaching science concepts to fourth-, fifth-, and sixth-graders with different techniques (Suchman inquiry method and conventional methods), significant differences in student cognitive styles were found. The fourth- and sixth-graders taught by the conventional method gave more categorical-inferential responses based upon function. The responses of the inquiry group were not consistent with the conventional group. The sixth-grade inquiry group offered more detailed classification and attribute-based responses. Scott and Sigel concluded that stylistic preferences of the inquiry children were definitely related to the problem-solving strategy used in the science lessons.

Another education-based perspective was offered by Hill (1975). Hill purported a cognitive-style approach for the classroom consisting of: 1) symbolic orientations; 2) cultural determinants; 3) modalities of inference; and 4) memory function. Hill said that educational cognitive style can be changed by the process of education.

The learner's educational cognitive style is reflected by the four concepts previously mentioned. Symbolic orientations consisted of language-related elements (theoretical symbols) and thought-related elements (qualitative symbols). Cultural determinants consisted of behaviors and individual attributes involved in decision-making (family, peers, values). Modalities of inference represented behavior the individual employed when reasoning (use of rules or examination of differences or relationships). Memory functioning is an area that still requires extensive study and defining, and was, therefore, not delineated by Hill. Hill further purported that knowledge of one's educational cognitive style can be used by an educator in developing instructional material and techniques.

Brown(1980) also presented evidence indicating that reflection-impulsivity could be influenced. Normal and hyperactive children were given age-group peers to model reflective problem-solving strategies. Results indicated that reduced impulsiveness occurred. Increased attention span was recorded as well. Brown pointed out, however, that classroom studies need to be performed.

Other research (Digate, Epstein, Cullinan, & Switzky, 1978) focused on the malleability of cognitive style. Developing reflective tendencies in impulsive children was the general focus of many cognitive-style training programs. This came from the notion that poor academic

performance is related to impulsivity (Keogh & Donlon, 1972). The cognitive style changes were implemented through teaching procedures, modeling and response consequences. Digate et al. (1978) reviewed the use of required delay, direct instruction, modeling, and self-verbalization as means of helping children to "inhibit, evaluate and recheck his responses" (Digate et al., 1978, p. 465). Even though Digate cited the positive effect of some of these techniques, she stressed the importance of studying long-range effects and the affect of teachers' cognitive style upon children.

Further studies in the educational area demonstrated the effect of instructional methods on learning and cognitive style. Bellar (1967) found that teaching word association with objects was more effective when one matched the method of teaching with the child's cognitive style. Pre- and post-test measures showed positive changes in performance on tasks when children were trained with methods consistent with their cognitive style. When dissonant methods were used, there was a negative change in performance.

In relating cognitive styles to scholastic ability and to learning structured and unstructured materials, Lezotte (1969) found that reflection-impulsivity correlated negatively with structured recall-span memory. It also correlated negatively with structured forward chaining-rote memory.

In researching cognitive style dimensions and teacher behavior, one can investigate the relationship of the student's cognitive style with teacher perception. It has been shown that teachers rated impulsive school children as equal to reflectives, slow-inaccurate, and fast-accurate children in learning motivation, but less attentive and more hyperactive than the other groups (Ault et al., 1973). By using reflection-impulsivity in learning- and teaching-research models, more insight can be obtained into whether this construct influences learning or teaching.

Achhpal and Mistry (1981) support this notion of the interaction of teacher behavior and cognitive style. They found that impulsive preschoolers were rated by teachers as being below their age level in learning-ability expectancies. Reflective preschoolers, however, were rated above their age level in learning-ability expectancy. Achhpal and Mistry support the use of cognitive style for planning appropriate instructional programs.

The studies in the area of education and cognitive style seem to stress two points: 1) the flexibility of reflection-impulsivity in the educational setting, and 2) the interaction of reflection-impulsivity with almost every aspect of learning, instruction, problem solving, and the student-teacher interaction, as well as student academic success.

One may conclude from these studies that

reflection-impulsivity plays a role in the educational setting. Further study could show how reflection-impulsivity interacts with classroom learning, teacher instruction style, group or individual learning style, verbal interaction, and time spent problem solving.

Cognitive Style and Problem Solving

Much psychological and educational research has investigated the relationship between problem solving and cognitive style.

When researching the problem-solving process, one can align with different approaches. Process-product or time-on-task advocates would focus on the amount of time spent working on the problem. The higher the score, the more time was spent on the task (Fisher, 1980). A behaviorist would focus on shaping behavior, or approximal steps to solve the problem. Attention might be given to examples so the student would generalize responses from examples to other problems (Skinner, 1968) while reinforcing the solving behaviors. The cognitive psychologist, however, focuses on the internal processing act. As mentioned earlier, Anderson (1980) perceives information processing as an active function of attending, analyzing, comparing, synthesizing, rehearsing, encoding, and elaborating. Information processing is related to and controlled by a coordinating system that identifies the problem,

plans appropriate strategies, monitors and evaluates the procedure. Researchers in the area of cognition and education have studied the cognitive style-problem solving system in a variety of ways.

Cognitive style has been studied in relationship to learning and problem-solving style in elementary-age students. Vaidya (1981) studied fourth-grade students on math problem-solving ability as it is related to field dependence-independence. It was found that field-independent learners performed better on word problems presented with adjunct questions. Field-dependent learners, however, gained more on the problems without adjunct questions. Vaidya supports training teachers on strategies of how students can structure information found in mathematics word problems.

McKinney (1978) found that reflective children (as measured by the MFF test) used more systematic or/and "mature strategies" on problem-solving tasks. These tasks demanded sequential hypotheses testing and information processing. In contrast impulsive children failed to use these strategies as readily and did not develop efficient strategies of problem solving. Another finding was that the influence of reflection-impulsivity on problem-solving behavior varied by the developmental level of the subject and by problem difficulty.

Walek (1974) offers another approach of problem solving methods and cognitive style. Walek investigated the problem

solving abilities of reflective and impulsive fourth-graders. Math achievement was assessed by using the Stanford Achievement Test in addition to reflection-impulsivity. It was found that reflective students within high and low math achievement groups performed better at identifying proper math operations than did impulsive students. Impulsive students had a slightly smaller mean error rate (not significant) on the math estimation tasks. Higher achievers fared better than lower achievers.

Lester (1980) investigated the problem-solving strategies of fifth- and seventh-graders on a problem-solving task (sorting a variety of blocks in complex arrays). Lester identified five strategies used: trial and error, heterogeneous groupings, local classification, partial global classification, and global classification. It was determined that trial-and-error strategies decrease with increasing age, while subjects' abilities to coordinate multiple conditions increases with age. Lester questioned the ability of elementary-age children to think conceptually on a consistent basis. This has implications for what subjects are introduced in the elementary curriculum, e.g., math, science, and also for how these concepts are presented.

Another aspect of cognitive style and problem solvers that has been investigated is self-perception and success. Heckel et al. (1981) studied a college sample of reflective

and impulsive students and their self-rated level of success. He found that high-success problem solvers tended to be more reflective, while the opposite was true for low-success problem solvers. It was also indicated that high-success problem solvers rated themselves higher on estimating success. Heckel interpreted this to mean that students experiencing low success rates may acquire an impulsive style to eliminate the frustrating task.

Self-perception and developmental trends again proved to be salient in reflective-impulsive styles. In addition to the problem-solving strategies used, Nuessle and Siegel (1972) found that ninth-grade subjects are more efficient focusers during problem-solving tasks than fifth-graders. This efficiency is related to their ability to inhibit impulsive responses. In turn, inhibiting impulsive responses, or being more reflective, is related to a more intense retrieval-recording effort. Therefore, the whole information-processing network, according to Nuessle, appears to be interrelated. Nuessle also stated that developmental trends alone are not solitary causative variables for reflective-impulsive differences. In addition, greater use of certain information-processing techniques may play a role.

Research has not only associated development, problem-solving strategies and instructional methods to cognitive style, but also to other classroom variables. For example,

Messer (1970) investigated reflection-impulsivity, the stability of this cognitive style and verbal intelligence, over a two-and-a-half-year period in a sample of first-graders (as they progressed to grade three). Messer found that elementary age children who had failed a grade were likely to be more impulsive than their peers, yet of similar verbal intelligence. Another finding indicated that reflection-impulsivity was moderately stable over two-and-a-half years of monitoring. Messer attributes this to possible modeling of teacher cognitive style, or possibly peer influence over time. The students who had failed first grade remained more impulsive even two-and-a-half years later.

Research on aptitudes such as cognitive style, and treatments such as instructional methods, modes of problem solving or learning styles have provided a framework for answering questions about how individuals of different cognitive styles and abilities learn and process information. Results indicate that not only do styles interact with problem-solving strategies but also with such variables as motivation, attitude, type of problem, and development (age).

Results of these studies provide the theoretical basis for further study into how these variables influence the classroom experience, teacher behavior, the mechanism for learning, and general student performance. This final

section of the literature review discusses those issues.

Implications for Teachers

Shavelson (1973, 1976) reported that teachers generally make rational decisions in instructional situations. The aim of instructional planning is to optimize student outcomes. Borko, Cone, Russo, and Shavelson (1979) indicated that these decisions concerning student instruction were based upon: 1) information about student characteristics relevant to instruction (e.g., reading achievement); 2) past student behavior; 3) teacher beliefs and attitudes about eduction; and 4) the nature of the instructional task. With this in mind, the consideration of instructional methods and cognitive style becomes important for teachers.

The discussions on ATI studies and cognitive style have emphasized the relationships of instructional methods, problem-solving strategies, or various classroom variables with aptitude and cognitive style. Studies cited state how various aptitudes (reflection-impulsivity, anxiety, compliance, etc.), interact with classroom variables (lecture-discussion, question format, time to problem-solve). ATI studies provide a format for instructional variables to be linked with aptitude. This study uses reflection-impulsivity cognitive style as the aptitude and problem-solving time as the treatment. One important aspect of this relationship to consider is the role of

the teacher. How the teacher influences, or is influenced by, the cognitive style-instruction interaction warrants discussion as well.

A teacher's awareness of a student's cognitive style may influence the manner in which problem-solving situations are presented. Teachers may be at a loss for how to introduce different problem-solving strategies to students who may be impulsive or reflective. Huhn (1981) studied cognitive strategies in elementary and secondary learners. Huhn states that the impulsive learner is one who may avoid a task because it appears confusing, or it requires much concentration. Huhn states that teachers may be able to teach impulsive students to "think through" tasks by introducing them to a specific model of problem solving tasks. The teacher relates the purpose of the tasks and how these tasks may help the student. In addition, the procedure is modeled for the student so the student can see, hear, and practice the thinking behind the strategy.

One may also consider how a teacher's notion of a student's cognitive style influences the teacher's expectations of that student and his or her interaction with that student. If a teacher perceives a student as impulsive, does the teacher provide less time for the student to answer? The teacher may consider the student to be predominantly inaccurate in responding, and therefore avoids asking him or her questions. A teacher may label a student

as below average in performance and in need of remedial help. The reflective student, though accurate in his or her responses, may be seen as a slow learner. Some teachers might see this as a signal that the student needs extra help.

A student's perceived cognitive style may also influence the way in which a teacher interprets errors. If an impulsive student misspells or misuses "flight" instead of "fright," the teacher could try slowing the student down in spelling, instead of drilling him or her on initial blends (Lezotte, 1983, personal communication). The consideration of cognitive style may also influence the wait time allowed a student.

Cognitive-style research can have an impact on the classroom setting and instruction by providing an information base from which instructional and interactional style changes can occur. This writer believes that many learning-disability problems experienced in schools may stem from teacher styles that are not compatible with a child's style of learning or reasoning. The Doebler-Eicke (1979) study showed that the teacher-student relationship could be improved just from the awareness of cognitive differences. This writer would speculate that if teachers could be trained further to alter instructional style to fit the student's cognitive style, the instructional unit of the classroom may be more effective. The extent of

these changes needs to be investigated. For example, reflective children may need longer teacher wait time or more individual small-group situations. This "special type" of consideration, however, always brings up the issue of teacher time and management. It may not be feasible to group children or extend problem-solving time.

This study of aptitude (cognitive style) and classroom behavior, and their relationship to problem solving or achievement, is important to the educational process. This study's objective is to investigate a few aspects of cognitive style and problem-solving patterns. Reflection-impulsivity was assessed in relationship to time given and time used to problem-solve.

CHAPTER III

METHODOLOGY AND DESIGN OF THE STUDY

The procedures and design used in this study are discussed in Chapter III. A factorial design using experimental procedures and modes of analysis typifies this investigation. The intent was to analyze the interaction between cognitive style and time to respond in learning or problem-solving situations.

This dissertation study was based on a previous pilot study that investigated the process of reflection-impulsivity in the classroom (see Appendix A). The pilot study had six research questions as a focus: 1) What is reflection-impulsivity? 2) How is reflection-impulsivity manifested? 3) Is reflection-impulsivity affected by contextual variables? 4) Is reflection-impulsivity measurable across four assessment modes? 5) Will impulsive children be given shorter response times by the teacher over reflective children? and 6) Will impulsive children complete problem-solving tasks in shorter time periods?

This pilot study and the dissertation study used similar data-collection procedures and instruments. In the pilot study, the Matching Familiar Figures Test (MFFT) was used to assess reflection-impulsivity in six

first-graders. Student problem-response times were obtained for problem-solving tasks. In addition, teachers were interviewed to determine what students they perceived as reflective and impulsive in the classroom. These teachers' classifications of students as reflective or impulsive proved to be consistent with the classifications of students on the MFFT test. No difference was found, however, in the performances of the reflective-impulsive students on the time taken to problem-solve. One notion obtained from this pilot study was of the interaction between cognitive entry variables and instructional/learning-process variables (see Figure 3.1). Various interactions may exist in the classroom between student entry characteristics, problem solving options, cognitive behavior, teacher behavior, and the classroom as a system. Teacher behavior may influence, for example, cognitive behavior as well as the reverse. Student entry characteristics influence the classroom system and problem solving behavior. The reverse holds true as well. In addition, problem solving behavior interacts with cognitive behavior. All of these components interact to have concomitant influences.

Sample

Three classrooms of third-grade learners from an urban school in a large midwestern city were used as subjects in the dissertation study. As Table 3.1 indicates, the

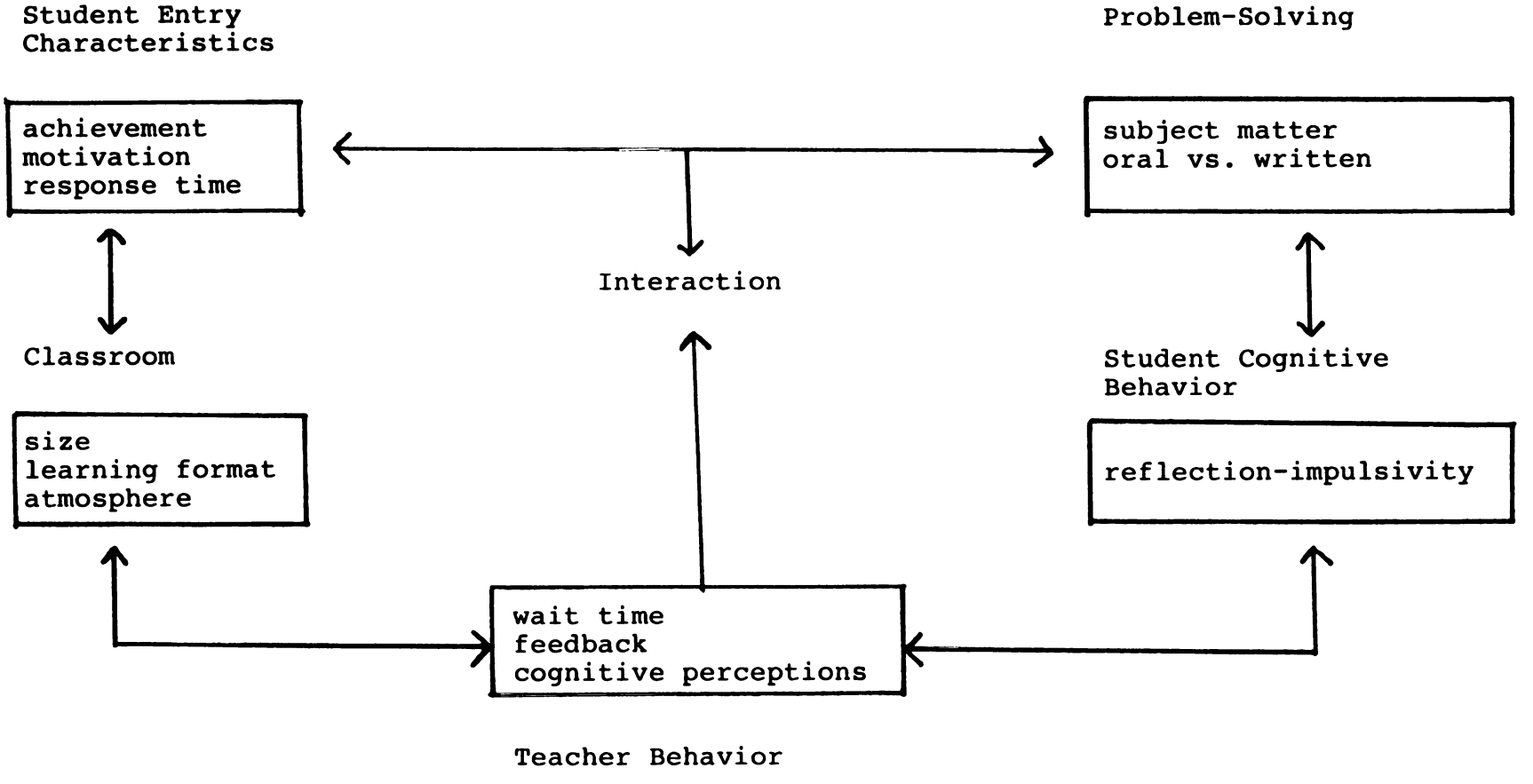

Figure 3.1

Reflection-Impulsivity and Instructional Variables:
An Interactional Model

Table 3.1

Subjects in the Sample

Class	Teacher	Number of Students	Male	Female	Ages 8	9	10	11	missing data
1	C	36 (36*)	17	17	14	17	5	0	
2	MB	29 (11*)	15	14	4	16	4	2	3
3	B	29 (17*)	17	12	6	14	5	3	1
Totals		94	49	42	24	47	14	5	4

*Valid subjects left in the analysis after controls.

sample was composed of ninety-four boys and girls ranging in age from nine to eleven. The children were from families of lower to middle economic status. The California Achievement Test (CAT) scores show that the majority of the students were performing at grade level. Any student more than one grade level below the class norm was dropped from the sample. This sample is not representative of third-graders in the nation or even in this city; however, it adequately represents third-graders at elementary schools in this immediate area. Table 3.2 shows the valid cases remaining as a result of cognitive-style classification, attrition of students, implementation of control procedures, and absenteeism.

Two instruments were administered to each student in the sample. First, the MFFT was given to measure reflection-impulsivity (see Appendix B for instructions and test items). Lewis (1976) reported that the MFFT has been used with elementary-age subjects. The instrument relies on the median measurement of latency scores (time used to respond) and error scores to classify students as reflective or impulsive. The MFFT error scores have been shown to correlate with intellectual competency, achievement ($p = .42$), as well as verbal and nonverbal indices (Lewis, 1976). As a result of this research, an attempt was made in this study to control for this correlation with achievement. The second instrument

Table 3.2

Valid Subjects*

Age					
8	9	10	11	blank	total
24 (38.1%)	30 (47.6%)	8 (12.7%)	1 (1.6%)	1	64

Sex		
Male	Female	Total
35 (54.7%)	29 (45.3%)	64

Race		
Black	White	Total
62 (96.9%)	2 (3.1%)	64

MFFT Classification		
Reflective	Impulsive	Total
26 (40.6%)	38 (59.4%)	64

*classifiable tests on MFFT and MEAP

administered to each student consisted of questions from the Michigan Educational Assessment Program (MEAP) exam (1982 edition). Thirty math problems from the MEAP exam were chosen, each possessing a similar level of difficulty and interitem correlational value. These math problems require students to: 1) recognize and manipulate fractions; 2) recognize geometric shapes; 3) recognize greater-than and lesser-than quantities; 4) recognize serials; and 5) recognize number places (hundreds and tens); and form equations (see Appendix C for MEAP problems). Table 3.3 shows the p value, Kuder-Richardson-20, point biserial, and mean and standard deviation values for each math item used in the dissertation study. These data are based on a statewide standardization procedure and were reported in the State Board of Education MEAP report (1982).

The Design

This study design is a three-by-two repeated-measures factorial design. Two factors, one, treatment time with three levels (five, ten, and variable seconds), the other factor, cognitive style, with two levels (reflection impulsivity), were the independent variables. Two dependent or criterion measures were obtained, a student's average time taken to respond and accuracy. Since several measures were obtained on each subject, multivariate techniques must be used in analysis. In addition, each subject was

Table 3.3

Summary of Item Analysis
MEAP Problems

Item Number	p-value	point biserial	KR20
97	.830	.745	.774
98	.869	.769	
99	.882	.771	
100	.812	.848	.903
101	.833	.894	
102	.884	.869	
103	.827	.800	.736
104	.847	.812	
105	.951	.555	
106	.614	.855	.805
107	.760	.805	
108	.697	.822	
127	.914	.768	.654
128	.850	.776	
129	.882	.754	
133	.884	.890	.865
134	.892	.894	
135	.903	.859	
136	.906	.693	.514
137	.887	.728	
138	.944	.683	
169	.882	.861	.944
170	.883	.873	
171	.887	.866	
172	.923	.806	.907
173	.936	.810	
174	.931	.747	

observed under each of the three treatment conditions; this produces the repeated-measures aspect of the design.

Procedure

Before the full-scale data-collection procedure was implemented, a pilot sample consisting of five students from classroom one were used to determine the average time required to answer the MEAP problems. These times were used in setting up treatment levels (time allocated for problem-solving responses). In addition, the administration of procedures and the timing mechanism were tested. Upon satisfactory completion of this procedure, the full-scale data-collection process was implemented.

During week one of data collection with each classroom, each student was individually administered the MFFT in a quiet room. The following week each subject was individually given the thirty MEAP problems. Each MEAP problem had been photographed onto a slide. The MEAP problems were projected onto a wall in the testing room by means of a slide projector. This writer administered the MFFT to each student, while another test administrator aided in the administration of the MEAP questions.

During the MFFT administration, students were read the required instructions (see Appendix), while latency time was recorded in seconds. Choices were recorded as well. Along with the MEAP administration, students were

read a set of instructions (see Appendix D). A research assistant operated the slide projector and read to each student the question projected onto the wall. It was this investigator's task to time (in seconds) the latency between the end of the question being read and the response given. The given answer was recorded also. Questions were administered under three different time-treatment levels. Based on the pilot administration with the five students, five seconds were allocated in treatment one for each question to be answered. In treatment two, ten seconds were allocated, while in treatment three, a random number of seconds were allocated (1, .9, 3, 6, 2, .8, 4, .6, 7 seconds). The questions, though not explained to students, were reread if requested. Student responses were recorded on forms constructed for that purpose (see Appendix E). Both the research assistant and this investigator observed student behavior during the testing procedure.

Control Procedures

Several control procedures were imposed to maintain some study consistency across the ninety-four subjects.

Each student was informed that the "task or game" was to be kept a secret until everyone in the class had a chance to participate. The second control entailed a rotation of treatment times. As stated before, three treatments were used. Each of these treatments was rotated

from class to class. With class one, three treatments were administered in the following order: 1) the five-second treatment; 2) the ten-second treatment; and 3) the random. With class two, the rotation put the ten-second treatment first, random second, and the five-second treatment last. With class three, the random treatment was first, the five-second treatment was second, and the ten-second treatment was last. Also, with each treatment level, the questions were rotated. Therefore, questions were not asked in the same order from student to student.

The third control used involved the observation of student behavior. During the MEAP administration, the research assistant and this researcher made note of any behaviors exhibited during the problem-solving process (e.g., anxiety, shaking hands, answering before time was up, facial expressions, etc.).

To control for differences in reading and math ability, the math problems and options were read to each student. In addition, 1982 CAT scores were obtained from each student's file (at the date of testing, the students had not been administered the 1983 CAT tests). If the student's scores were one grade level behind the norm, they were eliminated from the study sample.

To offset teacher influence on student behavior, teachers were not fully briefed until after their class had undergone each treatment.

To ensure that this researcher and the research assistant were not influenced by knowledge of the subject's cognitive style, the MFFT was not scored until after the MEAP was administered.

Rationale for Analysis of Data

As noted previously, the interaction and relationship of linear differences in problem-solving situations are of interest. The types of analyses used in this investigation are appropriate for the study of multivariate measures of a repeated factorial design. This three-by-two factorial design requires the use of analysis of variance (ANOVA) and multivariate analysis of variance (MANOVA).

The repeated-measures design entails a study in which several observations are made on each subject. Since this study involved taking three measures on each subject (three treatments) across thirty problems, a repeated-measures technique is required. Glass and Stanley (1970) and Nie et al. (1975) have proposed different methods for analyzing repeated-measures data. One procedure suggests the use of a mixed-effects ANOVA, while the other encourages the use of a MANOVA for repeated measures.

The MANOVA program in SPSS is a combined multivariate analysis of variance and covariance program capable of performing univariate and multivariate linear estimation and tests of hypotheses for nested and/or crossed designs

(Hull & Nie, 1981, p. 1). MANOVA is a statistical procedure, and more than one criterion (dependent) measure is involved in the analysis. The MANOVA yields a summary table that reports the source of variation, the sums of square cross products (SSCP) of the matrix, the degrees of freedom for row, column, interaction and within cell, and the F statistic (Tatsuoka, 1971).

The type of MANOVA required for this study is a repeated-measures MANOVA. Based on the design of this study, the repeated measures are time taken, and correct answers (accuracy). The independent variables are cognitive style (reflection-impulsivity) and treatment levels.

In ANOVA the effect of a series of treatments (in this case, time given to problem-solve) on one criterion variable is observed. With MANOVA, each experimental unit is observed on several criterion variables. Treatments can influence several criterion variables simultaneously. When analyzing each effect separately, one may omit accounting for the correlation between variables. The simultaneous consideration of these variables as one variable provides for more information about the total effect of treatment. In this study the effect of T_1, T_2, and T_3 (time given) is viewed in relation to time taken and accuracy during problem solving.

With repeated-measures MANOVA, the effect of the AVETT (average time taken) variable is treated as a vector

with three dimensions, and the cumulative effect is tested against the cognitive-style factor (reflection-impulsivity). A repeated-measures MANOVA considers the treatments together, as opposed to separating the treatments over subjects.

The power of multivariate methods in educational and behavioral research comes from the notion that few behaviors can be understood when based on one or two effects. MANOVA provides the capacity to consider several behaviors at one.

Research Questions

The general hypothesis states that there is an interaction between cognitive style: reflection-impulsivity and time taken to respond in problem-solving situations. This hypothesis and others were tested with the modes of analysis discussed previously and reported in Chapter IV.

The specific statistical hypotheses state that differences or effects exist between cognitive-style groups, time taken to problem-solve and respond, and correctness of responses.

Null hypothesis one: There is no difference between reflection-impulsivity and time taken to problem-solve and respond.

Alternate hypothesis one: Reflectives take more time on MEAP questions to problem-solve and respond in all treatment levels.

Null hypothesis two: There is no difference between reflective and impulsive groups in time taken to respond when controlling for CAT scores.

Alternate hypothesis two: There is a difference between groups in time taken to problem-solve and respond.

Null hypothesis three: There is no difference between time given to problem-solve and time taken to problem-solve and respond in all three treatment levels.

Alternate hypothesis three: There is a difference between the time given to problem-solve and respond and the time taken to problem-solve and respond in all treatment levels.

Null hypothesis four: There is no difference in the mean numbers of correct responses given in treatment conditions for reflective and impulsive groups.

Alternate hypothesis four: There is a difference in the mean numbers of correct responses given across treatment conditions for reflective and impulsive groups.

Limitations of the Study

There are several limitations within this study. As previously stated, the study sample is not representative of third-graders in the nation or this state. Results can only be generalized to similar third-graders, or third-graders in this regional school district. In addition, even though the MFFT has proved to be a reliable and objective measure of reflection-impulsivity, Arizmendi (1981) pointed out the group-specific nature of the MFFT. Since subjects are categorized as reflective or impulsive, based upon group median scores, any generalization outside of that group may be unfounded. Despite these limitations, the MFFT and the MEAP are reliable measures. The external validity of this study was appropriately interpreted.

Summary

This chapter presented descriptive information on the sample and instruments used in the study. It also indicated the treatment and measurements used to determine whether cognitive style relates to problem-solving time. Finally, the modes of univariate and multivariate analyses were discussed in regard to the study hypotheses.

Despite the many limitations of this study, it provides the framework for possible implications in psychology and education. The potential impact lies in its use in connection with basic research as well as instructional practice.

CHAPTER IV

RESULTS

Data Analysis

The research hypotheses for this study postulate finding differences between the times taken to respond among cognitive style groups of reflective and impulsive students. Differences or the lack of them were also examined between the groups in regard to the correct answers given within the treatment conditions.

Appropriate for this research design were analysis of variance (ANOVA) and multivariate analysis of variance (MANOVA) using repeated measures.

Analysis

The MANOVA technique allows for differences among the groups to be determined when several dependent variables are considered simultaneously. Each experimental unit is associated with two dependent measures (accuracy, time) under the three treatment levels. Significance tests for the main effects and interaction effect in MANOVA consist of discriminant analysis, canonical analysis, wilks, hotellings and pillais tests of significance.

Variables used in the analysis include the cognitive-style variable reflection-impulsivity (symbolized by

MFFTCLAS), the average time taken to respond to the problems in the treatment conditions (AVETT), California Achievement Test scores used as a control (CAT), and the average amount of correct responses given in the treatments (AVECAN). The research hypotheses were tested at the .05 alpha level.

Findings

The sample contains a total of twenty-nine female students and thirty-five male students. Fifteen and six-tenths percent (15.6%) (ten) of the total sample consisted of female students classified as reflective, while 25.0% (sixteen) of the male students were reflective in the total sample. Twenty-nine and seven-tenths percent (29.7%) of both male and female students were classified as impulsive in the total sample. The number of reflective boys was greater than the number of reflective girls (61.5% and 38.5% respectively). Equal numbers of boys and girls were impulsive (50% and 50%). Previous research data have typically shown greater numbers of reflective girls in samples.

With a chi square value of 0.429 ($X = 0.429$; $df = 1,95$) a significance value of 0.51 ($p = 0.51$), no relationship exists between sex and cognitive-style classification. These data are important for the interpretation of results. They substantiate the elimination of the sex variable as a confounding or nuisance variable. As a result,

hypotheses that include sex differences will be excluded from the study.

Frequency of Average Time Taken to Respond

Observing the average times taken to respond across the eight problems in all three treatment conditions (five seconds, ten seconds, random; ten seconds, random, five seconds; random, five seconds, ten seconds) reveals an interesting trend.

When the five-second treatment is implemented first, the average times taken to respond (across the eight problems) range from eleven to seventeen seconds. When the five-second-treatment condition occurs last (AVETT3), after the ten and random, the times range from fifteen to eighteen seconds. As AVETT2, the five-second treatment times ranged from fourteen to seventeen seconds (see Table 4.2).

When the ten-second treatment condition occurs first, the average times taken range from twenty to twenty-two seconds (over the eight problems). When the ten-second treatment follows the five-second treatment, the average times taken range from 11 to 20 seconds. As the final time condition implemented, the ten-second treatment yields average times taken from twenty-two to twenty-four seconds (see Table 4.2).

The random-treatment condition yields average times from fourteen to eighteen seconds when implemented first.

Table 4.1

Percentage and Chi Square for Males and Females by Cognitive Style

	MFFTCLAS		
	Reflective	+ Impulsive	Row Total
Female			
count	10	19	29
row pct	34.5	65.5	45.3
col pct	38.5	50.0	
tot pct	15.6	29.7	
Male			
count	16	19	35
row pct	45.7	54.3	54.7
col pct	61.5	50.0	
tot pct	25.0	29.7	
Column Total	26	38	64
	40.6	59.4	100.0

Corrected chi square 0.42913 with 1 df sig = 0.5124
raw chi square 0.82941 with 1 df sig = 0.3624
phi = 0.1134 contingency coefficient = 0.11311

When the random condition occurs second (after the ten-second treatment), the average times taken range from twelve to fifteen seconds. When the random-time treatment occurs last, the average times taken range from ten to sixteen seconds (see Table 4.2).

Effect of Average Times Taken and MFFTCLAS

The ANOVA testing for differences between reflective and impulsive groups in the first treatment condition found no differences between groups. No difference between reflective-impulsive students were found ($F = 0.122$, $p = 0.728$) in treatment one (five-second condition), with a small F value and a p value above the 0.05 level. A similar finding is evident when the first treatment level is combined with treatments two and three. The difference between reflective and impulsive groups across the three treatment conditions is not significant with an $F = 1.82$, $p = 0.171$, which is greater than alpha 0.05.

After the effect of treatment two and three is isolated, one again finds an insignificant difference between the cognitive-style groups. The analysis of variance shows insignificant differences across reflective and impulsive students in treatment two (ten second) with an $F = 1.6$, $p = 0.210$ and treatment three (random) $F = 0.91$, $p = 0.343$.

Table 4.2

The Frequency for Average Time Taken Per Treatment Condition

	Times Taken					
Treatment Conditions	five seconds	absolute frequency	ten seconds	absolute frequency	random seconds	absolute frequency
(five, ten, random)	11	1	11	1	10	2
	12	3	12	6	11	5
	13	8	13	5	12	8
	14	4	14	10	13	11
	15	11	15	2	14	8
	16	6	16	2	15	1
	17	3	17	5	16	1
		36	18	1		36
			19	2		
			20	1		
				36		
(ten, random, five)	15	2	20	7	12	3
	16	4	21	3	13	6
	17	4	22	1	14	1
	18	1		11	15	1
		11				11
(random, five, ten)	14	1	22	8	14	1
	15	2	23	8	15	2
	16	9	24	1	16	8
	17	5		17	17	5
		17			18	1
						17

Eight problems in each treatment; dependent measures: time taken = aggregate of several times taken across the eight problems: $X_1 + \ldots X_8/n$

Table 4.3

Analysis of Variance: Average time Taken to Respond in Treatment One with MFFTCLAS

Source of variation	Sum of Square	DF	Mean Square	F	Signif.
constant	53361.08694	1	53361.086	3224.52	0
MFFTCLAS	2.02565	1	2.025	0.1224	0.728
within cell	1026.00721	62	16.548		

Alpha = 0.05

Table 4.4

Analysis of Variance: Average Time Taken to Respond in Treatments Two and Three with MFFTCLAS

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
AVETT 2	15.653	604.821	15.653	9.755	1.604	0.210
AVETT 3	7.542	511.772	7.542	8.254	0.913	0.343

Univariate F tests with (1,62) d.f.; alpha = 0.05

Multivariate Effect of AVETT

The total multivariate effect of the three average-time taken treatments (AVETT = AVETT1 AVETT2 AVETT3) produces no difference in the performance of reflective and impulsive students (F = 0.963, p. = 0.387) (see Table 4.5).

Multivariate Effect of MFFTCLAS and AVETT

The total multivate effect of AVETT with the cognitive-style classifications produces no significant differences between the groups (F = 1.81, p. = 0.171) (see Table 4.6).

Multivariate Effect of Average Correct Answers

The analysis of variance for the average number of correct answers given per treatment one across reflective and impulsive students indicates no differences between the groups (F = 0.112, p = 0.739) (see Table 4.7). The multivariate analysis tested the cumulative vectorial effect of MFFTCLAS and AVECAN, finding no significant differences (F = 2.21, p = 0.118) (see Table 4.8).

The analysis of variance for treatments two (ten seconds) and three (random) shows a significant difference between the correct number of answers given for reflective and impulsive students for treatment 2, while there is no difference in treatment three. With F = 4.32, p = 0.042, there possibly is a difference between cognitive-style groups in the ten-second treatment. Therefore, the null hypothesis is not rejected. The third treatment condition produced an F = 1.02, p = 0.316 (see Table 4.9).

Table 4.5

Multivariate Test of Significance: Effect-Average Time Taken to Respond (AVETT)

Test Name	Value	Approx. F	Hypoth. df	Error df	Sig. of F
Pillais	0.0306	0.963	2.00	61.00	0.387
Hotellings	0.0316	0.963	2.00	61.00	0.387

Table 4.6

Multivariate Test of Significance: Concomitant Effect of MFFTCLAS and Average Time Taken to Respond

Test Name	Value	Approx. F	Hypoth. df	Error df	Sig. of F
Pillais	0.0563	1.819	2.00	61.00	.171
Hotellings	0.0596	1.819	2.00	61.00	.171

Table 4.7

Analysis of Variance: Effect-MFFTCLAS and Average Correct Answers Given in Treatment One

Source of Variance	Sum of Square	DF	Mean Square	F	Signif.
constant	52490.109	1	52490.109	3210.57	0.000
MFFTCLAS	1.826	1	1.826	.111	0.739
within cell	1013.645	62	16.349		

Alpha = 0.05

Table 4.8

Multivariate Test of Significance: Effect-Concomitant Effect of MFFTCLAS and Average Correct Answers Given

Test Name	Value	Approx. F	Hypoth. df	Error df	Sig. of F
Pillais	0.067	2.213	2.00	61.00	0.118
Hottelings	0.072	2.213	2.00	61.00	0.118

Alpha = 0.05; multivariate test of significance (s = 1, M = 0, N = 29½)

Table 4.9

Analysis of Variance: Average Correct Answers Given in Treatments Two and Three

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
AVECAN2	41.629	596.299	41.629	9.617	4.32	0.042
AVECAN3	8.618	521.865	8.618	8.417	1.02	0.316

Table 4.10

Multivariate Test of Significance: Effect of Average Correct Answers Given and MFFTCLAS

Test Name	Value	Approx. F	Hypoth. df	Error df	Sig. of F
Pillais	0.066	2.175	2.00	61.00	0.122
Hottelings	0.071	2.175	2.00	61.00	0.122

Alpha = 0.05; multivariate test of significance (s = 1, M = 0, N = 29½)

The multivariate effect of the variable AVECAN with MFFTCLAS shows no differences between the groups in regards to the average correct answers given across treatment levels (F = 2.17, p. = 0.122) (see Table 4.10).

The mean score and standard deviations for the significant ANOVA finding on average correct answers across the impulsive and reflective groups are reported in Tables 4.11 and 4.12. The significance between the groups on average correct answers given in treatment AVECAN2 (ten-second treatment) is reflected in the means 14.67 (reflective), with a standard deviation of 2.08; and 14.37 (impulsive), with a standard deviation of 1.83. On the average the reflectives produced more correct answers. The closeness of these harmonic means (not geometric $\frac{\Sigma X}{n}$) could be due to the difference in sample sizes between the reflective and impulsive groups.

Effect of AVETT, MFFTCLAS, and CAT

The effect of student math ability was considered (covariate) a possible nusiance variable in the study. Math ability was considered by using the total raw math California Achievement Test scores (CATMTR) as a covariate. Analysis of variance scores shows an insignificant difference between groups in the first treatment condition (AVETT1). When adjusted for by MFFTCLAS, nearly twenty percent of the effect of CATMTR occurred by chance (F = 1.71, p = 0.196). When CATMTR is accounted for, almost 70 percent

Table 4.11

Mean Scores for Reflective and Impulsive Groups
on Average Correct Answers in Treatments

Average correct answers	MFFTCLAS	Reflective (1)	Impulsive (2)	Marginals
AVECAN1		14.90	16.17	15.66
AVECAN2		14.67	14.37	14.50
AVECAN3		16.20	15.96	16.06
	marginals	15.26	15.51	15.40
	count	25	38	64

Table 4.12

Standard Deviation Scores for Reflective and Impulsive Groups
on Average Correct Answers in Treatments

Average correct answers	MFFTCLAS	Reflective (1)	Impulsive (2)
AVECAN1		2.09	2.81
AVECAN2		2.08	1.83
AVECAN3		4.54	4.31

of the differences between the reflective and impulsive groups occurred by chance in treatment one ($F = 0.175$, $p = 0.677$) (see Table 4.13). Since the factor and covariate had little or no effect in the analysis, the SPSS multivariate program dropped the covariate from the analysis. The multivariate interaction of MFFTCLAS and AVETT again shows no differences between groups ($F = 1.82$, $p = 0.171$) (see Table 4.14). The univariate and multivariate effect of the average times taken to respond in treatments two and three were insignificant, even when the covariate was adjusted. Tables 4.15 and 4.16 report insignificant F values.

Testable Hypotheses

Based on the frequency analysis, analysis of variance, multivariate analysis of variance and chi-square scores reported in this chapter, research hypotheses are restated and briefly discussed.

Time Given and Time Taken

> Null hypothesis one: There is no difference between time given to problem-solve and respond, and time taken to problem-solve and respond in all time treatment levels.
>
> Alternate hypothesis one: There is a difference between time given to problem-solve and respond and time taken to problem-solve and respond.

Frequency distributions show marked differences between the times given and taken to problem-solve and respond. Differences existed between times given and taken to

Talbe 4.13

Analysis of Variance: Average Time Taken to Respond with Covariate (Achievement Score)

Source of Variance	Sum of Squares	DF	Mean Square	F	Signif.
constant	2244.527	1	2244.527	137.189	0
regression	27.997	1	27.997	1.711	0.196
MFFTCLAS	2.867	1	2.867	0.175	0.677
within cell	998.009	61	16.360		

Alpha = 0.05

Table 4.14

Multivariate Test of Significance: Effect-Average Time Taken, MFFTCLAS, California Achievement Test Math Total Raw Score

Test Name	Value	Approx. F	Hypoth. df	Error df	Sig. of F
Pillais	0.056	1.819	2.00	61.00	0.171
Hottelings	0.059	1.819	2.00	61.00	0.171

Alpha = 0.05; multivariate test of significance (s = 1, M = 0, N = 29½)

Table 4.15

Analysis of Variance: Average Time Taken for Treatment Two and Average Time Taken for Treatment Three

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
AVETT2	15.653	604.821	15.653	9.75	1.60	0.210
AVETT3	7.542	511.772	7.542	8.25	0.913	0.343

Alpha = 0.05; df = 1,62

Table 4.16

Multivariate Test of Significance: Concomitant Effect of Average Time Taken

Test Name	Value	Approx. F	Hypoth. df	Error df	Sig. of F
Pillais	0.030	0.963	2.00	61.00	0.387
Hottelings	0.031	0.963	2.00	61.00	0.387

Alpha = 0.05

problem-solve in addition to being influenced by the arrangement of the conditioned times.

Differences between Groups

> Null hypothesis two: There are no differences between reflective-impulsive subjects on time taken to problem-solve and respond.
>
> Alternate hypothesis two: Reflective students take more time on MEAP questions to problem-solve and respond in all treatment levels.

ANOVA and MANOVA analyses show no significant differences between the groups of reflective and impulsive students on response times. The null hypothesis is not rejected.

> Null hypothesis three: There are no differences between reflective and impulsive students on time taken to respond when controlling for CAT scores (ability).
>
> Alternate hypothesis three: Reflective students take more time on MEAP questions to problem-solve and respond in all treatment levels when controlling for CAT scores.

ANOVA and MANOVA analyses again show no significant differences between the reflective and impulsive groups on response times. The null hypothesis is not rejected.

> Null hypothesis four: There are no differences in the mean numbers of correct responses given in the treatment conditions for reflective and impulsive groups.
>
> Alternate hypothesis four: There are differences in the mean numbers of correct responses given across treatment levels.

ANOVA and MANOVA analyses show marginal or possible differences in accuracy of the reflective-impulsive students' responses. This difference is supported by mean scores.

One informal hypothesis that will be discussed in Chapter V concerns teacher prediction of student reflection-impulsivity.

Summary

The analysis of data with frequencies, ANOVAs and MANOVAs shows little support for hypotheses stating that there are differences between cognitive-style groups and their response time patterns of MEAP math problems. Differences are shown however for AVECAN. Subsequent discussion of these results and the implications of these results follow in Chapter V.

CHAPTER V

DISCUSSION AND CONCLUSIONS

Overview

The scope of this study includes the realm of cognition and learning. The variables considered, cognitive style and time to problem-solve and respond, are germane to the areas of learning as well as to the areas of instruction. The purpose of this study was to investigate the interaction of a dimension of cognitive style, reflection-impulsivity, with response time under three problem-solving time conditions. Also of interest was the question of how learners behave under these time conditions. Questions considered were: a) How much time was taken to problem-solve and respond? and 2) How was response accuracy influenced by the timed conditions?

The Matching Familiar Figures Test (MFFT) and the math problems from the Michigan Educational Assessment Program (MEAP) were administered to a sample of third-graders in an urban midwestern elementary school. The MFFT classified students as reflective or impulsive. The MEAP problems were used to examine response time under the three timed treatment conditions.

Literature in the area of cognitive style, learning and teaching shows there are trends where process-learning variables such as student level of anxiety or cognitive ability interact with classroom mediation variables to influence learning outcomes. For example, student performance has been linked to the interaction of structured/unstructured teaching methods with conformity and anxiety as entry behaviors. Studies on reflection-impulsivity have investigated malleability, its interaction with problem-solving behavior, its interaction with IQ performance, and its interaction with teachers' perceptions of students.

The data were analyzed with univariate and multivariate methods to determine whether reflection-impulsivity cognitive style influenced time to problem-solve and respond under the three treatment conditions. Results indicated no relationship between sex and cognitive-style status; frequencies indicated some possible "conditioning" of student response time based on the previous timed condition given. No differences were found between reflective and impulsive students on time to respond and problem-solve across the average times taken within treatment levels. The multivariate analysis of average time taken as an independent effect and as the interactional effect with matching familiar figures test classifications showed no significant trends. The univariate effect of matching

familiar figures test classifications with average correct answers indicated significant differences between groups. When considering ability as a covariate, through the use of the California Achievement Test scores, however, the univariate and multivariate tests of differences between reflective and impulsive groups on time taken to problem-solve and respond were insignificant.

Discussion

The lack of relationship and effect of reflection-impulsivity and times taken to problem-solve were clear in this study. This researcher expected to see a consistent trend of reflective learners taking more time to problem-solve across the three treatment levels, or faring better (more correct answers) in the ten-second treatment over the five-second treatment. In considering this idea, several reasons come to mind to explain why differences in the performance of learners with different cognitive styles were not found.

First, as in many studies concerning learning, one must consider the influence of ability or intelligence as a possible overriding factor in the learning process. A learner's ability to perform a task, or their knowledge of subject matter, may be a greater influence than their cognitive style. If this is true, learner differences in time to respond or problem solve due to their cognitive

style may not appear. In contrast, learner differences due to ability would materialize. In this study ability was equated with performance on the California Achievement Test (CAT). CAT scores were used as a controlling variable in the analysis. One idea for future consideration would be to analyze the times taken to problem solve and respond by subjects of varying ability levels. This would show whether time taken to problem solve varies across ability groups.

A second consideration focuses on the nature of the MEAP test as a mastery test. The MEAP test was written based upon certain learning objectives. In turn teachers teach concepts and problems based upon these objectives. It was originally thought that this would insure each student a nearly equal chance of knowing the problem. This also, however, may have led to some influence over response time. If students knew the concept, their own cognitive response style may not have that much influence over response time. One way to test this notion would be to use strictly discriminatory tests, tests containing more variable problems. In this study, however, it appeared that the MEAP test did not influence accuracy level. There was no ceiling effect evident on a wide range of problems. Differences were found between reflective and impulsive groups on accuracy. In addition, there appeared to be no problems that were disproportionately difficult.

This researcher would consider using both kinds of tasks to determine what role the "type of test" played.

Third, the experimental study itself had somewhat artificial procedures for introducing the problems. Even though the tasks were administered in a classroom atmosphere, the use of the slide projector may have produced some anxiety on the learners' part. The research assistant and this investigator noticed some signs of nervousness (wringing of hands, wiggling in seats, patting feet, etc.). The response style of the reflective or impulsive learners may have been influenced by this atmosphere. The degree to which the experimental atmosphere influenced responses should be considered in future research as well. Methods more germane to classroom activities could be used. One possible way to do this would be to videotape a question answer session in a classroom while timing the response times. The use of more "natural" occurring classroom events has been emphasized in much educational research. It is also one reason for the use of ethnographic type methodology.

Fourthly cognitive style may not substantially influence the learning response time for tasks of this type. Discrepancies remain in the literature about whether cognitive style has a differential effect on learning or problem-solving behavior.

These four considerations may indicate possible

influences on the experiment's results. Some differences between reflective and impulsive learners were implied however in this study. Table 4.9 shows these differences between reflective and impulsive learners in the frequency of correct answers given for MEAP problems. This significant difference illustrates, in this researcher's mind, that the accuracy dimension of reflection-impulsivity appears to exist in this situation.

When examining the mean scores, reflective learners gave slightly more correct answers when given a longer period of time to problem solve and respond. Impulsive learners on the other hand produced more correct answers when shorter time periods were provided. This researcher speculates that impulsive students may commit more errors during long periods due to distraction, or maybe they change their problem solving schemes producing errors in their thinking. This idea contradicts a notion that if an impulsive learner is encouraged to slow down his or her pace, they will commit fewer errors. It appears that when reflective students are rushed, they are unable to problem solve effectively therefore producing errors. In the third treatment level, the condition intended to parallel the classroom situation, the mean scores for reflective students was higher. On the whole the efficiency or systematic problem solving processes of reflective learners fares better in this situation. It is possible that impulsive

learners are less capable of adapting to the changing response times. Overall the most correct answers were produced in the third treatment condition. If treatment three does actually parallel the classroom, providing varying response times to problem solve and respond, it provides both impulsive and reflective learners an opportunity to effectively respond. The difference in accuracy level has been shown in other research on problem-solving performance and cognitive style. The question of ability, however, remains an issue.

In addition to the differences in response accuracy, a possible time-conditioning effect was noted. Table 4.2 reports the times taken in all the treatment levels. One may note that the average times taken by all the learners vacillated according to the order of the treatment (this vacillation may not be a significant one). For example, when the five-second treatment followed the ten-second, the average times taken were greater than when the five-second treatment was given. The same trend can be found with the ten-second treatment. Considerably less time was taken by learners when the ten-second treatment followed the five, as opposed to when it was the initial treatment.

Beyond the consideration of students being conditioned within time restraints, other approaches may be considered. From a cognitive perspective, learners may be perceived as requiring a certain amount of time to process information.

Each learner's own cognitive operation requires process time based upon previous knowledge, ability, the way the problem is presented and structured, as well as other variables. Another aspect to consider when thinking of why these learners varied in average time taken is a function of the allocation of time. A learner may basically gauge him or herself to fit into the predetermined problem solving time span. Learning models that focus on allocated learning time consider time, student ability and task as factors influencing time used. Quite often the allocation of time given to problem solve is linked to policy decisions or classroom management.

A final consideration worth noting is an observation that states that teachers can assess a learner as reflective or impulsive. After each class had been through the experimental procedure, two of the classroom teachers were asked to classify their students as reflective or impulsive. The classroom teachers were given Kagan's definition of reflection-impulsivity. Results showed that in each case approximately fifty percent (50%) of the classifications given by the teachers were the same as the MFFT instrument. This 50 percent rate of agreement is not higher than that due to chance. Teachers reported they had a clear notion of whether their students were impulsive or reflective in the learning/problem-solving

process. They were also able to justify their classifications. They mentioned that some students may take a long time to respond, but they know the student knew the answer to the question. It was also mentioned that at times it was difficult to maintain class attentiveness while waiting for a slow responder to reply. This researcher believes that this may cause some teachers to avoid calling on reflective students or not wait for their answers for fear of losing the attention of others.

Another consideration for teachers is the issue of time management or time allocation. The notion of trying to gauge question-answer sessions or other learning situations to fit both reflective and impulsive response styles may prove to be difficult. The structure of classes and tasks to be completed within subjects in "X" amount of time leads to the necessitation of more homogeneous classroom functioning. It is this writer's opinion that this homogeneity contradicts a format needed by teachers to provide an individualized learner atmosphere. In addition, when thinking of classroom management, teachers need to keep control of classroom procedures. A final idea is that teachers have a finite level of tolerance or patience and energy. To keep track of individual student cognitive style may prove difficult. Despite these reasons for why the individual consideration of cognitive styles may be difficult in the classroom practice, from the theoretical

level it is obvious that teachers do have a perspective or idea about what reflection-impulsivity and their learners. During my interviews with the teachers of the classes in this study, teachers demonstrated a clear notion of what students they perceived as reflective or impulsive. The further study of teacher ideas concerning student ability and cognitive style would be essential to fully understand how this knowledge influences teacher-student interaction.

Implications and Future Directions

The results of this study have influence on learning theory and instructional practice. This is evident through implications for specific educational factors such as: 1) how learners respond within time allocations, 2) class management, 3) cognitive style theory, and 4) teacher assessment of student learning styles. Each of these factors will be discussed and related to this study.

Previous research and models on learner response and acquisition of knowledge have shown that learning time is influenced by allocated time. These models have also emphasized the importance of considering the time the learner is engaged in the task as well. This study focused on a smaller piece of the learning paradigm by looking at the time used on specific problems. This aspect can be put into the whole concept of time and learning.

The results of this study appear to show that the time learners take to problem solve and respond depend partly upon the time segment allocated. If the results here are true in classroom situations, then teachers may see learners responding according to expected time limits, or previously used time limits. Learners may pace themselves according to time limits used in the classroom. This in turn has the potential to influence what problem solving strategies the students use. Teachers may need to become more aware of time management as it relates to problem solving tasks. One consideration that appears unrelated to the time used by learners is reflection-impulsivity. The results from this study show that this cognitive style dimension produces no differences in time used during this kind of problem solving process.

Knowledge of time constraints makes a difference in how learners use time. Future research may need to investigate the effect of deleting the use of time restrictions. Also the investigation of other factors like problem type, ability in subject area, etc., may produce more information on how time is used by learners.

This study may also have implications for classroom management. If students gauge their problem solving time within that allocated for tasks, instructors may wish to consider that when planning and managing classes. Teachers may need to consider subject matter as well as

the objectives to be covered and class structure. Since classroom control is important to teachers, the differential use of time across students may need to be further investigated. This has implication for the attention span of students, general atmosphere and class control.

This experiment's implications for cognitive style theory falls into three ideas. One is that researchers may need to turn their attention away from one dimensional links between reflection-impulsivity and outcomes. The interaction of ability, problem type and other variables need inclusion in experimental questions. Secondly, a move toward more classroom based projects may prove helpful in monitoring this construct to determine whether it exists as defined and how it functions. Third, attention can be directed to when and where does reflection-impulsivity come into play? Is it situationally bound, influenced by task or situation? General questions of this type may lead to a redefining of reflection-impulsivity.

Finally, teacher assessment of students as reflective or impulsive is definitely linked to how teachers evaluate and interact with students. Teachers in this study held ideas about student functioning. It remains crucial for studies to look at how teacher perceptions play a role in student learning behavior.

Summary

This chapter reviewed the procedures and analyses of the study while speculating about implications and future research directions. From this study the researcher has determined that 1) reflection impulsivity cognitive style may not be a crucial factor in the problem solving response time of a learner, 2) modest differences do exist in the accuracy level of reflective and impulsive learners in some problem situations, 3) student learning ability is possibly a more crucial factor than reflection-impulsivity in accounting for learning outcomes, 4) the effect of teacher knowledge of a learner's reflectiveness or impulsiveness is an area for future research.

This entire project has centered around answering questions concerning exactly what happens when a learner ponders a problem and answers it? What influences the learner's time to respond and their level of accuracy? This researcher believed that the answers could be found in the influence of the cognitive style dimension that dealt with time and accuracy, reflection impulsivity. One variable that needed to be considered (beyond just controlling it) was ability. Another aspect necessitating consideration was the learning situation itself. So much exists in the learning atmosphere, such components as student attitude to type of problem to teachers style of problem presentation. Many researchers, including

this one, can obtain much knowledge concerning what learners learn and how they problem solve and respond if consideration is given to these range of components. Much can be shared with educators and those interested in learning if questions are continually posed and investigated.

APPENDICES

APPENDIX A

PILOT STUDY

APPENDIX A

PILOT STUDY

Assessment of Impulsivity-Reflectivity Cognitive Style: An Exploratory Study

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Acknowledgements

I would like to express gratitude to the following persons who, in some way, contributed to my efforts in this apprenticeship. There are some, however, to whom I am especially grateful: my apprenticeship committee, without whose expertise and support this apprenticeship could not have been completed; Dr. Chris Clark and Dr. Lawrence Lezotte, for their sharing of knowledge and research skills, as well as their constant encouragement; also to Janis Elmore for her expertise and friendship.

Gratitude is also given to Sheila Robinson, my close friend and colleague, who administered the Matching Familiar Figures Test and conducted the teacher interview; Joanne Hamilton, Karen Findlay, and Jerry Mosley for their editorial and typing skills; and to the teacher and students who participated in this study.

Last but not least gratitude to my family for their everlasting support.

Assessment of Impulsivity-Reflectivity Cognitive Style: An Exploratory Study

Appendix

observation sheet

matching familiar figures test

teacher interview questions

problem solving task

data sheets from MFFT

Abstract

This study focused upon the assessment of impulsivity-reflectivity cognitive style in an urban classroom setting. Six first graders were administered the Matching Familiar Figures Test, a problem solving task, and were observed during a class question-answer period. A teacher interview was conducted to inquire about reflective-impulsive students in the classroom. Responding time was also obtained for the reflective and impulsive students during the question-answer period. The results of the four data collection procedures were compared. The data showed that the four assessment modes yielded different classification results of students as impulsive or reflective. Responding time did not seem to relate to the teacher's perception of the student as impulsive or reflective. Contextual issues played a role in the impulsivity-reflectivity concept in the first grade setting.

Assessment of Impulsivity-Reflectivity Cognitive Style: An Exploratory Study

Introduction

Cognitive style is a construct which explains the process of mediation between stimuli and responses (Goldstein and Black, 1978). The process of mediation plays a crucial role in psychology and education because learning and instruction consist of the learner cognitively manipulating stimuli. The manipulation of stimuli is a precursor for responding. The style of responding, like the style of mediation, can be individual-specific. Much research and many theoretical perspectives (Brody, 1972; Harvey, 1963; Kagan, 1963; Witkin, 1954) demonstrate that individual ways of perceiving, processing, and responding exist in the psychological environment. For these reasons, it is for researchers in the areas of psychology and education to investigate how these individual modes of thinking, processing, and responding affect learning and instruction.

The emphasis of this study is to obtain a view of the interaction between individual response style and instruction, learning or decision-making. This is investigated through the cognitive style dimension of reflectivity-impulsivity.

Purpose and Need. The focus of this pilot study was to compare four methods of assessing reflectivity-impulsivity cognitive style in an urban classroom setting. This assessment was the initial step in devising a dissertation study that will more intensively investigate reflectivity-impulsivity under various contextual situations. In addition, the interaction of reflectivity-impulsivity cognitive style and the teacher's perception of a reflective-impulsive student is studied.

Several educational variables may relate to the study of reflectivity-impulsivity cognitive style. Response modes may vary across subjects or group size and classroom interaction. Another consideration is the length of time a teacher waits for a student response. This wait time may relate to the teacher's perception of the student as an impulsive or reflective individual. These relationships need to be investigated in order to ascertain how instructional style, planning, or classroom structure interacts with student cognitive style.

Research Questions. 1. What is impulsivity and reflectivity in the first grade setting? 2. How is impulsivity and reflectivity manifested? 3. Is impulsivity and reflectivity affected by contextual variables? 4. Is this construct measureable across the

four assessment modes? 5. Will impulsive children be given shorter wait times by the teacher than reflective children? 6. Will impulsive children complete the problem solving task in shorter time periods than the reflective children? 7. Will reflective children use mneomic devices more than impulsive children during the problem solving task?

Definition of Terms. Cognitive Style: The mode of cognitive style used for this study was reflectivity-impulsivity: manner in which individuals assemble and communicate information. Impulsive individuals have fast response rates and generally give the first hypothesis that enters the mind. This answer or hypothesis is usually incorrect. Reflective individuals, in contrast, have a slower rate of responsing and are generally accurate in their responses (Frierson, 1974, p. 6 & 8).

Other cognitive styles: Kagan, Sigel, & Moss (1963) Descriptive (analytic): split environmental stimuli into parts and attend to stimuli as discrete units. Relational and contextual: preference for seeing objects in the environment on a basis of the functional relationship of objects (spatial or temporal manner). Inferential-categorical: form categories on the basis of inferences made about stimuli that he groups together.

Leveling-sharpening (Gardner, 1959) a perceptual style.

Focusers-scanners (Bruner, 1956) strategies used in tasks of concept attainment.

Conceptual tempo (Kagan, 1963) tendency to respond in an impulsive or reflective manner when choosing between similar stimuli.

Field dependence-field independence (Witkin, 1962) global and analytic forms of perceiving.

Conceptual-perceptual (Weiner, 1948; Broverman, 1960) Broverman refers to the mode of perceiving the world in terms of concepts or visual orientation in cognitive responses. Weiner refers to the level of cognitive development in conceptual-perceptual terms.

Literature Review

The literature in this area of cognition ranges from theories and research on the origin and definition of cognitive style to psychological and social aspects of cognitive style. Early research on cognitive style concentrated on perceptual tests and studied situational factors contributing to various perceptual functions and stages (Gardner et al., 1959; Kelly, 1955; Lewin, 1951; Smith and Klein, 1953; Weiner, 1948; Witkin et al., 1954). For example, both Witkin (1954) and Gardner (1959) studied field articulation, while Kelly (1955) addressed subordinate and superordinate issues of perception. The tests used most often to derive this information were the Rod-Frame test, Body-articulation test, and Embedded-figure test. These tests each dealt with an object in a complex field which affected the way a person perceived the object. The tests were effective in eliciting a consistent mode of perceptual performance from the subjects. The goal of these studies was to derive a tool to measure cognitive style. These researchers perceived cognitive style as the consistent mode of functioning found within the individual (Witkin, 1967). Later research expanded, deviating from pure perceptual and psychological constructs into educational constructs as well.

Cognitive Style

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The field dependent-field independent construct has been studied most frequently and has been associated with the self concept/self esteem construct (Witkin, 1967). Other cognitive style and cognitive control dimensions have been defined as leveling-sharpening; field dependence-field independence; narrow-broad equivalence range; flexible-constructed; form boundedness-form lability; impulsivity-reflectivity; and conceptual tempo (Hamilton, 1976; Kagan, 1963, 1970). It was hypothesized that cognitive style developed from the interaction between various psychological systems and the environment (Gardner et al., 1959).

Cognitive style is observed within different modes of cognitive acquisition, information processing, retention and perception (Kobasigawa, 1974; McClusky and Wright, 1975; Zelniker, 1976).

Field Dependence-Field Independence. The field dependence-field independence construct has been extensively studied by Witkin (1954, 1962, 1964, 1967). Field dependence tasks test the susceptibility of the individual to be misled by postural and visual frames of references. The ability to distinguish and perceive the object independently of the frame (isolating an item from a complex test) reveals the field dependence or independence of the individual.

The field dependence-independence dimension has been related

to "Intelligence" (Goodenough and Karp, 1961), and to interference or distraction proneness (Karp, 1963) as well as other variables. Research has shown that the field dependent individual has a hard time isolating or separating parts of a stimulus. Field independent persons distinguish between stimuli and analytically view them as separate.

Research also correlated I.Q. performance to cognitive style. A study (Goodenough and Karp, 1962) using ten and twelve year old boys and the Weschler intelligence test showed that analytic skills and field independence-dependence were related, however, verbal ability did not relate to field dependence-independence. Sexual differences were also examined on the field dependence-independence dimension in an adult sample. As a group, women were more affected by perceptual contexts than men. This was found across education, economic, and cultural levels (Witkin, 1964).

Field dependence-independence was also related to several personality and psychological constructs. Witkin et al. (1954, 1962) showed a relationship between field dependence and a passive, dependent, submissive, low self-esteem, and self-reliant personality. These field dependent persons were more accepting of social norms without question. Field independent persons had greater capacities

for mastering their own feelings, were dominant, and had greater reserves of behavior and better body schema. Witkin (1976) also reported that high scores on the articulation body concept test related to field independence.

Research from the educational perspective of field dependence-field independence cognitive style has focused upon several concepts and relationships. One study has shown that the impact of cognitive style and achievement can extend beyond the child's performance to the teacher-child interaction. Doebler and Eicke (1979) pointed out that cognitive style was related to instruction. When teachers were aware of cognitive style differences and how it could affect learning, there was an "improved relationship" between teacher and child. They found that there was no significant difference between teacher and student on the School Sentiment Index they administered to the field independent and field dependent experimental groups.

The developmental issue of egocentrism has been associated with field dependent and field independent thought. Using the children's Embedded Figures Test, Flavell's three mountain task, Piagetian conservation tasks and other activities, Finley (1977) found that field independent children were less egocentric on most

tasks than field dependent children. This was an expected result when one considered that non-egocentric children were more abstract or 'other-oriented' in their thinking. Field independent children must be able to separate the concrete from the abstract, or dis-associate the surrounding environment from the task at hand.

Impulsivity-Reflectivity. The impulsivity-reflectivity dimension of cognitive style was extensively studied by Kagan (1963, 1970). Impulsivity-reflectivity is defined as the manner in which an individual assimilates and communicates information. The individual may respond quickly with little time between processing and reporting, or the individual may respond only after a longer period of time (more process time).

Studies on impulsivity-reflectivity cognitive style have investigated the affect on or interaction with academic achievement, I.Q., and other measures of school performance. Problem solving, an achievement related ability, has been related to impulsivity and reflectivity in children. Zelniker and Jeffrey (1976) discovered that impulsive children were more accurate in global aspects of problem solving (had higher error scores on detailed components). The reflective children were more accurate on detailed aspects (more errors on global aspects). In this same

study, Zelniker and Jeffrey also investigated memory capacity and various styles of analyzing exhibited by impulsive-reflective children. They found that impulsive children analyze in large units, while reflective children analyze in small proportions. The rate of decay in long term memory was the same for both impulsive and reflective children. Recall in impulsive and reflective children only differed by the type of information being stored and recalled. Recall may have also been affected by how information was presented to the children, in small pieces or large chunks. Zelniker's results seem to indicate that the differences between impulsive and reflective children lie within the manner in which information is synthesized. The wholistic approach of impulsive children may relate to their global analysis style. In some areas of academic study, this global approach may be of benefit. In addition, impulsivity and reflectivity styles may produce differential performances in technical courses versus art or visually oriented courses because they tap into different storage and retrieval styles.

Another study investigating achievement and impulsivity-reflectivity cognitive style was done by Frierson (1974), who investigated the relationship between socioeconomic status and

impulsive-reflective cognitive style with school achievement and I.Q. score attainment. He found that SES and conceptual tempo were associated with academic achievement in low SES children (fast accurate children demonstrated higher performance). Frierson purported that reflective children tend to be from high SES groups and impulsive children from lower SES levels.

In addition, conceptual tempo had an affect upon school achievement. Often times, studies like Frierson's fail to discuss the confounding variables that may interact with SES and cognitive style. Parenting style is a possible variable which may or may not affect cognitive style. Also cultural variables, which may be held consistent across all educational and professional levels, may have an affect upon cognitive style. These aspects have not been proven, however, and need to be investigated at length.

Greer and Blank (1977) found conceptual tempo to be related to problem-solving measures. Reflective children spent more time on problems and longer periods of time prior to giving solutions. In addition, the reflective children asked more questions. The training program used in this study was successful in increasing the child's total amount of time spent on a problem and time before giving a solution. It also increased the number of questions asked.

Greer and Blank interpreted this to mean that programs of this type show promise in bringing about effective problem solving abilities in children.

In this same framework, Ault (1973), based upon Zelniker (1972) and Kagan (1962, 1963), studied problem solving style and impulsivity-reflectivity. Ault found that impulsive children tend to ask "less mature" questions than reflective children. This could have an effect upon the learning process. The Greer-Blank training study did not share information on the type of questions the subjects asked, however, it seemed that the subjects were trained to ask more detailed questions or questions that zeroed in on main points. Greer and Blank may need to do a follow-up study to investigate whether these questioning skills were retained over time.

Further research on cognitive style and achievement has been done by McKinney. McKinney (1975) generally found that impulsive-reflective cognitive style behaviors influenced problem solving behavior and strategy of elementary school children. The reflective children performed better on some tasks than impulsive children. The reflective children progressed from trial and error behavior, grouping, categorizing, to abstract thinking and focusing strategy. McKinney stated that impulsive children did not progress

in strategy between nine and eleven years of age as reflective children. This writer would not interpret this statement to mean that impulsive children were developmentally or academically inferior to reflective children. This writer is of the opinion that different styles are not indicative of quality.

Research on the cognitive style and achievement aspect of cognition generally purported that cognitive style (impulsive-reflective) has an impact upon problem solving and strategy formation. These strategies can be beneficial or detrimental in the classroom situation.

Cognitive Style and Environmental and Cultural Factors. Other studies have investigated the influence of environmental components upon the development of cognitive style. Parental interaction is one environmental component that has been intensively investigated. Dyk and Witkin (1956) found a high relationship between fostering-differentiating mothers with a high body concept and a child's differentiation ability.

Sedar (1957) purported that coercive, authoritarian parents tend to yield field dependent children. This notion appeared to hold cross-culturally. Dawson (1967) found that field dependent African children came from homes with strict mothers or dominant

controlling mothers in comparison to field independent children.

Bing (1963) gave further support to the theory of child rearing affecting differential cognitive abilities. He concentrated his efforts upon verbal ability, and showed that high verbal mothers tend to have children scoring higher on verbal tasks. These mothers were 1- active in helping behavior, and 2- gave more help after a request. He furthered his discussion by saying that the nature of the mother-child interaction seemed to produce children who were more or less capable of dealing with cognitive tasks. Research demonstrates that parenting style is strongly related to a child's cognitive style. This notion may also indicate an interactive system at work upon cognitive style because parenting style, from this writer's perspective, is a reflection of culture, education, and income among other constructs.

The construct of cognitive style has been considered from a cross-cultural perspective. Witkin has stated that field dependent cognitive style is associated with "...cultural norms and institutions that prescribe both adherence to family and social authority and the use of severe socialization practices to enforce conformity to this authority" (Witkin, in Nedd, 1976, p. 24). To further this notion, Nedd and Gruenfeld (1976) stated that socially traditional

cultures foster field dependent cognitive styles. They investigated various cultural groups within Trinidad and found a strong relationship between ethnicity and the Embedded figures test scores (ethnicity was a good indicator). A relationship was also found between sex and EFT scores, while urbanization was a significant but weak predictor of field dependence or field independence.

Siann (1972) studied field dependence and field independence in Zambia by using Witkin's Rod-frame test and the Embedded figures test. Siann found that the RFT and EFT had a higher correlation for the Zambian sample than the EFT and verbal outcomes. Siann interpreted this to mean that EFT tests may measure educational ability rather than analytic modes of thinking. He stated that field dependence, as an underlying factor of the RFT and EFT, may not be relevant for Zambians.

Cognitive style dimensions have also been examined from a sociological perspective. Family experience has been related to cognitive style, as well as the socialization process (Witkin, 1967). Witkin (1974) reported that the more conforming the socialization process, the lower the development of differentiation. The dimensions of self-concept, body concept, and body articulation have been studied in adults as well as children

(Kagan, 1970; Witkin, 1967). Numerous studies have been done that support the premise of consistent cognitive styles within an individual. Witkin, Goodenough, and Karp (1967) demonstrated stability (inter-individual consistency) in the cognitive styles of two separate samples. One sample tested at the eight and thirteen year age groups, the other at ten, fourteen, seventeen, and twenty-four age levels. An increase in field independence was shown over time. From this author's perspective, the study demonstrated a consistent increase in field independent perceptions with age in each subject, however, the between subject comparisons or possibly group comparisons were inconsistent.

Due to the increasing study of children on the cognitive style dimension, cognitive style tests have been developed for use with younger samples. Coates (1972) has developed a Preschool Embedded Figure test, while Corah (1968) has developed a portable rod-frame apparatus for use with young subjects.

Impulsivity-Reflectivity Cognitive Style in Education. The concepts and definitions of cognitive styles may not differ from psychological to educational settings, but the perspectives from which cognitive styles are viewed may differ. Some psychological perspectives tend to view cognitive style as a personality trait

or a consistent mode of functioning (Coop & Sigel, 1971), while educational perspectives view cognitive style as less concrete and stable. A review of educationally-oriented cognitive style theories and studies may clarify this point.

Coop and Sigel (1971) posed many questions relating the cognitive style of individual students to learning and instructional methods. Scott and Sigel (1965) stated that the cognitive styles of students are related to teaching methods used in the classroom. After teaching science concepts to fourth, fifth, and sixth graders with different techniques (Suchman inquiry method and conventional methods), significant differences in student cognitive styles were found. The fourth and sixth graders taught by the conventional method gave more categorical-inferential responses based upon function. The responses of the inquiry group were not consistent with the conventional group. The sixth grade inquiry group offered more detailed classification and attribute-based responses. Scott and Sigel concluded that stylistic preferences of the inquiry children were definitely related to the problem solving strategy used in the science lessons.

Another education-based perspective is offered by Hill (1975). Hill purported a cognitive style approach for the classroom

consisting of symbolic orientations, cultural determinants, and modalities of inference and memory function. Hill stated that educational cognitive style can be changed by the process of education. The learner's educational cognitive style is reflected by the four concepts previously mentioned. Symbolic orientations consisted of language related elements (theoretical symbols) and thought related elements (qualitative symbols). Cultural determinants consisted of behaviors and individual attributes when coming to a decision (family, peers, values). Modalities of inference represented behavior the individual employed when reasoning (use of rules or examination of differences or relationships). Memory functioning is an area that still requires extensive study and defining and is, therefore, not delineated by Hill. Hill further purported that knowledge of one's educational cognitive style can be used by an educator in developing instructional material and techniques.

Other research (Digate, Epstein, Cullinan and Switzky, 1978) has focused upon the malleability of cognitive style. Developing reflective tendencies in impulsive children is the general focus of many cognitive style training programs. This resulted from the notion that poor academic performance is related to impulsivity

(Keogh & Donlon, 1972). The changes are implemented through teaching procedures, modeling, and response consequences. Digate (1978) reviewed the use of required delay, direct instruction, modeling, and self verbalization as means of helping children to "inhibit, evaluate and recheck his responses" (Digate, 1978, p. 465). Even though Digate cited the positive effect of some of these techniques, she stressed the importance of studying long range effects and the effect of teacher's cognitive style upon children.

Further studies in the educational area demonstrated the effect of instructional methods upon learning and cognitive style. Bellar (1967) found that teaching word association with objects was more effective when one matched the method of teaching with the child's cognitive style. Pre and post test measures showed positive changes in performance on tasks, when children were trained with methods consistent with their cognitive style. A negative change in performance resulted when dissonant methods were used.

In relating cognitive styles to scholastic ability and learning structured and unstructured materials, Lezotte (1969) found that reflectivity-impulsivity correlated negatively with structured

recall span memory. It also correlated negatively with structured forward chaining-rote memory.

Summary. The studies in the area of education and cognitive style seem to stress two important points: 1- the flexibility of impulsivity-reflectivity in the educational setting, and 2- impulsivity-reflectivity interacts with almost every aspect of learning, instruction, problem solving, and the student-teacher interaction, as well as student academic success.

The flexibility or malleability of impulsivity-reflectivity may support the notion that this construct is not stable or fixed over time or situation, but is influenced by development and context. One may also conclude from these studies that impulsivity-reflectivity plays a role in the educational setting. Further study can be done on how impulsivity-reflectivity interacts with classroom learning, teacher instruction style, groups versus individual learning style, verbal interaction, or teacher wait time.

Research Critique and Educational Implications. The studies reviewed in this paper indicate that cognitive style is related to several environmental aspects of a social and educational nature. The studies bring about the notion that individuals differ in thought processes. These differences were related to child

rearing, education, as well as experiences. Style differences have an impact upon performance, ability, and thoughts. Distinctions in style should in no way indicate that those with dependent or independent frames of thought are better or worse than the other. If anything, the knowledge of these existing differences should be used to alter styles of instruction and interaction, or to sensitize professionals to their possible existence.

Cognitive style research can have an impact upon the classroom setting and instruction by providing an information base from which instructional and interactional style changes can occur. This writer believes that many learning disability problems experienced in schools may stem from teacher styles that are not compatible with a child's learning style or reasoning style. The Doebler-Eicke study showed that the teacher-student relationship could be improved just from the mere awareness of cognitive differences. This writer would speculate that if teachers could be trained further to alter instructional style to fit into the cognitive style of a student, the instructional unit of the classroom may be more effective. The extent of these changes needs to be investigated. For example, reflective children may need longer teacher wait time or more individual small group situations. This

"special type" of consideration, however, always brings up the issue of teacher time and management. It may not be feasible to group children, or extend wait time.

The study of cognitive style and its relationship to achievement, socialization, culture, and internal structures of cognition have proven to be important for learning-education, problem solving, and cognitive development in general. Research should be continued in this area with a focus on: cognitive style and its relationship to instruction-learning; cognitive style differences and culture; the creation of new forms of cognitive style measurement; understanding the dynamics of teacher cognitive style and student cognitive style and instruction.

This study's objective was to investigate a few aspects of cognitive style in the classroom setting. Impulsivity-reflectivity was assessed and studied in relationship to teacher wait time, student responding, and problem solving. The study addressed the questions of: how impulsivity-reflectivity was manifested in the first grade, how consistent was the assessment of the impulsivity-reflectivity dimension, and how teacher wait time interacts with impulsivity-reflectivity.

Methodology

Sample. Six children were chosen randomly from a first grade class in an urban metropolitan elementary school. The sample contained two females and four males; with four black, two white children; two six year olds, three seven year olds and one eight year old. The class consisted of thirty-three students and one classroom teacher. The school ranged from kindergarten to fourth grade. The first grade was selected because children at this level, by and large, have not yet been exposed to the direct or indirect training that occurs in the educational system, to respond and learn in a reflective manner.

Table 1

Demographic Information

initials	sex	race	birthdate	age	grade
K.C.	F	B	2/28/74	7	first
P.G.	M	W	1/3/74	7	first
S.M.	M	B	2/11/74	7	first
D.M.	M	B	5/18/74	7	first
M.S.	M	W	12/3/73	8	first
T.W.	F	B	7/5/74	6	first
R.J.*	M	B	6/20/74	6	first

*practice subject

Cognitive Style

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Instruments. Four methods of cognitive style assessment were chosen: teacher interview, observation, matching familiar figures test (Kagan, 1963, 1965), and two problem solving tasks (see appendix for instruments).

Procedure. Day One: The teacher interview was conducted on day one. The teacher was asked questions about her perceptions of fast and slow responding students (questions in the appendix). The teacher was also interviewed by a separate researcher and the interview was taped.

The matching familiar figures test was administered by another researcher as well. A stopwatch was used for this test which included fourteen items (two practice) with pictures of familiar objects on eight by eleven sheets. The objective was for the student to accurately match the single key item with a row of choices. The time taken to make that choice was recorded. Also, the number of errors or trials used to choose the correct answer was recorded. After listing all of the students in the first grade class, and randomly choosing seven (one child was used as a MFFT practice subject), each child was administered the MFFT individually. The child was brought to a separate room across the hall from the classroom.

Day two: This researcher spent the day observing classroom behavior of the six children while engaged in learning exercises. Records were kept of the student response time and other responding characteristics, i.e., use of mneomic devices like counting on fingers, or verbalizations. The teacher's feedback to the student responses was also recorded (see appendix for observation sheet).

Day three: Two problem solving tasks were administered to the sample of six children. The two tasks were mathematics work sheets from the class book. The students had learned the skills necessary to perform the tasks. The students were timed on the task and the errors made were recorded (see the appendix for problem tasks).

Justification. Four data collection procedures were used in order to obtain a composite picture of cognitive style. The researcher did not want to limit the assessment to a purely psychological test (MFFT) or a purely observational mode of assessment. By using two testers to collect data, the bias on the part of the principal researcher was minimized. Also, the researcher could observe the students without prior knowledge of their cognitive style.

Design. The design for this pilot study is a combination of ethnographic (observation to determine what impulsivity-reflectivity is in the first grade setting) and survey-field interview (questionnaire administered to the teacher), and assessment-experimental (MFFT). All of these techniques were required for a comprehensive view of cognitive style. The study was exploratory in nature and was aimed at comparing the techniques while answering the basic questions of what is impulsivity-reflectivity, how it is manifested and influenced by classroom interaction/teacher perception, contextual assessment and interaction.

Teacher Interview. The teacher classified the following students as impulsive: Matthew, Lucas, Angela, Toya, Katina, Paul, Demetrius. The following students were mentioned as reflective students: Hazen, Michelle, Robert, Angela, Steven, Robert, Jerome, Alvia, Shanda. The teacher stated that sometimes the reflective students were correct in their first responses, while the impulsives were usually correct in their first responses. The teacher also stated that impulsive-reflective behavior was dependent upon the atmosphere of the class and the student's interest level in the subject matter. She further stated that group size affected whether a student answers impulsively. The teacher mentioned that

the competitiveness of the situation also influenced the student response.

Analysis. After administering all of the instruments, the time required to complete each task was averaged across all tasks. For the MFFT, latency times were ranked along with error scores, the median was found and the impulsive-reflective classification derived (see appendix for details on Kagan scoring procedure). According to the Kagan criteria, the sample clearly had two reflective children and two impulsive children. Two other children (DM, TW) had scores that were close to the borderline (see table 2).

Table 2

MFFT Times

latency time	errors	classification
76.4	27	
79.0	26	impulsives
110.0*	25	
----------	----------	----------median
200.2*	24	
237.2	18	reflectives
252.6	17	

The summary table includes the data obtained from the MFFT, the problem solving tasks, observation of teacher wait time, the teacher's classification of the students and the use of mneomic devices. The MFFT column reports the total number of seconds used by the student to answer the twelve items (minus two practice items). The number of errors and the classification of each student is also recorded. The second column contains the total time (in seconds) required to complete the problem solving tasks, and the errors are also recorded. Column three contains the average amount of wait time given by the teacher to the student when answering a question. Column four includes the teacher's classification of this sample of students.

During the observation of a question-answer period in the class, the teacher wait time (time between the end of the teacher initiated question and the student response) was recorded. The question-answer period was a review of concepts learned during a musical instrument lesson.

Statistical analysis can be performed to answer research questions five, six, and seven. Question five (Will impulsive children be given shorter wait times by the teacher than reflective children?) can be represented by the statistical hypothesis

Table 3

Data Summary Table

initial	MFFT	workbook tasks	ave. wait time	teacher classi-fication	mneomic device use
SM	reflective	33.6/3	3.0	reflective	yes
	237.2/18	105/2			
KC	reflective	71.8/2	6.4	impulsive	yes
	252.6/17	332/4			
MS	impulsive	32.8/0	14.5	impulsive	yes
	76.4/24	90/0			
DM*	reflective	26.4/2	2.0	impulsive	yes
	200.2/25	64/2			
TW*	impulsive	31.2/0	1.5	impulsive	no
	110/27	134/1			
PG	impulsive	26.4/1	1.0	did not	no
	79.0/26	92/1		mention	
	style	time/error1			
	time/error	time/error2			

*borderline subjects

time in seconds

H_o: $U_1 = U_2$. The mean of one group (reflectives) is equal to mean two. Question six (Will impulsive children complete the problem solving tasks in shorter time periods than the reflective children?) can be statistically represented by $U_1 = U_2$. Question seven (Will reflective children use mneomic devices more than impulsive children during the problem solving task?) can be statistically represented by $X^2 = 0$.

To statistically answer each question, a one way anova can be performed on questions five and six, while a chi square can be performed on question seven. The one way anova will distinguish significant differences between the groups. The chi square will indicate whether a relationship exists between impulsivity-reflectivity and mneomic device use. The independent variable is cognitive style with two levels, impulsivity and reflectivity. There are three dependent variables: teacher wait time, time on the problem solving tasks, and mneomic devices. The sample size is too small to compute a valid F or X^2, however, for the dissertation these would be appropriate modes of analysis. The anovas were completed for the sake of experiencing the full scope of a research study. The results are presented in tables four and five.

Cognitive Style

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Statistical hypotheses: Q5 $U_1 = U_2$ $U_1 > U_2$ Analysis: one way anova

Q6 $U_1 = U_2$ $U_1 > U_2$ one way anova (task 1 and 2)

Q7 $X^2 = 0$ $X^2 \neq 0$

The formulae used were:

$$SS_b = \Sigma n_j (X._j - \bar{X}..)^2$$

$$MS_b = \frac{SS_B}{J-1}$$

$$SS_w = \Sigma (n_j - 1) S_j^2$$

$$MS_w = \frac{SS_W}{N-J}$$

$$F = \frac{MSb}{MSw}$$

$$\frac{MSb}{MSw} > F_{j-1,N-j,\ 1-\alpha}$$ reject null

Results. The results indicate that there were no significant differences between this sample of impulsive and reflective students on teacher wait time or school problem solving tasks. The F scores were .12, .056, and 1.32 for cognitive style groups, teacher wait time and problem solving tasks respectively. Four out of the six students used mneomic devices -- all of the reflective students and one of the impulsive students.

The failure to statistically show a difference between the impulsive and reflective children could be due to a few study

limitations. The n (sample size) was extremely small because it was an exploratory-pilot study. Possibly with a larger sample results would differ.

The lack of differences between the groups could lend support for the argument that impulsivity-reflectivity is a contextually related variable. Therefore, differences between groups would vary depending upon the specific situation.

Contrasting teacher wait time against the MFFT classification of impulsivity-reflectivity may further this argument. Teacher wait time did not differ between the reflective-impulsive groups. If teacher wait time was statistically compared to the teacher's

Table 4

Anova Table

Teacher Wait Time-Cognitive Style

Source of Variation	SS	df	MS	F
Between groups	3.94	1	3.94	.12
Within groups	128	4	32	
Total	131.94	5		

rule: reject the null if $F_{1,4\ .95} > 7.71$; therefore did not reject this null hypothesis. There is no significant difference between the impulsive-reflective groups.

Table 5

Anova Table

Problem Solving Task-Cognitive Style (Task one)

Sources of Variation	SS	df	MS	F
Between groups	171.66	1	171.66	.056
Within groups	12109.14	4	3027.28	
Total	12280.8	5		

rule: reject the null if $F_{1,4,.95} > 7.71$; therefore, do not reject the null, no difference

Anova Table

Problem Solving Task-Cognitive Style (Task two)

Sources of Variation	SS	df	MS	F
Between groups	15204.9	1	15204.9	1.32
Within groups	46246	4	11561.5	
Total	61450.9	5		

rule: reject the null if $F_{1,4,.95} > 7.71$; therefore, do not reject the null, no difference

classifications, the results may show differences between the groups. The teacher classification results concurred with the MFFT results three times.

Different results occurred on the problem solving task and MFFT tasks. For example, on the MFFT test subject SM was reflective, however, on the problem solving task SM yielded more errors than an impulsive subject like MS, and required relatively equal time to complete the task. Subjects KC and PG were fairly consistent in their reflective and impulsive time behavior on the MFFT and problem solving tasks, however, the errors made were not consistent. On some of the tasks the impulsive subjects had fewer errors than the reflective subjects.

Overall, the results indicate no differences between the impulsive and reflective groups on the dimensions of teacher wait time and time on problem solving tasks. This result could be due to three aspects: 1-cognitive style could be context specific, 2-impulsivity and reflectivity could be related to knowledge of subject matter, i.e., if a student knows the answer there is no need to reflect, 3-teacher wait time could be a stylistic trait not related to perceptions of the student's impulsivity or reflectivity.

The research questions posed at the onset of this study can be addressed to some extent. First, from observation and teacher input, impulsivity and reflectivity in the first grade setting can be defined as the manner in which a student responds in problem solving situations. This response mode is influenced by the student's interest level, knowledge of subject matter or contextual variables like group size. Second, from observation and the teacher interview one can propose that impulsivity-reflectivity is manifested in the way a student responds. This response can be through a verbal interaction like the question answer period. Third, from the teacher interview and observation, one can state that impulsivity-reflectivity is influenced by contextual issues. Students are influenced by the other students present during the interaction, the subject matter, and the degree of motivation. Fourth, impulsivity-reflectivity was measureable across the four assessment methods. The MFFT was a direct measure of impulsivity-reflectivity and the two problem solving tasks were also direct measures. The teacher classification of students was a more indirect measure, as was teacher wait time. But all of the methods were a reflection of observed, perceived or tested impulsive-reflective ability. Fifth, the results of this study revealed no

differences between groups on teacher wait time. Sixth, no differences were found between groups on problem solving tasks. Impulsive children may have completed the task in a shorter time period, however, this did not drastically differ from the reflective children's performance.

For the dissertation study of cognitive style in the first grade setting, several procedural or methodological changes can be made. One could use a larger sample size, and implement a more elaborate observational technique. One could observe the students in a variety of class situations, i.e., small group situations and not just large question-answer sessions. This may provide a more comprehensive view of teacher wait time. One could track the changes of impulsive and reflective students across time or contexts, and instructional styles. One could also contrast teacher wait time to teacher perception of student style. Overall, this study provides a basis for further study of impulsivity-reflectivity, teacher wait time, and assessment methods in the first grade setting.

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Errata

page 5 and 6 Weiner (1948) to Werner (1948)

Deleted references:

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APPENDIX B

MATCHING FAMILIAR FIGURES TEST

APPENDIX B

MATCHING FAMILIAR FIGURES TEST

MATCHING FAMILIAR FIGURES

Answer Sheet

Elementary

Note: First two items are practice

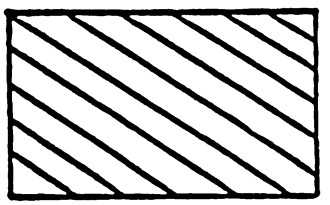
Item		
	1.	house. . . .1
	2.	scissors. . . .6
	3.	phone. . . .3
	4.	bear. . . .1
	5.	tree. . . .2
	6.	leaf. . . .6
	7.	cat. . . .3
	8.	dress. . . .5
	9.	giraffe. . . .4
	10.	lamp. . . .5
	11.	boat. . . .2
	12.	cowboy. . . .4

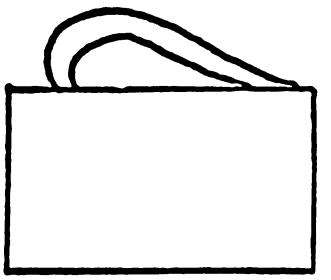
DIRECTIONS FOR MATCHING FAMILIAR FIGURES

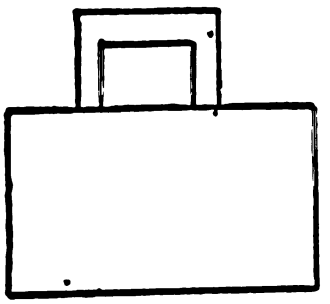
"I am going to show you a picture of something you know and then some pictures that look like it. You will have to point to the picture on this bottom page (point) that is just like the one on this top page (point). Let's do some for practice." E shows practice items and helps the child to find the correct answer. "Now we are going to do some that are a little bit harder. You will see a picture on top and six pictures on the bottom. Find the one that is just like the one on top and point to it."

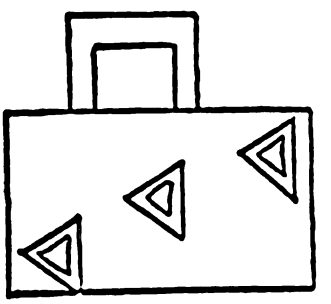
E will record latency to first response to the half-second, total number of errors for each item and the order in which the errors are made. If S is correct, E will praise. If wrong, E will say, "No, that is not the right one. Find the one that is just like this one (point)." Continue to code responses (not times) until child makes a maximum of six errors or gets the item correct. If incorrect, E will show the right answer.

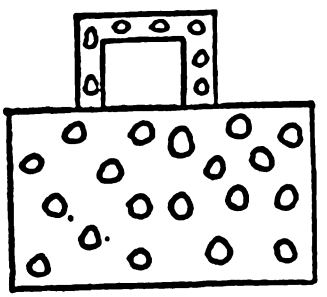
It is necessary to have a stand to place the test booklet on so that both the stimulus and the alternatives are clearly visible to the S at the same time. The two pages should be practically at right angles to one another. Note: It is desirable to enclose each page in clear plastic in order to keep the pages clean.

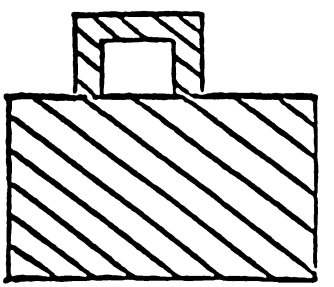


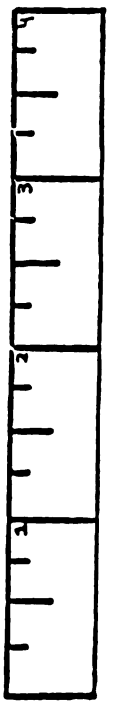


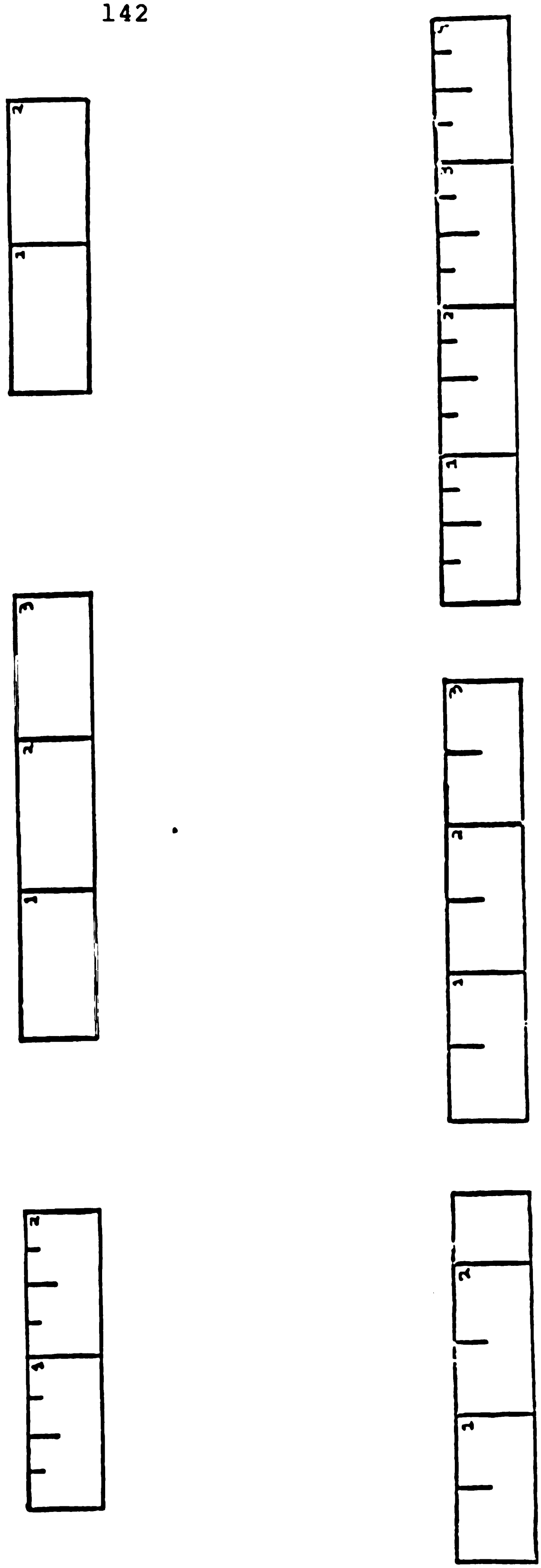


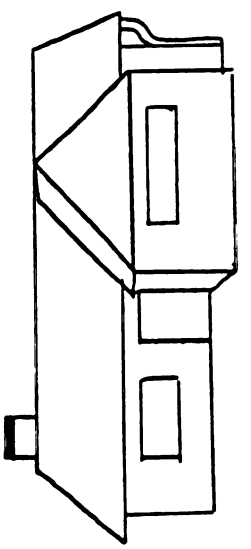


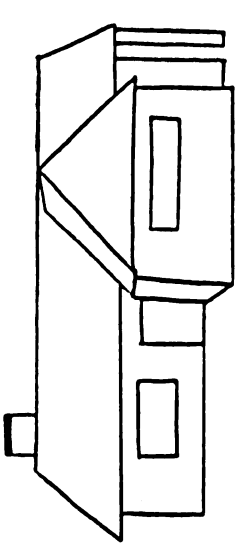


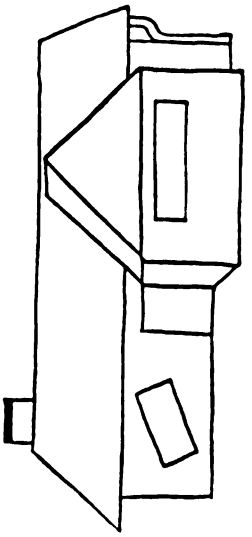


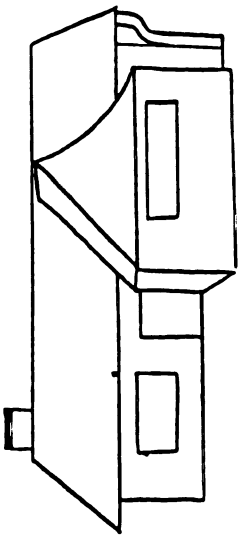

4
3
2
1

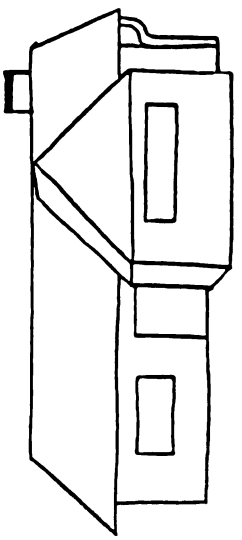


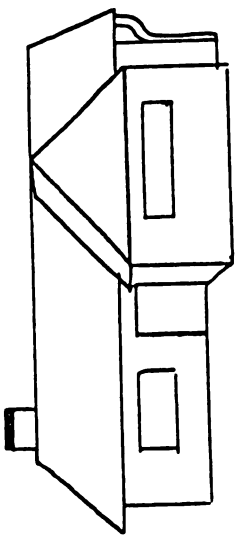


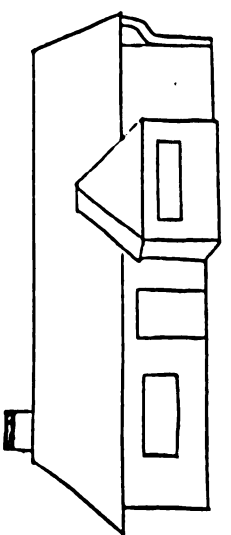


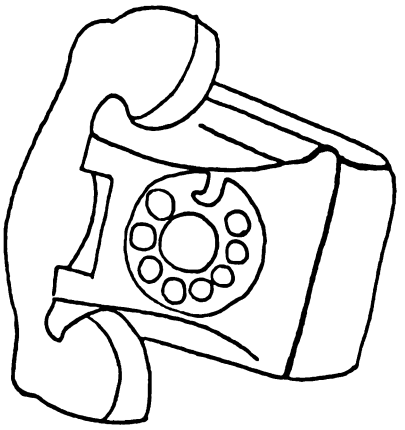


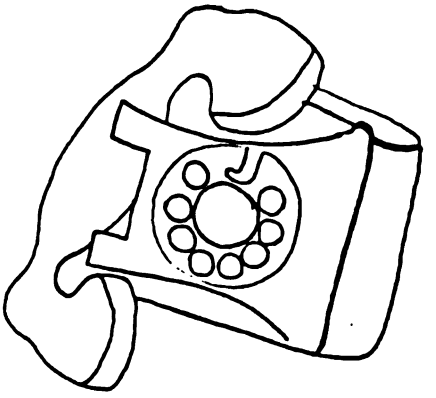


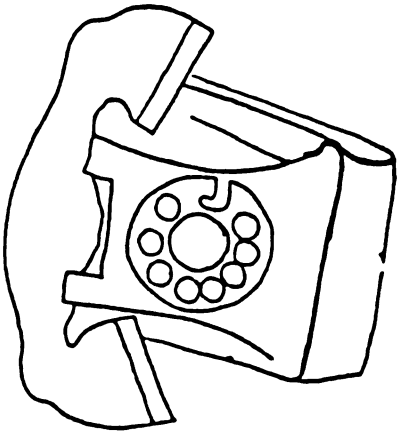


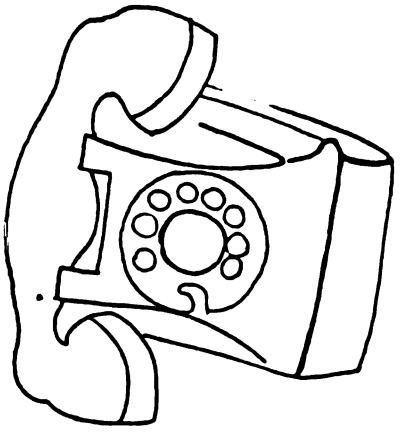


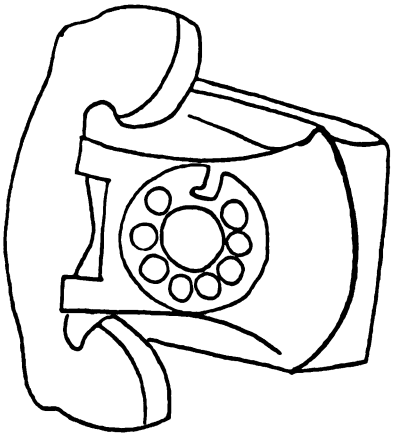


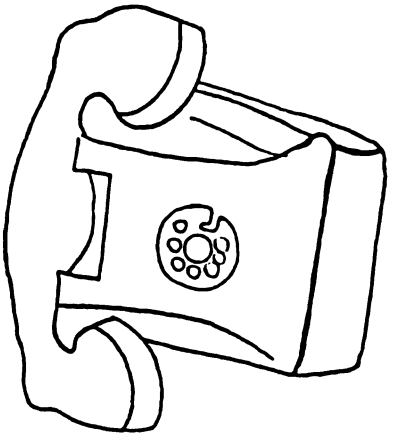


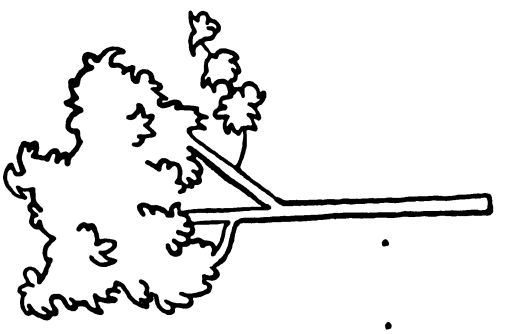


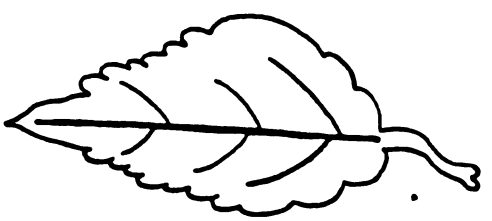


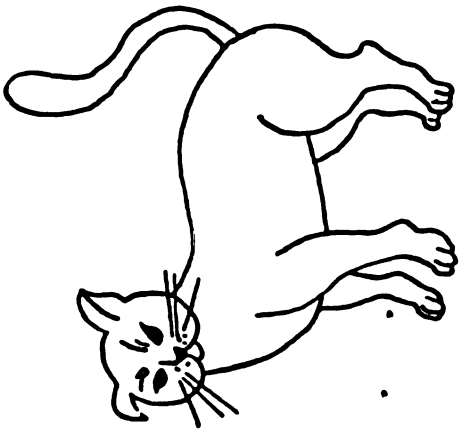


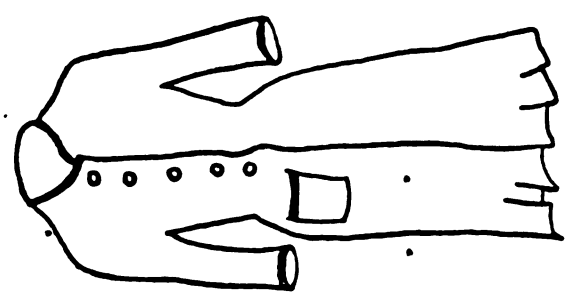


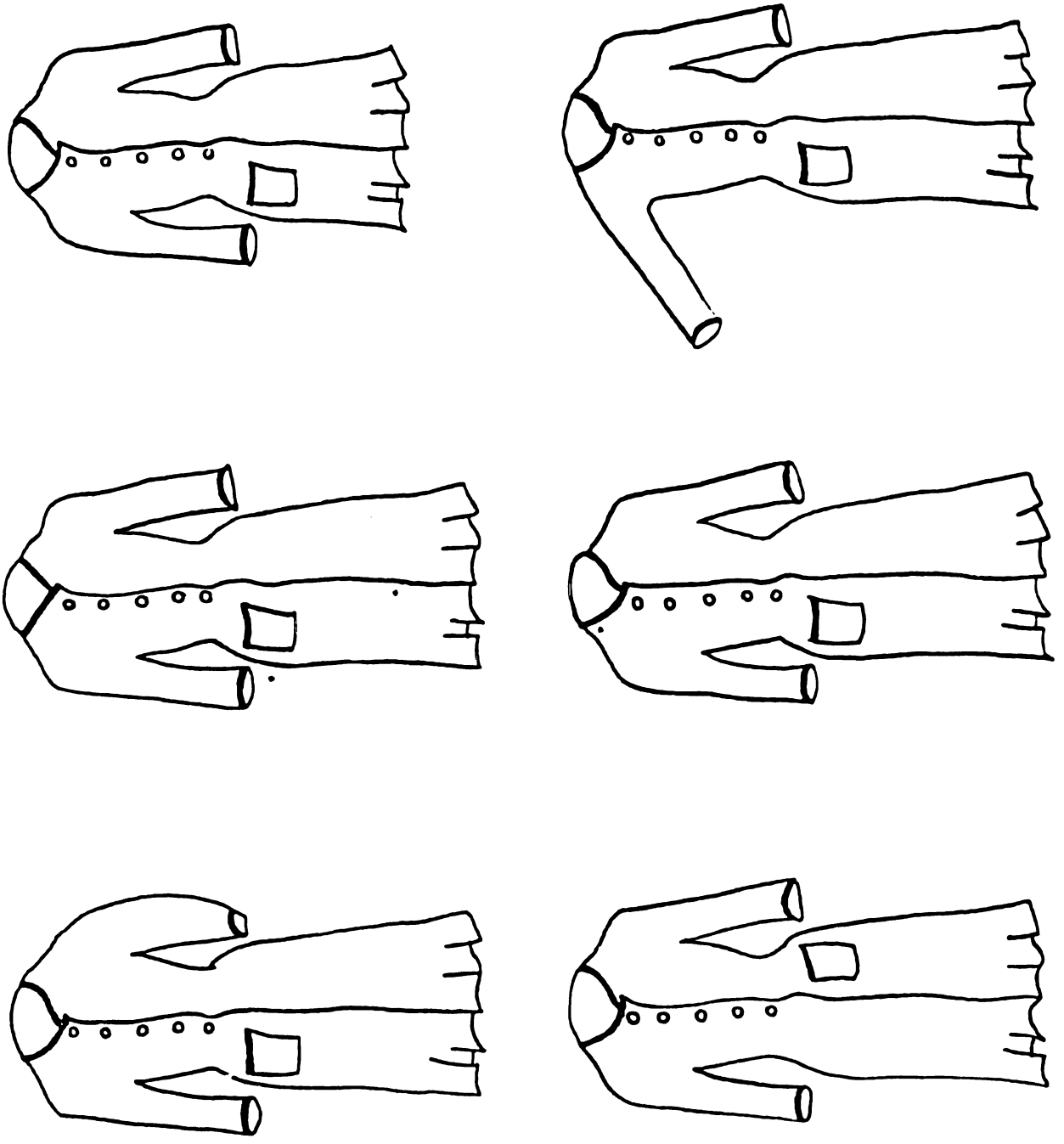


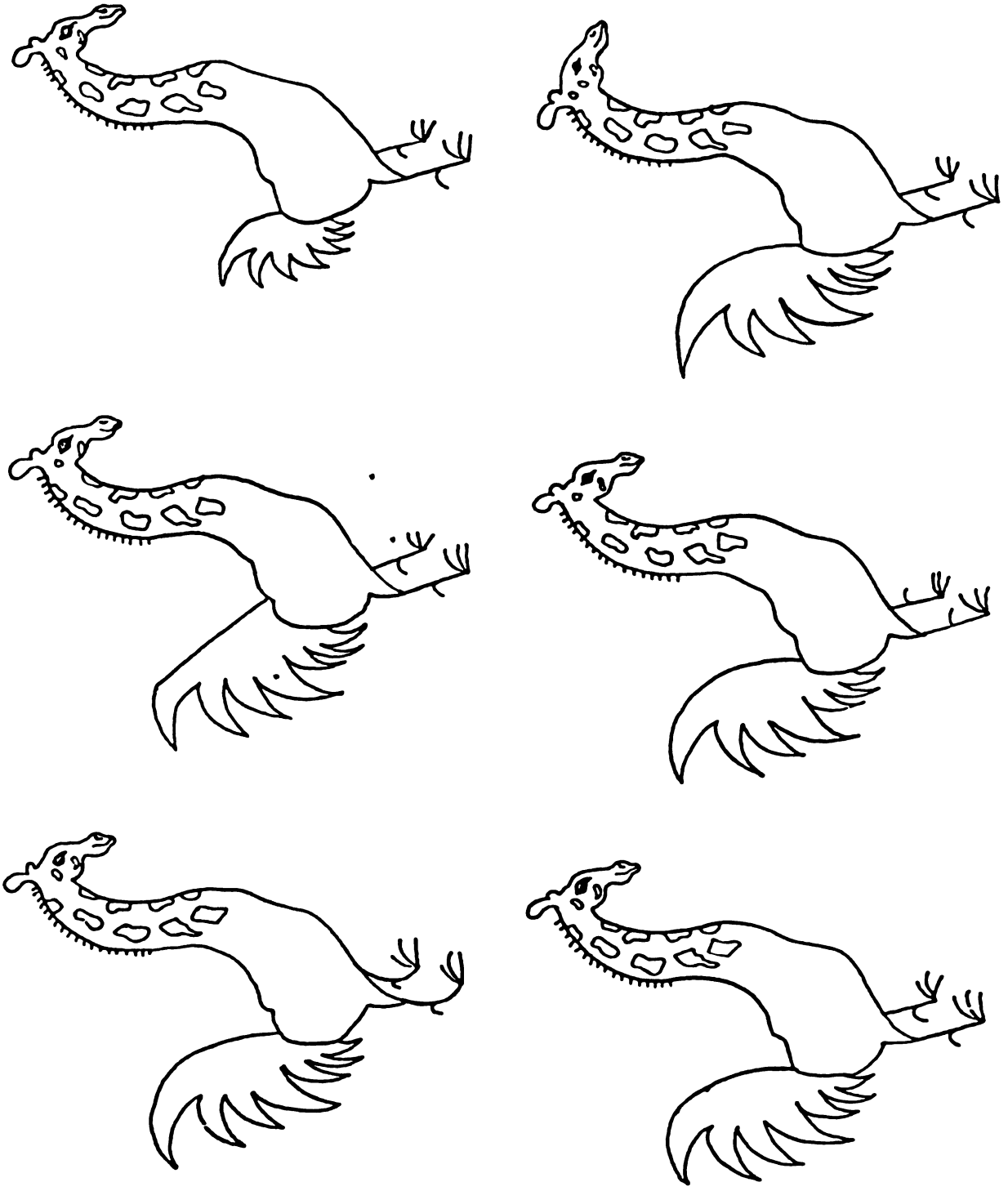


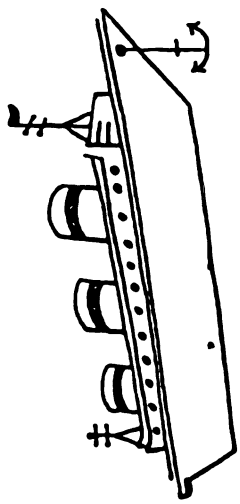


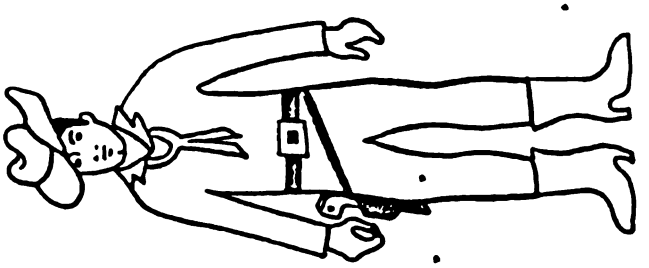


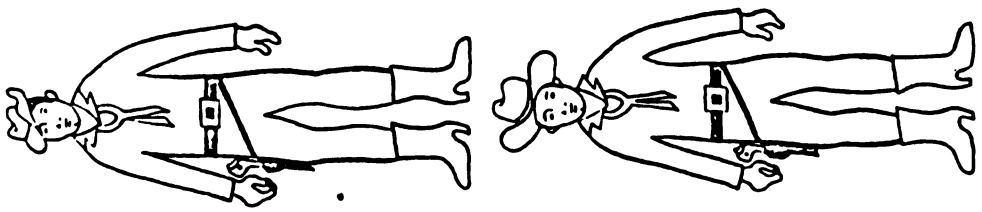


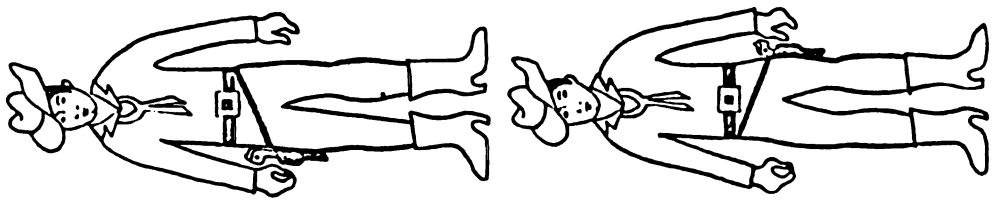


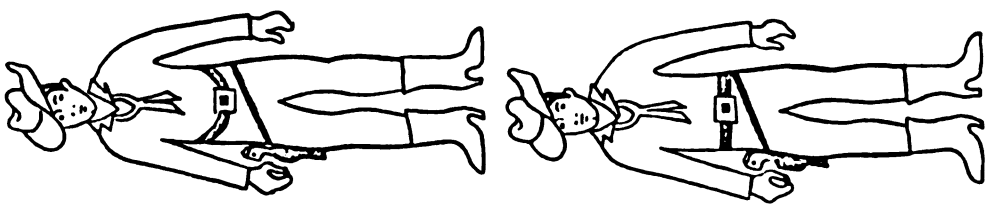












APPENDIX C

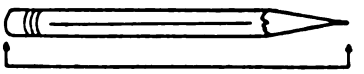
MICHIGAN EDUCATIONAL ASSESSMENT PROGRAM PROBLEMS (MEAP)

APPENDIX C

MICHIGAN EDUCATIONAL ASSESSMENT PROGRAM PROBLEMS (MEAP)

DIRECTIONS: Use the metric ruler provided to measure each picture below to the nearest centimeter.

88 How long is the pencil?



A 2 cm

B 4 cm

C 5 cm

D 6 cm

89 How high is the flagpole?

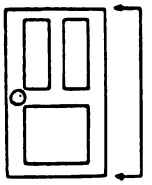
A 3 cm

B 4 cm

C 5 cm

D 6 cm

90 How high is the door?



A 1 cm

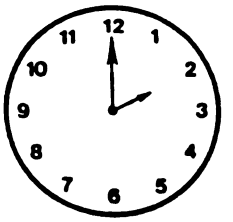
B 2 cm

C 3 cm

D 4 cm

DIRECTIONS: Find the answer.

91



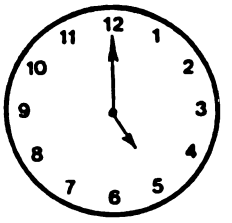
A 1:00

B 2:00

C 3:00

D 12:00

92



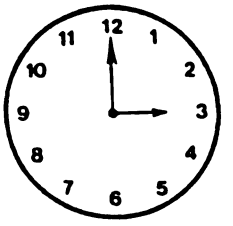
A 5:00

B 6:00

C 7:00

D 12:00

93



A 2:00

B 3:00

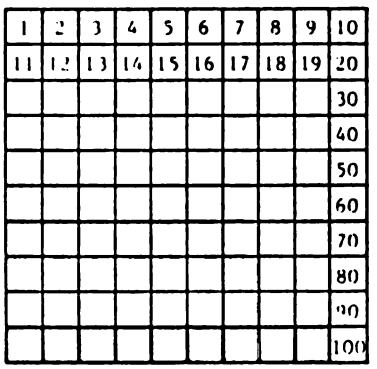
C 9:00

D 12:00

GO ON TO THE NEXT PAGE

DIRECTIONS: Find which numbers belong in the shaded area.

94



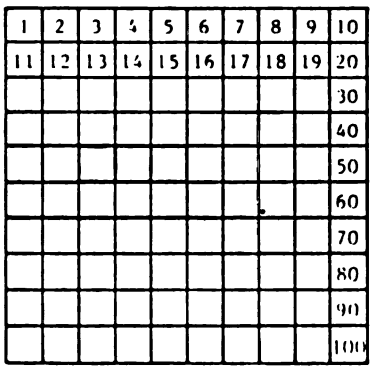
A 29, 39, 49, 59, 69, 79, 89, 99, 109

B 911, 912, 913, 914, 915, 916, 917, 918, 919

C 91, 92, 93, 94, 95, 96, 97, 98, 99

D 901, 902, 903, 904, 905, 906, 907, 908, 909

95



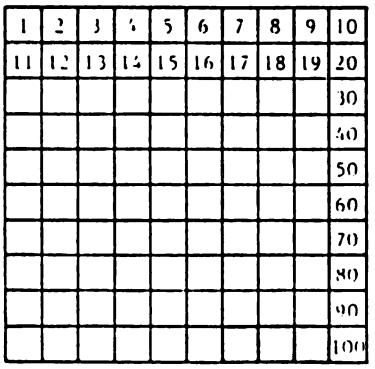
A 43, 44, 45

B 15, 16, 17

C 13, 14, 15

D 65, 75, 85

96



A 80, 90, 100

B 91, 92, 93

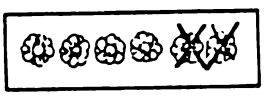
C 17, 18, 19

D 97, 98, 99

GO ON TO THE NEXT PAGE

DIRECTIONS: Find the answer.

97 Which number sentence below tells about this picture?



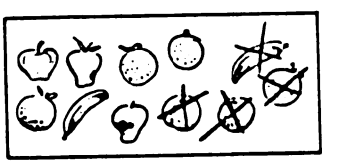
A 4 - 2 = 2

B 6 - 2 = 4

C 2 + 6 = 8

D 8 - 6 = 2

98 Which number sentence below tells about this picture?



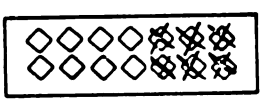
A 7 - 4 = 3

B 8 + 3 = 11

C 4 + 1 = 5

D 11 - 4 = 7

99 Which number sentence below tells about this picture?



A 9 + 5 = 14

B 8 - 8 = 0

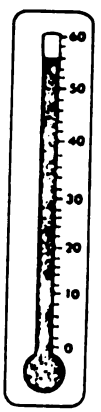
C 8 - 6 = 2

D 14 - 6 = 8

GO ON TO THE NEXT PAGE

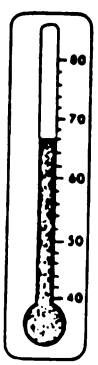
DIRECTIONS: Find the answer.

100 What is the temperature?



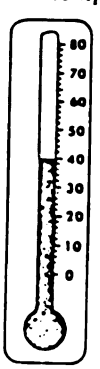
A 46°
B 50°
C 56°
D 60°

101 What is the temperature?



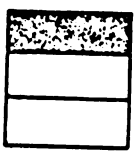
A 36°
B 56°
C 60°
D 66°

102 What is the temperature?



A 40°
B 45°
C 50
D 55°

103 Which part is shaded?

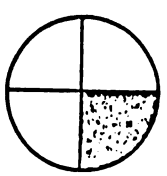


A $\frac{1}{2}$
B $\frac{1}{3}$
C $\frac{1}{4}$
D 3

104 Which part is shaded?

A $\frac{1}{2}$
B $\frac{1}{3}$
C $\frac{1}{4}$
D 2

105 Which part is shaded?



A $\frac{1}{2}$
B $\frac{1}{4}$
C 2
D 4

106 Which numbers are in order from smallest to largest?

A 682, 286, 231, 97
B 286, 97, 231, 682
C 97, 231, 286, 682
D 97, 286, 682, 231

GO ON TO THE NEXT PAGE

DIRECTIONS: Find the answer.

107 Which numbers are in order from smallest to largest?

A 23, 65, 175, 483

B 23, 175, 65, 483

C 483, 175, 65, 23

D 23, 483, 65, 175

108 Which numbers are in order from smallest to largest?

A 61, 313, 84, 451

B 451, 313, 84, 61

C 61, 84, 313, 451

D 84, 313, 451, 61

109 Which is less?

A 481

B 814

110 Which is greater?

A 295

B 925

111 Which is greater?

A 734

B 437

112 $\begin{array}{r} 13 \\ +\ 24 \\ \hline \end{array}$

A 11

B 27

C 37

D 73

113 $25 + 70 = \square$

A 55

B 59

C 95

D 105

114 $\begin{array}{r} 84 \\ +\ 14 \\ \hline \end{array}$

A 70

B 88

C 90

D 98

115 $\begin{array}{r} 74 \\ +\ 6 \\ \hline \end{array}$

A 70

B 80

C 710

D 810

116 $\begin{array}{r} 56 \\ +\ 8 \\ \hline \end{array}$

A 614

B 514

C 64

D 54

GO ON TO THE NEXT PAGE

DIRECTIONS: Find the answer.

117 38 + 7 = ☐

A 415
B 315
C 45
D 35

118 795 means

A 7 ones 9 tens 5 hundreds
B 7 hundreds 9 tens 5 ones
C 5 hundreds 9 tens 7 ones
D 7 tens 9 hundreds 5 ones

119 428 means

A 8 hundreds 2 tens 4 ones
B 4 hundreds 2 tens 8 ones
C 4 tens 2 hundreds 8 ones
D 4 thousands 2 tens 8 ones

120 375 means

A 3 hundreds 7 tens 5 ones
B 5 hundreds 7 tens 3 ones
C 3 ones 7 tens 5 hundreds
D 7 tens 5 tens 3 ones

121 Which number comes next?
2, 4, 6, ———

A 5
B 7
C 8
D 9

122 Which number comes next?
3, 6, 9, ———

A 10
B 11
C 12
D 15

123 Which number comes next?
65, 75, 85, ———

A 80
B 90
C 95
D 105

124 Which is a triangle?

A B C D

125 Which is a rectangle?

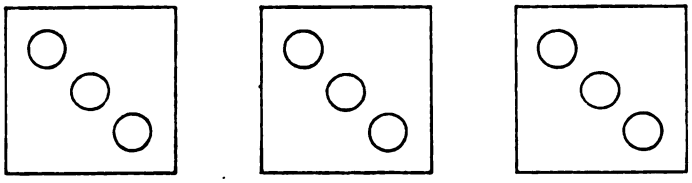
A B C D

126 Which is a square?

A B C D

DIRECTIONS: Find the answer.

127

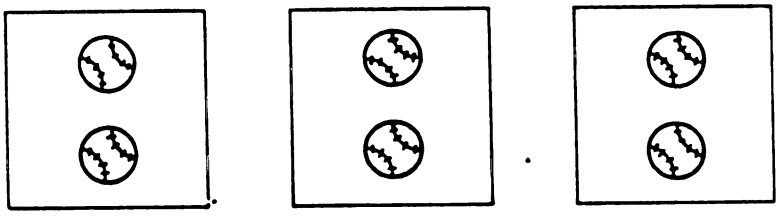


Which sentence describes how many circles are here?

A 3×3 C $9 \div 1$

B 9×1 D 1×9

128

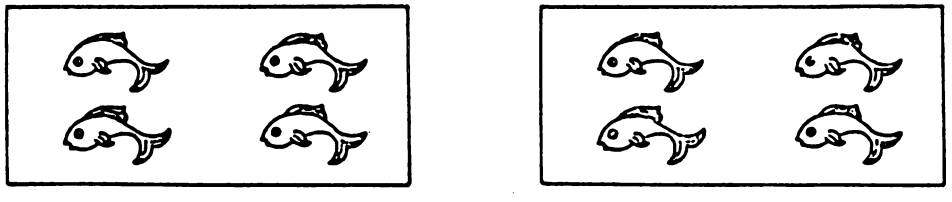


Which sentence describes how many baseballs are here?

A 1×6 C 3×2

B $6 \cdot 6$ D $6 \div 1$

129



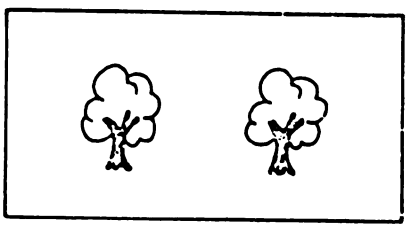
Which sentence describes how many fish are here?

A $8 \cdot 1$ C 2×4

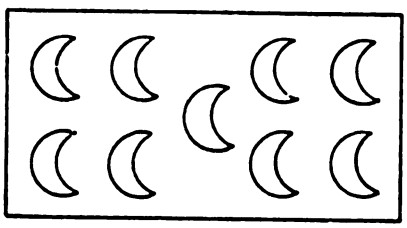
B $1 \cdot 8$ D $8 \div 1$

DIRECTIONS: Find the answer.

130 Which set has fewer members?

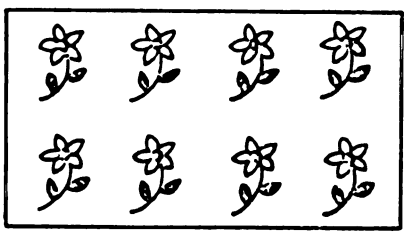


A

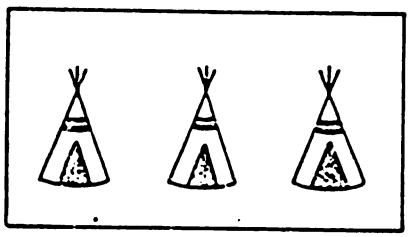


B

131 Which set has fewer members?

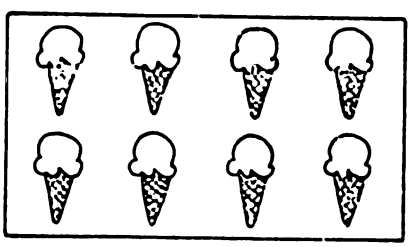


A

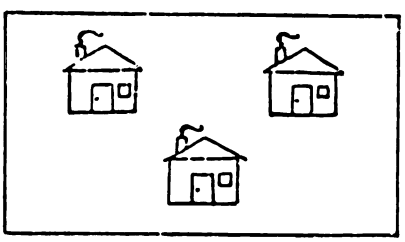


B

132 Which set has fewer members?



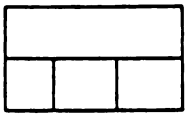
A

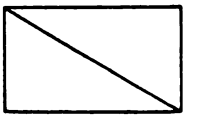


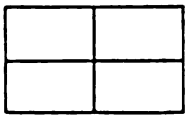
B

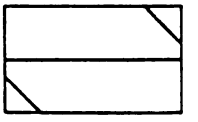
DIRECTIONS: Find the answer.

133 Which object is divided into four parts of the same size and shape?

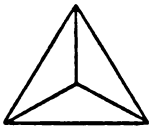
A 

C 

B 

D 

134 The object below is divided into how many parts of the same size and shape?



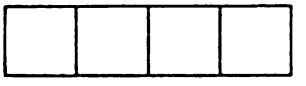
A 2

B 3

C 4

D 5

135 The object below is divided into how many parts of the same size and shape?



A 2

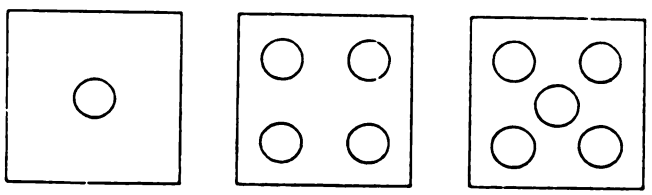
B 3

C 4

D 5

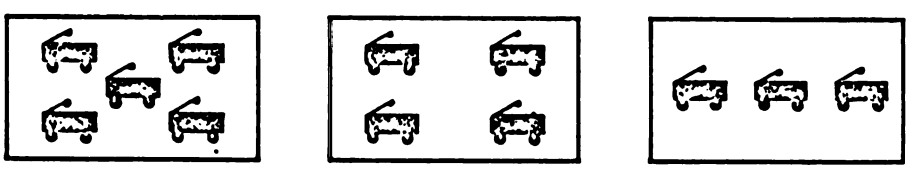
DIRECTIONS: Find the answer.

166 Which set has the fewest members?



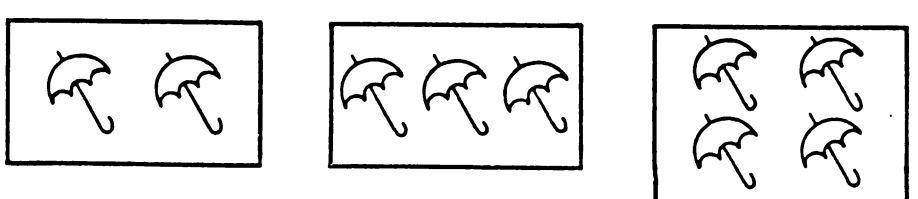
A B C

167 Which set has the fewest members?



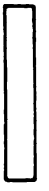
A B C

168 Which set has the fewest members?

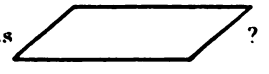


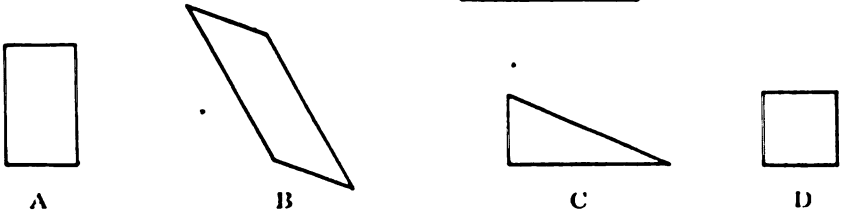
A B C

DIRECTIONS: Find the answer.

169 Which picture is the same size and shape as  ?

A B C D

170 Which picture is the same size and shape as  ?



A B C D

171 Which picture is the same size and shape as  ?

A B C D

APPENDIX D

INSTRUCTIONS TO MICHIGAN EDUCATIONAL ASSESSMENT PROGRAM

APPENDIX D

INSTRUCTIONS TO MICHIGAN EDUCATIONAL ASSESSMENT PROGRAM

On the wall you will see math problems that you are familiar with. You know the answers to most of these problems. Miss _____ will read the problem to you. When she is finished reading the problem, you will have a certain amount of time in which to solve and give the answer to the problem. If you do not know the answer, let me know.

If you do know the answer, tell me the answer as soon as you know it.

Do you understand?

Now explain to me what you are to do.

APPENDIX E

DATA FORMS FOR MICHIGAN EDUCATIONAL ASSESSMENT PROGRAM

APPENDIX E

DATA FORMS FOR MICHIGAN EDUCATIONAL ASSESSMENT PROGRAM

Student Name _____ Sex _____
Date of Birth _____ Grade _____
Date of Test _____

Item	Time Given	Time Taken to Respond	Answer Given Correct
Item 94			
Item 95			
Item 96			
Item 97			
Item 98			
Item 99			
Item 100			
Item 101			
Item 102			
Item 103			
Item 104			
Item 105			
Item 106			
Item 107			
Item 108			
Item 127			
Item 128			
Item 129			
Item 133			
Item 134			
Item 135			
Item 136			
Item 137			
Item 138			
Item 169			
Item 170			
Item 171			
Item 172			
Item 173			
Item 174			

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