Order Number 8801710

The relationship of cognitive style and scaffolding on a multiple choice visual matching task and assessment of the zone of proximal development

Farkas, Ervi, Ph.D.

City University of New York, 1987

U·M·I
300 N. Zeeb Rd.
Ann Arbor, MI 48106

PLEASE NOTE:

In all cases this material has been filmed in the best possible way from the available copy. Problems encountered with this document have been identified here with a check mark __✓__.

1. Glossy photographs or pages _____
2. Colored illustrations, paper or print _____
3. Photographs with dark background _____
4. Illustrations are poor copy _____
5. Pages with black marks, not original copy __✓__
6. Print shows through as there is text on both sides of page _____
7. Indistinct, broken or small print on several pages __✓__
8. Print exceeds margin requirements _____
9. Tightly bound copy with print lost in spine _____
10. Computer printout pages with indistinct print _____
11. Page(s) _____ lacking when material received, and not available from school or author.
12. Page(s) _____ seem to be missing in numbering only as text follows.
13. Two pages numbered _____. Text follows.
14. Curling and wrinkled pages _____
15. Dissertation contains pages with print at a slant, filmed as received __✓__
16. Other _____

_____

_____

U·M·I

THE RELATIONSHIP OF COGNITIVE STYLE AND SCAFFOLDING ON A MULTIPLE CHOICE VISUAL MATCHING TASK AND ASSESSMENT OF THE ZONE OF PROXIMAL DEVELOPMENT

by

Ervi Farkas

A dissertation submitted to the Graduate Faculty in Educational Psychology in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.

1987

This manuscript has been read and accepted for the Graduate Faculty in Educational Psychology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

June 3, 1987
Date

Nicholas Anastasiow
Chair of Examining Committee

June 7, 1987
Date

Executive Officer

Nicholas Anastasiow

Marian Fish

David Rindskopf

Supervisory Committee

The City University of New York

Abstract

THE RELATIONSHIP OF COGNITIVE STYLE AND SCAFFOLDING
ON A MULTIPLE CHOICE VISUAL MATCHING TASK
AND ASSESSMENT OF THE ZONE OF PROXIMAL DEVELOPMENT

By

Ervi Farkas

Advisor: Professor Nicholas Anastasiow

Two areas of research suggest that the multiple choice format and response contingencies particularly disadvantage cognitively impulsive children. Thus, the validity of tests with multiple choice formats is impaired to the extent that these formats evoke the tendency to respond either impulsively or reflectively. Previous research dealing with the apparent disadvantage of impulsive children attempted to modify their cognitive style and make them more reflective. These efforts, however, have not always succeeded in reducing the number of errors for these children. Rather than focus on the child, this study focused on the collaboration of the child and his/her environment.

This study draws from several bodies of literature in order to examine how instruction can best support the child's cognitive style on a multiple choice task requiring visual matching, so that all children, regardless of cognitive style, function at their optimal level. In addition, this study extends the research

of Brown and Campione and their associates regarding the predictability of dynamic and static measures relative to visual matching problems.

Subjects consisted of 62 kindergarteners. This study was run in four phases: pretest, training, treatment conditions (high support vs. low support), and posttests. All subjects were administered the Matching Familiar Figures Test (MFFT) and Vane Kindergarten Test (VKT), in order to provide a basis for equating subjects according to their initial level of ability. During the training phase, subjects received graduated prompts until they reached a criterion of solving three problems independently. The number of prompts given was their learning rate measure. The subjects were randomly assigned to one of two maintenance treatment groups. One group was given graduated prompts, while the other was not. During the posttest phase, the MFFT was readministered.

Contrary to expectations, there was no significant interaction effect between cognitive style and support condition. Dynamic measures were better predictors of MFFT posttest scores when compared to the static measures used. For both the high and low support groups, there was a significant increase in mean initial response times and a significant decrease in the total number of errors. Educational implications and suggestions for future research are discussed.

ACKNOWLEDGEMENTS

I would like to thank the many people who helped in completing this study.

First of all, I would like to thank Professor Nicholas Anastasiow for his support and encouragement which I felt throughout. It was his guidance which led me to this study and his faith in me which led to the completion of this paper.

Thanks to Professor Marian Fish for her constant support and enthusiasm regarding the study. Thanks to Professor David Rindskopf for his help with the analysis of the data and his warmth.

Thanks to the many people in the Bethpage Schools who enabled me to do the study including: Mr. George Mann - Asst. Superintendent of Schools; Mr. Kenneth Blau - Principal; Dr. Paul Cooper - Director of Pupil Personnel. Thanks to Ms. Estelle Baker and Mrs. Roseann Cordiner who opened their classrooms to me to do the study.

Thanks to Maura Olson for her support and understanding throughout the program. Special thanks and love to Dr. Milton Kornrich who continues to inspire me.

Love and thanks to my loving children Elissa and Eric who help me to keep this all in perspective.

Love and thanks to the person who supported me with her unconditional love, boundless energy, faith and support. My wife, Susan.

TABLE OF CONTENTS

Chapter | Page

LIST OF TABLES

CHAPTER I

INTRODUCTION

The past few years have seen an increase in federal and state regulations regarding testing of all school children. Regulations (Chapter 53 of the Education Laws of 1980 - section 3208) now mandate that all new entrants to the schools be evaluated or screened in order to identify those children with handicapping conditions and to remediate these deficits. Other regulations (Part 100 of the Regulations of the Commissioner of Education - N.Y.S.) concern competency (reading and math) tests given at the third and sixth grade level in the elementary schools and again later in the child's school career. These tests also are intended to determine the need for remedial services and/or retention in the grade. In addition, there are regulations (PL 94-142) regarding testing requirements for all children referred for possible handicapping conditions such as learning disabilities and hyperactivity.

Most school districts have a yearly achievement testing program to evaluate children's progress and needs. Testing programs often include an intelligence test that is administered to the children at least once and often more frequently during their school careers. Since all of these mandated tests are used to refer, remediate, identify and/or place children, it is crucial that they be valid for all children with respect to format as well as content.

Many screening, competency, achievement and intelligence tests,

especially group administered tests, rely on a multiple choice format which requires the selection of the correct choice from several alternatives. These testing programs assume that all children are similarly affected by format and response contingencies. Two areas of theory and research suggest that both the multiple choice format and the response contingencies requiring the child to perform an instrumental act (i.e., fill in the correct choice) and withhold several others, particularly disadvantages impulsive and hyperactive children.

The first area of research is the work of Jerome Kagan who, with his colleagues, studied children's cognitive styles using the Matching Familiar Figures Test (MFFT). In a series of studies, it was found that on tasks of high response uncertainty certain children (impulsives) consistently make more errors than other children (reflectives) (Kagan, 1965a, 1965b, 1965c, 1966).

The second area of research is the work of Luria (1959a, 1961) and his associates who demonstrated that the withholding of impulsive motor responses is particularly difficult for cerebro-asthenic (equivalent to hyperactive) children, especially if they do not have the verbal self-directive abilities necessary to regulate their own behavior.

Research has demonstrated that cognitive style generalizes across similar tasks (Kagan, 1966; Messer, 1976). Messer (1976) found in his review of the impulsivity-reflectivity literature that the correlations between IQ and MFFT scores were higher when the test format was similar to the format of the MFFT. Thus, children with an impulsive cognitive style are particularly disadvantaged by tests having a multiple choice format. Hoy, Weiss, Minde and Cohen

(1978) and Weithorn and her associates (Weithorn and Kagan, 1979; Weithorn, Kagan and Marcus, 1984) have questioned the validity of tests with these formats (e.g., group IQ tests and most achievement tests) as they are negatively affected to the extent that the response requirements inherent in the test formats evoke the tendency to respond impulsively or reflectively.

Much of the research concerned with the apparent disadvantage of impulsive children in learning situations has attempted modifications of their cognitive style. A variety of modifications have been studied. Among these are reinforcement contingencies (Briggs, 1968; Weinberg, 1969), modeling (Cohen and Prezybycien, 1973; Debus, 1970; Meichenbaum and Goodman, 1971), direct teaching of efficient scanning strategies (Egeland, 1974; Zelniker, Jeffrey, Ault and Parson, 1972), training in attention to distinctive features during problem solving (Orbach, 1977; Zelniker and Oppenheimer, 1973, 1976), and verbal self-direction (Meichenbaum and Goodman, 1969, 1971). These studies attempted to train impulsive learners to be more reflective.

Readence and Bean (1978) proposed an alternate route. They suggested that rather than making efforts to change the child to suit the learning environment, the environment should be modified to fit the needs of the child.

With this in mind, several areas of research emanating from Vygotsky's theories are relevant. Of special interest is Vygotsky's (1962, 1978) concept of the zone of proximal development. He was concerned with the relationship between two levels of development. The first, is the child's level of 'actual development' or the level

of individual, independent functioning. The second, is the child's level of 'potential development' or the level at which the child has not mastered the task but can participate in its execution with the assistance and supervision of an adult or more capable peer. Vygotsky (1962, 1978) was critical of Western psychologists' intelligence and achievement testing because it focused on the child's current level of development, to the exclusion of the child's potential for growth.

Vygotsky made a distinction between a child's performance on a static test, where the child performs independently, and the performance of that child following some form of intervention. Budoff (1974) and Feuerstein (1979) developed dynamic assessment procedures which utilized a test-train-test procedure to measure the child's current level of functioning as well as the child's potential for learning. They found significant improvement after brief training during the assessment procedures. Brown and her associates have begun a series of studies examining how indices of the zone of proximal development (potential for learning) relate to traditional IQ scores (Brown and Ferrara, 1985; Campione, Brown, Ferrara and Bryant, 1984). By using a series of graduated prompts, they are able to assess the child's speed of learning, the ability to transfer this learning across tasks and the width of the child's zone of proximal development.

Concern with the relationship between the child's level of actual development and the child's level of potential development led to considerations of the appropriate levels of collaborative functioning for a child. Vygotsky's theory (1962) stresses that cognitive functioning occurs first on the social level, between

people, and that the child internalizes this learning in individual development. From Vygotsky's theory of how social interaction at the interpsychological level leads to independent problem solving at the intrapsychological level, Wood, Bruner and Ross (1976) developed the notion of 'scaffolding', a process whereby an adult or more capable peer provides support to a child who is learning to master a problem. Fischer and Bullock (1984) have elaborated on this line of research with their work on scaffolding, the collaborative cycle and the optimal level hypotheses, which posit the notion that with support a child can advance to the upper limit of his or her processing ability. A number of processes in individual functioning appear to be facilitated by social guidance, among them: (a) language and skill acquisition (Cross, 1977; Swensen, 1983); (b) reading (Cazden, 1979); (c) problem solving (Wertsch, 1979); (d) number reproduction (Saxe, Gearhart and Guberman, 1984); and (e) series completion and progressive matrices (Brown and Ferrara, 1985; Campione, Brown, Ferrara and Bryant, 1984).

The present research effort attempts to integrate several bodies of literature in order to examine how instruction can best support the child's cognitive style on multiple choice tests requiring visual discrimination, so that all children regardless of cognitive style function at their optimal level. In addition, this research examines the difference between children's performances on a task when given low levels of support and when given high levels of support. In this way, the child's level of potential development, as well as his or her level of actual development, and their relationship, can be examined.

CHAPTER II

REVIEW OF THE LITERATURE

COGNITIVE STYLE

There are individual differences in the cognitive processes of problem solving which children employ. While describing the general character of problem solving behavior, Kagan (1966) postulates four phases the individual goes through while arriving at a solution. The first phase involves decoding and comprehension of the problem. The second phase involves the selection of a likely hypothesis on which to act. The third phase involves the implementation of the hypothesis. Finally, the fourth phase involves the evaluation of the validity of the solution arrived at. Reflectivity-impulsivity is a cognitive construct which describes the tendency to reflect on the validity of problem solving when several possible alternatives are available and there is uncertainty about which choice is the most appropriate.

The instrument most often used to measure the reflectivity-impulsivity dimension is the Matching Familiar Figures Test (MFFT) which assesses problem solving via visual discrimination and visual matching. Different forms of the MFFT are available for school-age children and adults. The MFFT developed by Kagan consists of 10 or more items, each of which contains a familiar figure (standard) and six facsimiles. The subject's task is to select from this array of alternatives the one picture which is identical to the standard.

The mean of the response times to the first response (also referred to as response latency) and the total number of errors summed across all items (also referred to as accuracy) are used as indicators of cognitive style, classifying children as either reflective (long response time and few errors) or impulsive (short response time and many errors). Those subjects with fast response times and few errors are referred to as 'fast accurates' while those with slow response times and many errors are referred to as 'slow inaccurates' (Block, Block, and Harrington, 1974, 1975; Messer, 1976). Readence and Baldwin (1978) described the difference between impulsives and reflectives in their review article on the modification of cognitive style:

> Kagan, et al.(1964), postulated that impulsivity-reflectivity relates to the selection and evaluation of solution alternatives in situations of high response uncertainty. Where numerous solution hypothesis are simultaneously available, the child must evaluate each possibility differentially. An impulsive child tends to act upon his initial response with little reflection, to process a false hypothesis, and to issue a solution with little or no critical analysis with regard to potential accuracy. On the other hand, a reflective child typically delays before carrying out a solution hypothesis, actively considers available alternatives, and compares their validity.
>
> (Readance and Bean, 1978, p.327)

Block et al. (1974) have criticized much of the impulsivity-reflectivity research due to the fact that in these studies,

impulsives and reflectives are sample generated. Due to the use of the median-split procedure rather than reliance on normative data, we cannot be certain that one researcher's reflectives are not another researcher's impulsives. Salkind (1978) has published a set of preliminary norms in an attempt to address the above shortcoming of impulsivity-reflectivity research.

Another drawback as Block et al. (1974) noted is that the use of the median-split to dichotomize the continuous variables of the MFFT (response time and errors) leads the investigator to think of impulsives, reflectives, fast accurates and slow inaccurates as separate groups rather than as on a continuum whereby an impulsive may have committed only a few errors more than a subject who was classified as fast accurate. In addition, the median-split procedure forfeits potentially important discriminating information, which results in a loss of statistical power. The solution to these problems is to use a multiple regression analysis of the impulsivity-reflectivity data. An impulsivity-reflectivity index (IRI), similar to the one used by Bentler and McClain (1976), Loper and Hallahan (1980) and Weithorn, Kagen and Marcus (1984), can be computed by transforming response time and errors into T scores.

DEVELOPMENT OF COGNITIVE STYLE

Children typically increase their response times and decrease the number of errors on the MFFT, becoming more reflective, with age. This finding is confirmed both by cross-sectional and longitudinal studies (Ault, 1973; Campbell and Douglas, 1972; Kagan, 1965b) as well as by the preliminary age norms given by Messer

(1976) and Salkind (1978).

Response times and errors are negatively correlated to a moderate degree, -.40 to -.65 (Kagan, 1966). The typical strong inverse relationship between errors and response times is not evident in samples of pre-schoolers but is consistently found in samples of school age children. This negative correlation between response time and errors tends to become larger with age. (See Messer, 1976 for review and norm tables). Ward (1973) suggested that the reason that this negative relationship is not as evident in pre-schoolers is because pre-schoolers are more oriented to the tester than to the task itself and that they also tend to engage in task irrelevent behaviors.

Kagan asserts that:

> The results are persuasive in suggesting that a tendency for reflection increases with age, is stable over periods as long as 20 months, manifests pervasive generality across varied task situations, and is linked to some fundamental aspects of the child's personality organization.
>
> (Kagan, 1965b, p. 134)

RELATION OF IMPULSIVITY-REFLECTIVITY (COGNITIVE STYLE) TO COGNITIVE FUNCTIONING

Cognitive processes which have been related to reflectivity-impulsivity, include attentiveness, information gathering and processing and problem solving.

Attentiveness

Hagen (1972) postulates a two stage model of selective attention. Subjects must first identify both the relevant and irrelevant cues and secondly, they must focus on the relevant while ignoring the irrelevant cues. Weiner and Berzonsky (1975) found that among sixth graders, reflective children begin to employ selective attention on experimental tasks while impulsive children do not appear to do so. They speculated that impulsives may have trouble attending selectively because of problems in stage one which relates to difficulty in distinguishing the relevant from the irrelevant cues. This difficulty could result in efforts to remember all the cues due to their inability to distinguish the relevant from the irrelevant.

These findings are in accord with previous research suggesting that impulsive children are less analytic than reflective children (Kagan, Moss and Siegel, 1963), and that impulsives may do better when the task requires them to perceive wholes rather than details (Zelniker and Oppenheimer, 1976).

The ability to sustain attention also has been investigated by testing impulsives' and reflectives' reaction times with a variable interval between the signal to "get ready" and the presentation of the stimulus to which they were to respond (Zelniker, Jeffrey, Ault and Parsons, 1972). No differences were found between impulsives and reflectives on the short preparatory intervals, but on the longer intervals, impulsives took longer to respond. This outcome suggests a greater inability on the part of impulsives to sustain attention in a laboratory setting.

Information Gathering and Processing

Researchers have attempted to analyze the way reflectives and impulsives actually use their attention when responding on MFFT-like tasks (Ault, Crawford and Jeffrey, 1972; Drake, 1970; Sigelmen, 1969; Zelniker, Jeffrey, Ault and Parsons, 1972). The major disparity of findings among these studies of scanning strategies is in the percentage of eye fixations to the standard. Sigelman (1969) reported that impulsive children spent more time than reflectives looking at the standard while Drake (1970) reported that reflectives spend more time than impulsives looking at the standard. Ault et al. (1972) and Zelniker et al. (1972) found no differences between impulsives and reflectives in this regard.

Kagan, Pearson and Welch (1966) report that, on the MFFT, the longer the latency, the greater the number of distinct glances. Sigelman (1969) refined this exploration of the scanning strategies of impulsives and reflectives by requiring them to press a button for the MFFT figures to come into focus. He found that while impulsives spend more time looking at the standard, reflectives look more often and longer at the variants than the impulsives.

Drake (1970) found that reflectives usually scanned more variants and made more eye fixations per stimulus than did impulsives. Reflectives also spent a greater percentage of the time comparing pairs of stimuli that include the standard and an alternative.

Other findings suggest that while all groups use the same basic strategy of making comparisons between the standard and one variant or between two variants, reflectives and fast accurates are more systematic and make a greater proportion of these kinds of

comparisons than do impulsives and slow inaccurates (Ault et al., 1972).

Messer (1976) in his review of the reflectivity-impulsivity literature noted that:

> These studies suggest that the search of reflectives involves greater concentration on homologous parts of the variants. By contrast, the viewing behavior of impulsives is less systematic and more global. In particular, they do not scan the field for distinctive features as systematically as reflectives.
>
> (Messer, 1976, p. 1037)

Problem Solving

Previous investigations suggest that impulsives are at a seeming disadvantage in problem solving situations. On various perceptual and perceptual-motor problem solving tasks involving response uncertainty, impulsives consistently perform poorly and less maturely when compared to reflectives.

Reflectives have been shown to display better short term auditory recall on serial learning tasks than impulsives (Kagan, 1966). They also have been found to display better short term visual recall on tasks requiring the child to recall which of two similar pictures had been previously presented (Siegel, Kirasic and Kilburg, 1973). Siegel et al. (1973) note that reflective children tend to utilize a more thorough and detailed feature analysis of the stimulus array on recognition tasks with a multiple choice format.

Reflective children also have been found to use a different and more efficient hypothesis-testing strategy than impulsive children.

Impulsive children were found to be less prone to test abstract hypotheses and more often used information in a random, trial-and-error manner (McKinney, 1973). McKinney and Bannerjee (1975) found that reflective and impulsive children gave the same number of solutions when memory support (light stays on) was provided. While this outcome indicates that reflectives are less reliant on memory supports, it also suggests that short term memory failure may be an important factor in the poorer performance of impulsives on tasks with several alternatives and high response uncertainty.

Reflectives were found to solve Porteus mazes more successfully than impulsives (Palkes, Stewart and Kahana, 1968). Ault (1973) and McKinney (1973) found that reflectives were more apt to ask questions that eliminate a greater number of possible answers which lead them to the correct answer on a variation of the 20 questions game.

Zelniker and his colleagues found that impulsives perceived wholes better than details, whereas reflectives in matching problems perceived details better than wholes (Zelniker and Oppenheimer, 1973; 1976; Zelniker, Renan, Sorer and Shavit, 1977). These findings lend support to the view that the impulsive cognitive style is a result of a different strategy of information processing, rather than a deficient problem solving ability. In fact, Klein, Blockovich, Buchalter and Huyghe (1976) found that while reflective children make fewer errors on a convergent problem solving task than impulsive children, there were no differences found between reflectives and impulsives on divergent problem solving tasks. Zelniker and his colleagues concluded that reflective children perform better on tasks requiring attention to details (i.e.

multiple choice tasks) since they tend to analyze stimuli into detail components (Zelniker and Jeffrey, 1976; Zelniker et al., 1977).

COGNITIVE STYLE AND SCHOOL ACHIEVEMENT

Impulsive and reflective children have been found to differ in their performance on problem solving tasks, and consistently, the impulsive learner is at a disadvantage in the classroom. Impulsive children have been found to perform less well academically than reflective children. Kagan (1965a, 1965b), found that among primary grade students (grades 1 and 2), impulsive youngsters made more errors in reading words on both a word recognition test and an oral reading test. It should be noted that the reading tests used were very similar in format to the MFFT in that there was a multiple choice selection in a match to standard task. As Weithorn, Kagen and Marcus (1984) point out, this makes it difficult to sort out the contributions of cognitive style and word recognition skills to these reading scores. Nevertheless, impulsive children make more errors of commission than omission on a variety of tasks (Kagan, 1965b, 1966).

Egeland's (1974) study lends further support to the relationship of a reflective attitude and reading proficiency. He employed a training procedure which successfully increased the children's reflectivity and this resulted in improved reading comprehension among second grade impulsives. On the other hand, Denny's (1974) study of children in grades 2 through 5, did not reveal any significant differences between impulsives and reflectives on four subtests of the Gates-McKillop Reading

Diagnostic Tests nor did MFFT response time and errors discriminate between poor and average readers on the Gilmore Oral Reading Test.

Messer (1970), working with youngsters for a two and one half year period (grade 1 to middle of grade 3), found that children who failed a grade were significantly more impulsive than their peers, even though there was no significant difference on measures of verbal intelligence between the groups. Loper and Hallahan (1980) found both response time and errors on the MFFT to be significantly correlated with achievement. Response time appeared to have greater salience than errors.

In their review of the relationship between reading achievement and cognitive style, Readence and Searfoss (1976) conclude that impulsivity-reflectivity is a more important factor in reading acquisition than it is for more fluent readers. The authors cite the research of Shapiro (1974) and Margolis (1974). Shapiro, studying first graders, found that reflectives performed significantly better than their impulsive peers on a total measure of reading readiness which contained items of high response uncertainty (Gates-MacGinitie Readiness Skills Test). Margolis' (1974) study confirmed this with kindergarten children on the Metropolitan Readiness Test.

Weithorn, Kagan and Marcus (1984) found that reading accuracy (Gilmore Oral Reading Test) was significantly related to impulsivity-reflectivity. They also found that attention and impulsivity were much more highly predictive of school success and academic achievement than were ratings of activity level alone.

RELATIONSHIP OF COGNITIVE STYLE AND INTELLECTUAL FUNCTIONING

Cognitive style was found to be moderately related to IQ when IQ scores fall within the normal range (Messer, 1976). The relationship was higher for errors than for response time and was slightly higher for girls than for boys. The median correlation between response time and IQ was .14 for boys and .22 for girls. The median correlation between errors and IQ was -.30 for boys and -.34 for girls (Messer, 1976).

Messer (1976), summarizing the 27 studies (see p. 1035 for tables) in which MFFT errors and response times were correlated with IQ measures, notes that the IQ tests utilized in these various studies had two different test formats. The test formats were either the standard question and answer format where the individual has to generate a response (i.e., Wechsler Scales) or the multiple choice format where the individual has to choose his response from several alternatives (i.e., Otis Lennon Test). The latter test format is much like the MFFT format. Therefore, as Messer (1976) observes, it is not surprising that there is a higher correlation between MFFT scores and IQ scores when the test format and the task requirements are similar, as they are on the group administered IQ tests (such as the Otis-Lennon Test). Messer concluded:

> When the content of an IQ test is primarily nonverbal and the format requires decision about alternatives (multiple choice), correlations of MFFT response time to IQ are higher than when the test calls for verbal responses, especially to items with minimal response uncertainty. This was confirmed in studies that found higher correlations between both MFFT variables and nonverbal

> (vs. verbal) sections of the Otis-Lennon Mental Abilities Test (Eska and Black, 1971), and higher correlations between MFFT errors and WISC Performance (vs. Verbal) IQ (Plomin and Buss, 1973).
>
> (Messer, 1976, p. 1036)

Brannigan and Asch (1977) found that reflective children between the ages of 8 and 11 perform significantly better on the WISC-R than do impulsive children. Mean full scale IQ scores were 99.9 for reflective youngsters and 88.6 for impulsive youngsters. The reflective children were superior in both the verbal and non-verbal areas. Farkas (1984) found that reflective children entering kindergarten performed significantly better on the Vane Kindergarten Test (VKT) than did impulsive children entering kindergarten. The mean total VKT IQ score for reflective children was 111.2 while the mean total IQ score for the impulsive youngsters was 100.9. There was also a significant difference in the ages of the impulsives (61.0 months) and the reflectives (63.81 months). The difference in performance on the MFFT and the Metropolitan Readiness Test, may have been due to differences in age and IQ between the groups. Since IQ and age were not controlled in this study, it is difficult to sort out the contribution of cognitive style, IQ and age.

Messer (1976) suggests that there should be a control at least for verbal IQ in future studies. Weithorn and her associates found that a language measure significantly distinguished high active children who achieved in later grades from those who did not achieve (Weithorn, 1978; Weithorn and Kagen, 1980).

In sum, research on the relationships between impulsivity-

reflectivity and reading achievement and between cognitive style and intellectual performance remain equivocal. In large part, this is due to the generalizability of impulsivity-reflectivity across tasks (Kagan, 1966). Therefore, as Weithorn, Kagan and Marcus (1984) pointed out, the multiple choice format used in most standardized achievement and group IQ tests may be affecting the content validity of these tests to the extent to which the response contingencies inherent in the test format evoke the tendency to respond either consistently impulsively or consistently reflectively. It is important for studies to control for IQ since impulsives do less well and this is especially true if a multiple choice format is used.

LURIA'S THEORY OF MOTOR CONTROL

Another area of research that is particularly relevant to this research is the work of Luria (1959a, 1961) and his associates. They demonstrated that withholding of impulsive motor responses is particularly difficult for hyperactive children, especially if they do not possess the verbal self-directive abilities necessary to regulate their own behavior.

Luria (1959a, 1959b), advancing the theories of Vygotsky (1962), asserted that internalization of speech is necessary in the child's development of voluntary control of the child's own behavior. He also noted that initially it is the adult's speech which regulates the behavior of the child, then it is the child's overt speech and finally the child's covert speech which controls and regulates the behavior of the child. Flavell (1977) termed the second and third stages of this developmental process and the

gradual transfer of control from others to the self, 'self-external' and 'self-internal'.

A second, parallel development concerns the type of control exercised by regulative speech. Luria demonstrated that, at first, the motor or impulsive component of speech dominates the child. The child can initiate but not really inhibit behavior since he only responds to the motoric element of speech. However, at about the age of five, the child begins to respond to the semantic elements of speech and speech then serves to inhibit behavior and to guide and/or modify behavior. As development proceeds, verbal control becomes more frequently semantic rather than impulsive. The child's behavior is more often controlled by what is said to him rather than by the purely physical stimulus effect of just saying anything to him/her at that moment. What we are dealing with, as Flavell (1977) points out, is an age trend, a trend from more to less susceptibility to impulsive type responding, and from less to more ability to respond in terms of the meaning alone.

Luria's research (1961) on the development of language as a regulator of behavior suggested a relationship among the traits of hyperactivity, instrumental response impulsivity and a developmental lag in the ability to use verbal self-regulation. E.D. Homskaya, a student of Luria's (1961), worked with cerebro-asthenic children. These children were hyperactive, impulsive and easily distracted. She found that these children do not develop the ability to use speech as a regulator of behavior until 7-8 years of age, as opposed to 4-5 years of age. Thus, these impulsive children are delayed in the use of language as a regulator of behavior, i.e., the ability to inhibit a motor response.

RELATIONSHIP BETWEEN COGNITIVE STYLE AND LURIA'S THEORY

There have been several studies linking the relationship between motor inhibition and cognitive style. Meichenbaum and Goodman (1969) found that MFFT determined impulsive kindergarteners, when using covert self-instructions on a Luria type lever - depression task showed significantly less verbal control of inhibitory motor behavior and made more errors than reflective children. However, under the overt condition, when the children said the instructions aloud, no significant differences between the impulsive and reflective children's performances were found. Furthermore, impulsive children were more likely to use the self-instructions in a motoric (impulsive) manner as opposed to the reflective children's reliance on the semantic (selective) content of their speech. Meichenbaum and Goodman concluded that children's self-verbalizations contribute to their cognitive response style.

The tendency on the part of reflectives to delay in giving a response in problem situations like the MFFT appears to extend to their ability to delay or withhold a motoric response. Using the Motor-Inhibition Test (Maccoby, Dowley, Hagen and Degerman, 1965) which requests that subjects execute motor acts slowly, Harrison and Nadelman (1972) found that 4 year old reflective children were better able to withhold or inhibit their action than their impulsive peers. Maccoby et al. (1965) found that scores on the inhibition of motor movement were correlated with measures of intellectual ability, while scores of activity level were not correlated. Thus, they concluded that the ability to inhibit motor movement seemed to be functional for problem solving. Impulsive responding on tasks

with high response uncertainty may represent a failure to use language to mediate responses where such verbal mediation would be necessary for successful performance.

In several studies, impulsive youngsters made more errors of commission than omission on a variety of tasks such as serial learning (Kagan, 1965b), reading recognition in both textual and non-textual contexts (Kagan, 1965b), doing a maze (Palkes et al., 1968) and attentional tasks (Hoy, Weiss, Minde, and Cohen, 1978). The findings of these studies further suggest that impulsive youngsters have a great deal of difficulty withholding or inhibiting a response and are at a disadvantage on tasks with high response uncertainty such as a multiple choice type task.

Weithorn and Kagan (1978) investigated the interaction of language development, activity level and cognitive style. They compared first graders of high activity level to those of low activity level and found that language maturity was a significant variable in task performance and overall school achievement for the high activity level group only. The higher language maturity enabled these children to compensate and function well despite their behavioral impulsivity. In subsequent studies (Weithorn and Kagen, 1984) reflectivity was significantly associated with the production of relevant verbalizations on tasks such as a multiple choice perceptual matching task and to better performance as well. Cognitive style was found to be much more highly predictive of success in school than activity level ratings alone (Weithorn, Kagen and Marcus, 1984).

MODIFICATION OF COGNITIVE STYLE

Many of the research studies dealing with the apparent disadvantage of impulsive children in learning situations have attempted modifications of their cognitive style. Researchers typically have attempted to make impulsive youngsters more reflective based on the underlying premise that reducing impulsivity would enhance cognitive performance. Generally, response times were more readily modified than were total error scores.

Reinforcement Contingencies

Several studies used reinforcement contingencies to modify impulsive cognitive style. Briggs (1968) found that reinforcement for increasing response times produced longer response times and fewer errors, whereas reinforcement for shorter response times resulted in shorter response times and increased errors (Briggs, 1968). While these effects generalized to the WISC Picture Arrangement subtest, they did not generalize to a motor inhibition test. In a similar study, using social approval and tangible reinforcers, Weinberg (1969) reinforced longer response times. While response times increased, total error scores did not change. There were no significant changes in either response times or error scores from the pretest to the posttest on the MFFT. In addition, the changes produced while various reinforcers were being used were not sustained once these reinforcers were removed.

Messer (1976) in his review of the impulsivity-reflectivity literature, cites Scher's (1971) study in which Scher reinforced subjects for decreased errors. The results indicated that reinforcement and withdrawal of reinforcement modified response

times but did not alter error scores on the MFFT.

Modeling

In several studies attempts were made to modify cognitive style with the use of experimental models (Debus, 1970; Denney, 1972; Meichenbaum and Goodman, 1971). In these studies the subjects observed models who either responded quickly or slowly while making statements such as "I take my time" and "I'm checking my answers". It was found that response times changed but that there were no significant changes in error scores. In contrast with these results, Cohen and Prezybycien (1974) paired subjects with a peer model who was rated as their choice for a work partner and these models were trained to be reflective and to express aloud their strategy. There were significant changes in both response times, which increased, and error scores which decreased. Meichenbaum and Goodman (1971) found that modeling alone decreased response time but in order to reduce errors as well, a modeling plus self-instruction condition was necessary.

Teaching Scanning Strategies

Several studies have instructed impulsive subjects to use the scanning strategies employed by their reflective peers. Meichenbaum and Goodman (1971) taught scanning strategies to one group while another group was instructed with the scanning strategies plus self-verbalizations of instructions. While both groups increased their response times, only the self-verbalization group decreased error scores.

Egeland (1974) trained impulsives to employ a reflective scanning strategy, resulting in increased response times as well as

decreased errors. Subjects' reading scores improved as well.

Training in Attention to Distinctive Features

In several studies, subjects were required to focus on specific details and to pay attention to stimulus features of the task (Egeland, 1974; Zelniker, Jeffrey, Ault and Parsons, 1972; Zelniker and Oppenheimer, 1973, 1976). While there were no specific scanning strategies given, the subjects were presented with MFFT-like tasks which forced them to attend to more comparisons among the choices. The subjects had to become more aware of the details distinguishing among the stimuli. This resulted in a decrease in errors.

In one study which compared the effects of modeling, teaching scanning strategies and distinctive feature training, Orbach (1977), found that distinctive feature training effected greater change in impulsives than either modeling or teaching efficient scanning strategies.

Self-instruction Training

There has been some research in the use of self-instruction or verbal mediation training in order to modify an impulsive response style. The interest in verbal mediation training is based on the notion that attention and impulsivity can be mediated through training in verbal self-direction. Luria's associate, E.D. Homskaya (Luria, 1959b, 1961) found that verbal self-direction improved the performance of cerebro-asthenic children on several tasks involving responses to light signals by pressure on a lever. Once the verbal self-direction was excluded, disinhibition of the motor reactions reappeared.

In an early study investigating the relationship between cognitive style and verbal control of motor behavior, Meichenbaum and Goodman (1969) classified children as either impulsive or reflective based on their MFFT performance. Using a lever press procedure similar to that used by Homskaya, they found that when covert self-instructions were used, there were more impulsive presses to the "don't press" instruction by impulsive subjects than by reflective subjects. However, there were no differences between impulsives and reflectives when overt self-instructions were employed. In their 1971 study Meichenbaum and Goodman placed kindergarten and first grade students in either a modeling, modeling plus verbal mediation training, or attention control group. While modeling alone increased response time, self-instruction was necessary to show a corresponding significant decrease in errors.

Agnew and Young (1979), Meichenbaum and Goodman (1969, 1971), Palkes et al. (1968) , Weithorn and Kagen (1979) and others have found improved performance on either the MFFT, Porteus Mazes, reading achievement, teacher ratings or a combination of the above and/or other measures when children are trained to verbally mediate their way through a task. Messer (1976) noted that the most consistently successful strategy to modify impulsive responding is to teach children improved scanning strategies while having them verbalize aloud what they are doing (e.g., Egeland, 1974; Meichenbaum and Goodman, 1971).

Abikoff (1979) and Meichenbaum and Burland (1979) in their reviews of the cognitive training studies of children exhibiting behavioral, attentional or cognitive difficulties, note that cognitive training does improve academic performance. Hobbs,

Moguin, Tyroler and Lahey (1980) are more critical of these studies from a methodological point of view but conclude that results do point to improved performance when verbal mediation is used with hyperactive children.

MODIFYING THE ENVIRONMENT TO FIT THE CHILD'S COGNITIVE STYLE

Reinforcement techniques, modeling, direct instruction in reflective scanning strategies and training to look for relevant distinctive features in tasks involving variant analysis, all have modified impulsivity. While these techniques have tended to increase response times, they have not always been effective in reducing errors. However, as Readance and Bean (1978) conclude, the transfer and maintenance of a child's newly acquired reflective cognitive strategy has not been confirmed in the classroom with tasks which differ from Kagan's task. They suggest an alternate approach which modifies the environment to fit the child's cognitive style rather than those which are geared to changing the child to be more suited to the learning environment. This approach requires finding and using instructional materials and methods which are most compatible with the child's current cognitive style.

To test this latter hypothesis that matching the environment to suit the child's cognitive style would result in better performance, Schwebel and Bernstein (1970) investigated the effects of altering the administration procedures of four subtests of the WISC. They found that imposing a latency period, whereby the children were not allowed to respond until a certain period of time had elapsed, significantly improved the performance of the lower (SES) class children who typically have a more impulsive response style on three

of the four WISC subtests. Erickson and Otto (1973) examined the effects of learning word lists with high and low similarity. They found that reflective learners performed significantly better on word recognition tasks when they learned the words from high similarity lists. Impulsive learners, however, did not show any significant differences in performance when learning from either a low or high similarity word list. Readance and Baldwin (1978) explored the way in which impulsive and reflective second grade children performed on the vocabulary and comprehension subtests of the Gates-MacGinitie Reading Test when phonics instruction was taught using a synthetic or analytic approach. When a synthetic approach was used, reflective children performed significantly better than impulsive children only on the vocabulary subtest. When an analytic approach was utilized, the reflective children performed significantly better only on the comprehension subtest. While the latter two studies produced changes in performance only for the reflective children further research attempting to match the instructional environment to the cognitive style of the learner is necessary.

RELATIONSHIP OF COGNITIVE STYLE AND PERFORMANCE ON MULTIPLE CHOICE TASKS

Research with the MFFT has documented the generalizability of cognitive style across similar tasks (Kagan, 1965b, 1966; Messer, 1976). The research and theory reviewed above suggest that the response contingencies in multiple choice tests would be particularly disadvantageous to impulsive children in contrast to reflective children. The task of choosing the correct response from

an array of choices on a multiple choice test means eliminating incorrect choices while withholding motor responses. This requires scanning, mediation and withholding of motor activity. These characteristics are associated with reflectivity not impulsivity. Mussen, Conger, Kagan and Huston (1984) noted that tests and their formats (i.e., multiple choice formats) can handicap impulsive children. Weithorn and her associates have questioned the content validity of these tests to the extent to which the format evokes the tendency to respond either impulsively or reflectively (Weithorn and Kagan, 1979; Weithorn, Kagan and Marcus, 1984). Hoy, Weiss, Minde and Cohen (1978) also questioned the validity of the multiple choice format with hyperactives. In their study of adolescents who had been diagnosed as hyperactive, it was found that the performance of the hyperactives was significantly poorer than that of the control group on a multiple choice spelling test, whereas previously there were no significant differences between the two groups in spelling (Douglas, 1972). In the follow up study by Hoy et al. (1978) the hyperactives' performance on a five choice format spelling test was significantly below that of the controls on a word knowledge test but the two groups did not differ on a two choice format of the word knowledge test. Again, these two groups showed no significant differences in their vocabulary skills in the earlier study (Douglas, 1972). Hoy et al. concluded that their results were probably attributable to the difficulty hyperactives have with multiple choice formats. It should be noted that the literature on hyperactivity has indicated that hyperactive children typically have short attention spans and tend to be impulsive (Connors, 1971; Douglas, 1972).

If, as Luria (1961) suggested, it is difficult for impulsive children to inhibit their motor responses, then multiple choice tests, especially tests of visual perceptual discrimination,may not be the best way of evaluating whether an impulsive child does or does not have the specific skill or knowledge being assessed. Thus, as Weithorn and Kagan (1979) note, it is interesting to speculate that a more valid way to assess a child's ability on multiple choice type tests might be to require the child to cross out all the choices that are incorrect rather than to check the one that is correct. Since the process of choosing involves the discarding of incorrect alternatives, by the examiner's test instructions, the child's scanning strategy would be guided. In addition, since the crossing out of the incorrect alternatives involves motor activity as well, then it is possible that fewer impulsive errors would result. This hypothesis was tested by Farkas (1984) with beginning kindergarten students. Although the study failed to demonstrate that altering test instructions to cross out all the incorrect choices would improve the performance of impulsive children, it did support studies indicating that reflective children achieve higher scores than impulsives on tests with high response uncertainty.

An important variable to consider when attempting to find and match the instructional methods which are most compatible with the child's cognitive style is the instructions given to the child. The importance of the instructions given to the child is best described by Wozniak:

> Soviet theory is also a theory of language function. The very variable of interest in the work reported by Luria is the effect of language on the child's behavior-the experimenter's

> language in the instructions every bit as much as the child's own language in self-vocalization. Consequently instructions to the child are necessarily of tremendous importance. They must be extraordinarily simple and clear, capable of being directly internalized; and they may necessarily require repetition on every trial. Western psychology, however, has tended to view instructions to the child as something given once at the beginning of an experiment as a means of conveying at one time all of the information the child will need for the entire procedure. Instead of simple one sentence commands, instructions often run to whole paragraphs. If direct internalization of instructions is a crucial feature of the development of verbal regulation, complex instructions given only initially might well fail to have the desired effect.
>
> (Wozniak, 1972, p. 40)

VYGOTSKY'S THEORY OF THE ZONE OF PROXIMAL DEVELOPMENT

Vygotsky (1962, 1978) was critical of Western psychologists' intelligence and achievement testing because they are static measures reflecting the end result of previous learning. These static measures, however, do not provide a sensitive estimate of the child's potential for improvement. Vygotsky was most interested in finding a good index of the child's potential for learning or what he called the zone of proximal development. He defined it as:

> the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem

solving under adult guidance or in collaboration with more capable peers.

(Vygotsky, 1978, p. 86)

He was concerned with the relationship between two levels of development. The first is the child's level of 'actual development' or the level of individual, independent functioning. The second is the child's level of 'potential development' or the level at which the child has not yet mastered the task but is able to participate in its execution with the assistance and supervision of an adult or more capable peer. Vygotsky felt that the static measures of western intelligence and achievement tests focused on where the child has been; that is, on the child's level of 'actual development', to the exclusion of the child's level of 'potential development'. He argued that what children are able to do with the assistance and guidance of others may be more indicative of their mental development than what they can do alone.

STUDIES ON THE ZONE OF PROXIMAL DEVELOPMENT AND DYNAMIC ASSESSMENT

Vygotsky (1978) differentiated between a child's performance on a static test, where the child performs independently, and the performance of that same child following some intervention. He argued that the difference between the two performances was a measure of the width of the child's zone of proximal development. Furthermore, this measure provided diagnostic information beyond that attained by a static measure. Two students who at first perform at the same level within a cognitive domain, may still differ in their ability to profit from instruction within that

domain and this additional information is instructionally relevant.

Budoff (1974) developed a series of procedures for assessing the learning potential of educably retarded youngsters. He felt that learning potential assessment instruments were more culture fair measures of ability and intelligence when it is defined as the ability to learn and profit from instruction or what he called an 'optimizing experience'. Budoff utilized a three stage procedure which included a pretest, training and a posttest. Learning potential status was defined conceptually as improvement in performance following training (gain score). Budoff noted that the pretest scores reflect the child's current functioning ability while the posttest score, after training, "represents the child's optimal level of performance following an optimizing procedure. It permits a comparison between his/her presently low level of functioning, as indicated by his IQ and his potential level of functioning." (Budoff, 1974, p. 33) Budoff found three types of children within the educably retarded children he worked with: (a) 'non-gainers' who showed little or no gain following instruction; (b) 'gainers' who showed significant gain; and (c) 'high scorers' who performed quite well on the pretest.

Feuerstein (1979) like Vygotsky (1978) noted that cognitive growth was a result of the child interacting with an adult, who guides the child's problem solving and structures the learning environment to suit the child's needs. Gradually, the child begins to structure and regulate the problem solving activities independently. Feuerstein believed that the primary reason many disadvantaged adolescents performed poorly on static measures was due to a lack of consistent mediated learning experiences. Thus, he

developed the Learning Potential Assessment Device (LPAD) which utilizes the test-train-test procedure to measure the child's current level as well as the child's potential for learning. Feuerstein and his colleagues noted that:

> The LPAD is more than a set of devices or techniques of assessment. It represents an approach that attempts to deal with the what, the why, and the how of assessment. The what, or target of LPAD assessment, is cognitive change or modifiability; the why, or purpose, is the assessment of learning potential and the identification of those factors that produce poor performance; the how, or method, is to provide structured learning experiences that permit cognitive changes to be monitored in a systematic manner.
>
> (Feuerstein, Miller, Rand and Jensen, 1981, p. 201)

Feuerstein (1979) found that youngsters showed significant improvement after brief training within the cognitive domains utilized in LPAD.

Brown and Ferrara (1985) reviewed some of the work on diagnostic testing procedures used at the Institute of Defectology in Moscow. They noted that the Soviets following Vygotsky's theory of the zone of proximal development, assess the child's starting level of competence and the level of competence the child can reach with assistance. By using graduated prompts, the Soviets are able to assess the child's speed of learning as well as the child's ability to transfer this learning across tasks. These measures provide important diagnostic information which could not be obtained from static measures alone. The Soviets found that dynamic assessment measures were quite sensitive to differences between

learning disabled, developmentally delayed and truly retarded youngsters.

Brown and her colleagues inspired by the dynamic testing methods the Soviets are using, have recently begun a series of studies examining how indices of the zone of proximal development relate to traditional IQ scores (Brown and Ferrara, 1985; Campione, Brown, Ferrara and Bryant, 1984). Brown and her colleagues are investigating the feasibility of standardizing the dynamic assessment procedures they observed in the Soviet Union.

In the studies, children are taught to solve problems (such as series completion problems or matrices problems) which require the application of certain specified sets of rules. Each problem is given to the child to solve while working independently. Prompts are then provided by the examiner as necessary, in a graduated manner. At first, subtle hints are given to the child and these hints become more explicit until finally the child may even be given the solution. The number of standardized prompts to reach a criterion of a predetermined number of independently solved problems, constitutes the index of speed of learning. Once the child reaches criterion, he or she is given a series of transfer problems with the same graduated prompting procedure. Some of the transfer problems are of the pattern types learned (maintenance) while others deviate in a systematic manner in that they are more difficult to solve (near and far transfer). (See Brown and Ferrara, 1985, pp. 287 and 292 for specific examples of series completion tasks and matrices tasks.)

The first experiments involved comparing groups of children who differed on measures of intelligence such as the Wechsler Scales

or Ravens Progressive Matrices. Ferrara, Brown and Campione (1986) compared third and fifth graders who were either of average intelligence (mean IQ score of 101) or above average intelligence (mean IQ score of 122). Using a graduated hinting procedure to support the children, the children were required to solve two types of letter series completion tasks in the first session. In subsequent sessions the children were asked to solve variations of the original patterns. This measured their ability to transfer the learning done during the first session. The results indicated that fifth graders required fewer hints than third graders to reach the criterion of solving two problems. It was also found that the children with above average IQ scores required fewer hints than the children with average IQ scores. The transfer data were of more interest. Ferrara et al. (1986) found that group differences increased as transfer distance increased.

Campione, Brown, Ferrara, Jones and Steinberg (1985) compared the performance of mildly retarded children (mean IQ score of 72) and non-retarded children (mean IQ score of 118) on matrices tasks. The groups were matched by a mental age of approximately 10.5 and they were matched on a pretest which assessed starting competence on the rules to be taught and used in the study. As in the Ferrara et al. (1986) study, the children with higher IQ scores required fewer hints during the transfer sessions. The retarded children's performance was significantly impaired during the maintenance phase while the non-retarded children required almost no hints. Novel examples were enough to disrupt the retarded children's performance. These studies indicate that as the degree of change increases from the learning phase to the transfer phase, ability related

differences also increase. Also of note, is the finding that the lower the ability of the child the smaller the change necessary in order to disrupt their performance.

Budoff (1974), Feuerstein (1979) and Vygotsky (1978) argued for the use of dynamic test procedures, whereby performance measures obtained under unassisted conditions are supplemented by measures obtained after some type of instruction had been provided. They assumed that the presence or absence of improvement is of major importance as a predictor of the child's subsequent success. To investigate this assumption, Bryant, Brown and Campione (1983) used a simplified matrices task with five year olds. They investigated which of the following measures best predicts the child's future performance within a learning domain: (a) an intelligence or achievement pretest (various subtests of the WPPSI and Ravens Progressive Matrices); (b) The learning index (number of prompts given to reach criterion); or (c) the transfer indices (number of prompts given during transfer sessions). From the test-train-test procedure, a residual gain score or an overall improvement score as a result of the training sessions was computed by measuring the difference in the amount of assistance necessary from the original learning to the amount of assistance required on the posttest following the transfer sessions.

Using a number of hierarchical multiple regression analysis, Bryant et al. (1983) found that various subtests of the WPPSI and Ravens Progressive Matrices accounted for 37% of the variance in residual gain scores. The learning index accounted for an additional 22.4% of the variance, which was a significant increment. The transfer indices accounted for another significant increment of

18.7% of the variance in residual gain scores. While the IQ measures predicted residual gain, the learning and transfer indices each accounted for significant increments in the predictability of the residual gain scores. Consistent with Vygotsky's view that measures of a student's response to instruction is more predictive than his or her performance on static achievement tests, the best predictors of the gain scores were the far transfer items, followed by the indices of near transfer and learning speed. All three indices were better predictors than the various static pretest measures. This leads to the conclusion that individual differences in learning rate and transfer ability are moreimportant predictors of how much children profit from instruction in a given learning domain than the static measures that are typically used.

SOCIAL INTERACTION

Vygotsky's theory of the zone of proximal development is not just a theory about assessment but is part of a theory of social interaction. Vygotsky' theory (1962, 1978) stresses that cognitive functioning first occurs on the social level, between people and that the child internalizes this in individual development. In other words, social interaction at the interpsychological level leads to independent problem solving at the intrapsychological level. This process of internalization is gradual. At first, the adult or peer controls and guides the child's activity because the child's understanding of the task is limited. The child and the adult then share the problem solving functions with the adult being the more active one at first. Eventually the child

takes more initiative in the situation while the adult corrects and/or guides when the child has difficulty. Finally, the adult functions more as a supportive and encouraging audience as the child assumes total control of the problem solving task. Wertsch (1979, 1984) sees this developmental progression as the essence of mother and child learning dyads.

It is within this context of the theory that Vygotsky developed the concept of the zone of proximal development. Concern with the relationship between the child's level of actual development and the child's level of potential development led to considerations of the ways in which the environment supports the optimal functioning of the child. Overton and Newman (1982) posited that competence is not a fixed characteristic of the child but an emergent one within a particular context. In other words, although the child may have the competence he or she is prevented from demonstrating this competence in his or her performance. Vygotsky's theory postulates that social interaction facilitates the realization of the child's cognitive potential.

Fischer (1980, 1983) and Bullock (1983) have elaborated on and combined Vygotsky's work with social learning theory in their theory of skill acquisition or cognitive development. In their 'optimal-level hypothesis' Fischer (1980, 1983) and Fischer and Bullock (1981) note that when a child moves to a new cognitive developmental level, the child shows an increase in his or her capacity or the upper limit of the complexity of skills the child is able to control. The child's optimal performance shows a sudden increase when he or she enters this new developmental level. The development of skills must be induced by the environment but is limited by the

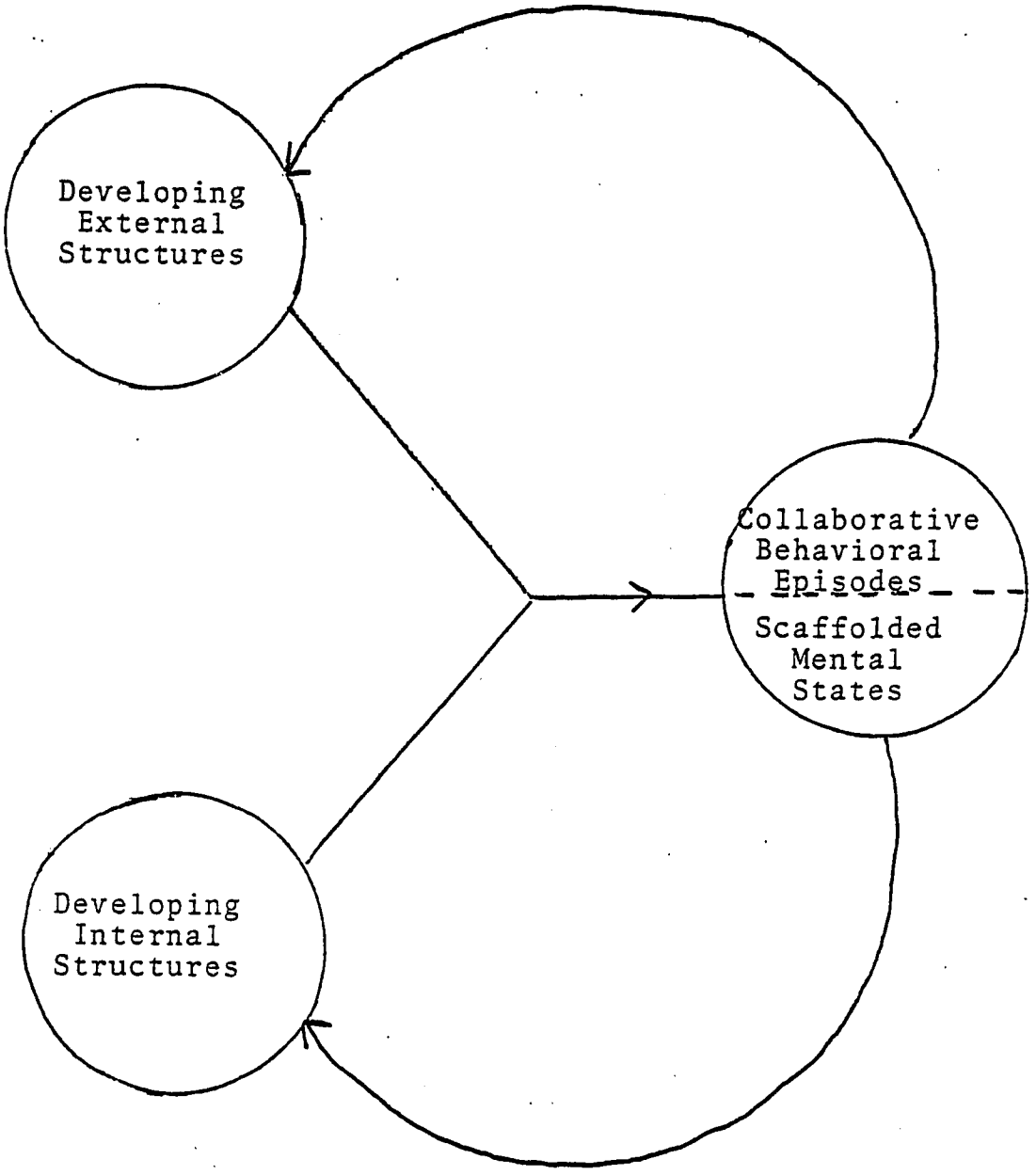
highest or optimal level at which the child is capable of functioning. As the child develops, the child's highest level increases, and therefore, the child can be induced to extend these skills to the higher level. Bullock (1983) argues further that social support induces the child to perform beyond the highest capabilities that the child can demonstrate when performing unassisted. The child alone should not be characterized as possessing a developmental level. Rather he feels some particular combination of the child and the child's environment determines the level.

Collaborative Cycle

Fischer and Bullock (1984) see cognitive development as a collaborative cycle whereby two individuals come together to solve a problem and neither one has all the elements that eventually will be in the solution (See Figure 1). During their collaboration, each individual's behavior supports the other's behavior and thought in ways that would not have been taken by either one alone. Eventually, a solution emerges which has elements of each individual but did not exist in either one prior to their collaboration, nor would it have emerged without the collaboration.

In Figure 1, the two left circles represent structures that are external to one individual and internal to another individual. For matching task with his or her teacher. The teacher provides the child with the external structures in order to support the child's problem solving by either stating the goal of the task, giving the child verbal hints, pointing to specific features of the stimulus

FIGURE 1. Development schematized as a collaborative cycle



Taken from Fischer and Bullock, 1984, p.88

example, imagine a child attempting a multiple choice visual and the variants in order to show how they are alike or different, or by showing the child how each choice was eliminated leaving only the correct answer. The child's knowledge and abilities for doing the visual matching multiple choice task comprise the child's developing internal structures.

The behavioral episodes in the right circle are produced by the collaboration of these external and internal structures. The child and teacher work at solving the problem and due to the collaborative process, the child is able to achieve a scaffolded mental state, which he or she could not have achieved as quickly or in the same way had the child worked on the problem independently.

The feedback arrows running from the right circle to the left circles show the dependence of developmental change on collaboration. Due to the scaffolded or supported interaction between the teacher and child, the child eventually learns to solve the task unassisted. In this way, the child develops a higher internal structure and thus is less dependent on the external structures provided by the teacher. This developmental process is gradual and the teacher is constantly updating his/her scaffolding based on the cues given by the child. The teacher's scaffolding is fitted to the child's present knowledge and skill and as the child develops a higher structure, the teacher provides less scaffolding. Thus, developmental change occurs both inside the child and outside the child.

Fischer and Bullock (1984) distinguish between two processes in the collaborative cycle. When the emphasis is on the joint contribution of the two individuals, the process is called

coregulation. When the emphasis is on the role of the teacher, parent, expert or any other person who is supporting and advancing the child's behavior the process is called scaffolding. For the purposes of this research, we are primarily concerned with scaffolding.

Scaffolding

Wood, Bruner and Ross (1976) developed the notion of scaffolding, a process whereby an adult or more capable peer provides support to a child's learning to solve a problem. In their study of the role of tutoring in problem solving, Wood et al. (1976) found that the intervention of a tutor involves much more than modeling and imitation. Tutoring involves a kind of scaffolding process whereby the child is enabled to solve a problem or carry out a task which was beyond the child's reach when working alone. The scaffolding process involves the adult or more capable peer as an activator who controls those elements of the task that are initially beyond the child's capacity. Scaffolding allows the child to concentrate and complete only those elements of the task that are within his or her abilities. This results, eventually, in the development of task competence by the child at a pace that is much faster than if the child worked unassisted.

The adult facilitates the child's learning by regulating the difficulty of the task. The adult does this by segmenting the tasks into manageable subgoals. This requires sensitivity to the child's ability level in the particular task. During the problem solving, the adult's involvement is fitted to the child's ability and scaffolding is provided so that the child continues to participate

at a comfortable yet challenging level (Rogoff, Malkin and Gilbride, 1984; Wertsch, 1984).

Griffin and Cole (1984) note that the changes in the adult support reported in scaffolding research point to qualitatively distinct kinds of support. Sometimes, the adult focuses the child's attention, while at other times, he or she breaks down the task to more manageable limits. At still other times, the adult's role in this collaborative process may be to encourage the child or to be the child's silent audience. Feuerstein and Jensen (1980) called this process, mediated learning experience. They defined it in the following manner:

> MLE (mediated learning experience) is what takes place when an imitated human being, a mother, father or other caregiving adult, interposes himself or herself between the organism and the stimuli impinging on it and mediates, transforms, reorders, organizes, groups, and frames the stimuli in the direction of some specifically intended goal and purpose. The mediating person transmits with the stimuli certain specific meanings by virtue of selecting some stimuli, making them salient as compared with others, and making certain stimuli accessible to the organism in a repetitive, reinforced way as compared to others which are ruled out and rendered dim.
>
> (Feuerstein and Jensen, 1980, p. 409)

Another way in which scaffolding can be provided is proposed by Rogoff et al. (1984). They suggest that the adult make the messages redundant, so that if the child is unable to understand the

instructions, another form of instruction is available in order to make the message clear. As the child develops better understanding of the task, the level of redundancy can be reduced and in this way the level of scaffolding is adjusted to fit the child's needs and abilities. This is much like Wozniak's (1972) position regarding the need to repeat test instructions when they are not internalized immediately.

A most important point is that the scaffolding or support given by the adult must maintain the social interaction within the learner's zone of proximal development. The child should be challenged to some degree by being induced to perform, with support, at a more advanced level than the child's current level. The transition is gradual and the child is not asked to perform without support until the child is ready.

During the collaboration of the adult and child in the child's zone of proximal development, the adult has the responsibility for breaking down the task into managable subgoals and for changing the child's understanding of the task to become more like the adult's understanding. Through their collaboration in this scaffolded situation, the child's skills and knowledge of what is to be done go to a more advanced level which is closer to that of the supportive adult. In other words, the adult facilitates the child's learning by regulating the level of activity the child participates in.

Guided Reinvention

Fischer and Bullock (1984) use the term guided reinvention to explain the process which takes the child to a higher cognitive level during the collaborative process. In guided reinvention the

child and adult share an understanding of the task in which they are collaborating. The adult's scaffolding takes that understanding as a take off point while cueing into contextual restraints and developmental constraints. The child works to discover the relevance of the adult's support to his own goals while the adult tries to insure that what he is doing is relevant to the child's activity in a way that the child can discover and understand. It is this shared understanding over long periods of interaction which leads to rapid development.

The most intensive research on social interaction in the natural setting has been in the field of language development (Brown, 1980; Bruner, 1982; Cross, 1977; Swensen, 1983). Most of this research involved preschoolers and their mothers. Normal language development depends on social-cognitive coordination between the child and someone who while interacting with the child, uses language in a contextually appropriate manner. There is evidence that a very high degree of social-cognitive coordination accelerates language development (Cross, 1977; Swensen, 1983). Fischer and Bullock (1984) called this embedded teaching, "elaborative and corrective acts embedded in the flow of joint goal directed activity". (p. 116)

A number of other cognitive processes in individual functioning appear to be facilitated by social guidance, among them: (a) number repreproduction (Saxe, Gearhart and Guberman, 1984); (b) reading (Cazden, 1979); (c) problem solving (Wertsch, 1979); (d) series completion and matrices tasks (Brown and Ferrara, 1985) and (e) maintaining joint attention in four month old children (Rogoff et al., 1984).

SUMMARY

Social interaction theory focuses on the collaboration of the child and his environment. The child is viewed as acting in a particular context that supports the child's behavior to different degrees. A result of this focus on the collaborative process is that the concepts of ability and competence are changed. They are viewed, not as fixed characteristics of the child but as emergent characteristics of the child in a particular context. In other words, the child does not have any true competence independent of a particular context but competence varies with the degree of support in that context. Thus, children who are impulsive or reflective, perform within contexts in relation to the degree of support they are provided. Fischer and Bullock (1984) note that the difficulty children sometimes have in the transition from learning from mother to school learning is often due to the failure of the schools to adapt to the child's needs and abilities.

Focusing on the collaboration of the child and his or her environment leads to questions such as: (1) How does context support or fail to support a child's optimal performance that is within the child's reach? (2) How do specific collaborative systems support the acquisition of particular skills in different contexts?

The specific context which is the focus of this research, involves the performance of impulsive children on multiple choice format tests. Research has shown that cognitive style generalizes across similar tasks (Kagan, 1966). Thus, children with an impulsive cognitive style are particularly disadvantaged by multiple choice formats. The validity of tests with these formats (e.g., group IQ tests and most achievement tests) is impaired to the extent

that these formats evoke the tendency to respond either impulsively or reflectively.

The focus of previous research has been to modify the impulsive cognitive style to become more reflective. While various techniques have shown the ability to increase response times, errors were not always reduced. Readance and Bean (1978) suggest an alternate route. Rather than change the child they suggest modifying the environment. Social interaction theory says we should not focus primarily on either the child or the environment but instead we must focus on the collaboration of the child with his environment. As Bullock (1983) notes, social support induces the child to perform beyond the highest capabilities that the child could demonstrate when working without assistance. With scaffolding being provided to the more impulsive child, the child will eventually be able to perform the task without assistance.

This research investigates how instruction can best support the child's cognitive style on multiple choice tasks requiring visual discrimination, so that all groups, regardless of cognitive style, function at their optimal level. This research explores how instruction can best support impulsive children's performance on a multiple choice matching task so that these children are able to demonstrate their competence and skill in that learning domain. This research examines the difference between children's performance on a multiple choice matching task when given minimal support and when given higher levels of support. This research also seeks to extend the research of Brown and her associates regarding the dynamic assessment of learning potential to another cognitive domain. Finally, this research examines whether dynamic measures of

learning potential are more predictive of future performance than static measures.

RESEARCH HYPOTHESES

Hypotheses 1 and 2 test the effect of scaffolding (high support vs. low support) on the performance of children with varying cognitive styles. Hypothesis 3, concerns the effect of cognitive style on learning rate. Hypotheses 4-6 concern the predictability of learning potential (dynamic) measures and static measures on the future performance of children on a multiple choice visual matching task.

1. At high levels of MFFT pretest scores, there will be no difference in MFFT posttest scores between high and low support conditions.
2. At low MFFT pretest levels, children in the high support group will have higher MFFT posttest scores than children in the low support group.
3. As MFFT pretest scores increase, children will require fewer prompts in order to reach criterion of three problems solved correctly without assistance; thus, learning rate score will increase as MFFT pretest score decreases.
4. Learning rate scores will be more predictive of MFFT posttest scores over and above MFFT pretest scores and IQ scores.
5. For the high support group, dynamic maintenance scores will be predictive of MFFT posttest scores over and above MFFT pretest scores and IQ scores.
6. Dynamic maintenance scores for the high support group will be more predictive of MFFT posttest scores than static maintenance

scores for low support group when IQ and MFFT pretest scores are controlled.

CHAPTER III

METHODOLOGY

SUBJECTS

The subjects of this study consisted of 65 children from three kindergarten classes in an elementary school in a predominantly white, multiethnic, suburban residential community in Nassau county, N.Y. The data of three children were omitted from the analyses due to their failure to reach the learning criterion within two forty five minute sessions. Thus, the sample analyzed consists of 62 kindergarteners, of which 34 are boys and 28 are girls. The children ranged in age from 4 years, 10 months to 5 years, 11 months (M = 5yrs, 3.5 months; SD = 3.9 months).

MATERIALS

VKT - Vane Kindergarten Test

The Vane Kindergarten Test (VKT) was developed by Vane (1968) in order to assess the intellectual and academic potential of young children. The VKT is made up of three subtests, a perceptual motor subtest, a draw-a-man subtest and a vocabulary subtest. On the perceptual motor subtest, the child is asked to copy three designs three times each. The draw-a-man subtest requires the child to draw a picture of a man. These two subtests can be group administered. The vocabulary subtest, which is individually administered, requires the child to tell the examiner what eleven words mean.

MFFT - Matching Familiar Figures Test

The MFFT developed by Kagan (1965d) has different forms for school age children and adults. This investigation utilized the elementary school version. The format of the test involves the simultaneous presentation of a figure (i.e. a boat, a telephone) with 6 facsimiles, five of them differing in one or more details and only one of which is exactly the same as the stimulus figure. On each of the 12 items on the test, the subject is asked to select from the 6 alternatives the one that exactly matches the standard. If the choice is incorrect, the child is asked to choose again until the child either chooses correctly or makes 5 incorrect choices. Latency is computed as the mean reaction times to the first responses. Errors are the total number of errors summed across all items.

TRAINING MATERIALS AND PROBLEMS TO BE USED FOR PRE, POST AND MAINTENANCE TESTING

Four additional problems similar to the MFFT problems were utilized during the MFFT pretest and four others during the MFFT posttest. These problems were developed by this author and are like the MFFT in that there is a stimulus item and six facsimiles, only one of which is exactly the same as the stimulus. In order to use the 8 items which have the best reliability, 38 problems from a pool of 75, were piloted on 20 kindergarten children. The 8 items chosen for the pre and post tests had a corrected item-total correlation ranging from .3446 to .6088, with the average difficulty level at .5047. Using the same item analysis procedure, 12 other problems were chosen for the maintenance or treatment conditions phase of the study. The corrected item-total correlation for these 12 problems

ranged from .3232 to .7776 and the average difficulty level was .4695. Items which were found to be very easy (> .90 item difficulty) during the pilot research were used during the training and maintenance phases for motivational purposes but they were not scored. Like the MFFT, the training and testing material is in a booklet form of 11 x 8 1/2 white laminated paper. The stimulus item is on the top sheet while the six facsimiles are on the bottom sheet. The training material differs from the MFFT in that it does not only use familiar figures but also includes shapes and combinations of letters much like those found on the Metropolitan Readiness Test and Marianne Frostig's Developmental Program in Visual Perception (Frostig and Horne, 1972).

PROCEDURE

Pretests	Training	Maintenance	Posttests
All subjects administered VKT (IQ) & MFFT (IRI)	All subjects receive graduated prompts until they reach criterion (learning rate)	Group 1 (High Support) receives graduated prompts (# of prompts) (dynamic maintenance)	All subjects administered MFFT (IRI)
		Group II (Low Support) no prompts given (# of errors) (static maintenance)	

The study was run in four phases: pre-tests, training, treatment conditions (high support vs. minimal support) and post-tests. All of the test and training sessions occurred in the children's school building. Most of the tests and all of the

training sessions were done individually and in the same place (just outside of the child's own classroom). Two subtests of the pretests were administered to each class in their own classroom in a group format.

Preceding the pretests, subjects were assigned to one of two treatment conditions. Random assignment was assured by listing all students alphabetically and assigning each a number from 1 through 65. All odd numbered children were assigned to one group while all even numbered children were assigned to the other group.

Pretests

All subjects were administered two static pretests, the VKT and the MFFT. These tests provided a basis for equating the children according to their initial level of ability. All of the children were given the perceptual motor and draw-a-man subtests of the VKT as a group within their own classroom. This was done first so that the children would be familiar with the examiners when the examiners administered the subsequent test and training sessions individually. The vocabulary subtest of the VKT was administered next along with the MFFT to each child individually. The VKT subtests were administered in the standardized manner as provided in the VKT manual (Vane, 1968).

The VKT provides IQ scores for each of the three subtests, as well as a total IQ score. The total IQ score was the measure used in this study. This test was chosen due to practical considerations, specifically the ease of administration and the short amount of time needed to administer the test. In this way, the children did not have to undergo prolonged periods of testing

and miss classroom time. The two group administered subtests required about 20 minutes while the vocabulary subtest was administered within 5 minutes.

The six odd numbered MFFT items and four additional similar items were administered individually immediately following the administration of the vocabulary subtest of the VKT. This pretest provided a static measure on the criterion task itself, which is a multiple choice visual matching task. The MFFT also served to categorize the children as either impulsive or reflective.

The MFFT was administered as per the directions in the MFFT booklet (Kagan, 1965d). The examiner said to the children, "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 pictures on this bottom page (point) that is just like the one on this top page (point). Let's do some for practice." The examiner then showed the child the two practice items and helped the child find the correct answer if necessary. Then the examiner said, "Now we are going to do some that are a 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."

If the subject's first response was correct, the subject was told, "That's right." If the subject's response was incorrect, the examiner said, "No, that is not the right one. Find the one that is just like this one (point to top page)." The subject continued to choose until he/she pointed to the correct picture or made a maximum of six errors. At that time, the examiner showed the child the correct answer. The MFFT usually takes between 5 and 10 minutes per child. In order to be able to use a multiple regression

analysis, an impulsivity-reflectivity index (IRI) similar to the one used by Bentler and McClain (1976) was computed by transforming response times and errors into T scores. The distribution of the standard scores for errors was inverted so that higher scores signified fewer errors. Afterwards, standard scores for response times and errors were summed together to form the IRI.

Training

Due to the difficulty the kindergarten children had thinking out loud during the pilot research, each of the three kindergarten classes received a group lesson (approximately 30 minutes) showing them how to think out loud while solving the visual-matching problems. The lesson consisted of the examiner showing the children 4 visual matching problems with a stimulus picture on top of the chalkboard and 6 facsimiles on the bottom of the chalkboard with only one of the choices being exactly like the stimulus picture on top. The examiner modeled the first picture (of a face) by pointing to each of the 6 choices and telling the children if the 6 choices looked like the top picture. For the 5 choices that were different than the top picture, the examiner showed the children how the choice differed from the stimulus picture. The examiner then asked the children to think out loud just as the examiner had done. Several children then went up to the chalkboard and pointed to each of the 6 choices and told the class whether the choice was just like the picture on top or not and why not. If the child had some difficulty verbalizing aloud, the examiner helped by pointing at the picture and asking if that choice looked like the top one or not. This was repeated as necessary through the 6 choices. Three other

examples were used so that all the children had a chance to go up to the chalkboard and try thinking out loud while solving the problem. If the child did not want to go up to the chalkboard, the examiner asked again if they would try and added that he would help the child. However, if the child refused, the child did not go to the chalkboard. The lesson was presented after the pretests and prior to the training phase.

During the second phase of the study, the children were told that they were going to do some more problems where they would have to find the picture that looks just like the top picture. All children received the pictures in the same fixed random order. Several easy problems (> .90 item difficulty level) were used for motivational purposes but not scored. The children were also told that they would be given hints if they needed it to help them solve the problems, but that they should try to do the problems with as little help as possible. The children were also asked and encouraged periodically during the training session (as was necessary) to think aloud while they were working on the problem. All children were shown by the examiner how to think out loud while solving the problem. The first problem which was modeled was matching a picture of a hammer (see appendix A). The examiner said:

> Let me see which one looks just like this one (examiner points to top page). Can it be this one (examiner points to number 1)? No, this one (examiner pointing to number 1) is all black with two white lines on it and the top one (examiner points to top page) is all white with two black lines on the handle. Can it be this one (examiner points to number 2)? (Examiner pauses 2-3 seconds) No, it can't

be this one (examiner points to number 2) because the head of the hammer (examiner points to head of hammer on number 2) is pointing in the opposite direction. The top one is facing the left side of the paper and this one (examiner points to number 2) is facing the right side of the page. Can it be this one (examiner points to number 3)? (After pausing 2-3 seconds) This one could be it, it looks just like the one on top, but before I give my answer, let me look at the others to make sure it's not one of them (examiner points to bottom 3 pictures). It's not this one (examiner points to number 4) because the lines on the handle are slanted down and the top one has lines that are straight across. It's not this one (examiner points to number 5) because this one has three lines on it. Let's look at the last one. I don't think it's this one because the top is different. This one (examiner points to number 6) is round on the end and the top one is pointy on the end. So, it has to be this one (examiner points to number 3).

After the examiner modeled the first problem for the children, a second sample problem was shown and the children were asked to think aloud as the examiner had just done. If they did not verbalize, the examiner asked them to point to each of the six choices and tell aloud why each choice was or was not like the stimulus picture. If the child still did not verbalize aloud, the examiner pointed to the first choice and asked the child, "Does this one look just like the one on top?" If the child said, "No", the examiner asked the child to "tell me why it does not look just like the picture on top. Tell

me how is it different than the one on top." This process of pointing to the choices and asking the child to tell the examiner how the choice was different than the top picture, continued through the six choices as was necessary. After the second sample, the children were told to go about the task in the same manner when solving the rest of the problems. In addition, the children were told to take their time and look closely at all the choices before choosing. The child then attempted to solve the first problem.

The hints were given one at a time in a graduated manner (see Appendix B). The hints began with general prompts which basically redefined the task such as:

> Take your time and look at all the different parts of the picture (examiner points to top picture) and then look carefully at each of these other pictures (examiner points to bottom page). Only one of these (examiner points to bottom page) looks exactly like this one (examiner points to top page). The others have one part of the picture that is different than the top one (examiner points to top page).

The hints then oriented the child to the different features of the picture, such as:

> Look at the table (examiner points to table on top page) carefully. Now look at the chair on this side (examiner points to chair on top page) and bed on the other side. Now look down here (examiner points to bottom page) to find the picture that looks just like this top one (examiner points to top page).

Finally, the hints became more specific and oriented the child to

specific features of the picture, such as:

> Look at the chair next to the table with the dot (examiner points to top picture). You see the chair is on the left side (examiner points to chair on top picture) and the chair is facing the table so that if you were sitting on the chair, you would be looking at the table. Find the picture down here (examiner points to bottom page) that is just like this one (examiner points to top page).

If the child responded quickly and incorrectly, the examiner provided the child with a general prompt which redefined the task (e.g. Appendix B, hint 1). The same kind of general prompt was given if the child eliminated only one or two of the choices and then quickly responded before looking at the other choices (as noted by their verbalizations and lack of scanning of the other choices). However, if the child eliminated several choices and had studied all the choices (as noted by verbalizations and scanning of the 6 choices) and then chose incorrectly, a prompt that oriented the child to the different features of the picture was given.

If, after two minutes, the child appeared to be making little progress as determined by his/her verbalizations while thinking aloud (e.g. saying "I don't know this one", "This is too hard", or "I'm stuck") and/or not making a choice, the examiner provided the child with a hint that oriented the child to the various features of the stimulus picture. (e.g. Appendix B, hint 2).

If the child pointed or chose before the hint was given or completed by the examiner, the examiner instructed the child to wait until the examiner had finished giving him/her some help before he/she chooses. Once the hint was given, the child's choice after

the hint was given was recorded.

If the child committed five errors before choosing correctly or had not chosen the correct one after six errors, the examiner gave the child the correct answer and showed the child how each choice was eliminated by being different than the stimulus picture.

If the child did not appear to understand one of the hints, it was rephrased (e.g. Appendix B, hint 1a for hint 1). If a child prompted him/herself, while verbalizing aloud, the examiner did not give that prompt in the sequence but gave the next prompt instead. Training continued until the child solved three successive problems independently on the first attempt.

The experimenter recorded the hints that were provided. The hints were assigned increased values as they were provided. The first prompt was scored as '1', the second was scored as '2', and so on. The sum of these scores was the dynamic measure of the child's learning rate.

Experimental Conditions

Preceding the pretests, the children were assigned to one of two treatment groups. The subjects were assigned randomly. One group was given high levels of support while the other group was given minimal support. This phase of the study assessed maintenance in the manner done by Bryant et al. (1983) and Ferrara et al. (1986). The maintenance phase was done on the day following the training session for each child unless the child was absent or other unforseen scheduling difficulties occurred.

Each group received the same 12 problems. Two very easy problems (> .90 item difficulty) were administered but not scored.

One was towards the beginning and the other towards the end. These two problems were used for motivational purposes.

High Support (Group I)

The group receiving high levels of support to assess maintenance, was given graduated prompts as was done during the training phase. The subjects were also encouraged to think out loud. The problems were presented in a fixed random order in booklet form, as was done during the training session. The problems were similar as well and the scoring procedure was the same. This score constituted the dynamic measure of maintenance.

Minimal Support (Group II)

The group receiving minimal support was presented the same booklet of problems as the high support group. However, this group did not receive graduated hints nor were they encouraged to think out loud. Instead, the problems were administered in the same way that the MFFT was administered during the pretest. The total number of errors constitued the static measure of maintenance.

Post-tests

On the day following the maintenance or treatment conditions phase, the post-test was administered. The post-test consisted of the six even numbered MFFT items and four additional similar problems administered with the same directions and procedures as was done during the pretest.

CHAPTER IV

RESULTS

This chapter presents the findings related to the testing of seven hypotheses. Multiple regression analysis was the statistical procedure used to test the seven hypotheses stated in this study. The determinants of the MFFT posttest scores included support conditions, MFFT pretest scores, IQ, learning rate, and maintenance scores. Multiple regression analysis was used to examine the separate and combined contribution of one or more independent variables on a dependent variable and to test interaction (Pedhazur, 1982). The test procedure was used to examine the changes in R^2 using the contribution of a series of variables to a dependent variable. A total R^2 was calculated and then the change in the R^2 accounted for by each independent variable to the dependent variable was calculated in the order in which they were entered into the regression equation. The order in which the independent variables were entered into the regression equation is listed in their respective tables from top to bottom.

HYPOTHESIS TESTING

Hypotheses 1 and 2 examined the effect of scaffolding (high support vs. low support) on the performance of children with varying cognitive styles. Hypothesis 3 sought to determine the effect of

children's cognitive style on learning rate. Hypotheses 4-6 predicted the effect of dynamic measures and static measures on the future performance of children on a multiple choice visual matching task.

Table 1 presents the means and standard deviations of the independent and dependent variables used in the multiple regression procedure. Although the high support group had higher observed mean scores on IQ, MFFT pretest and MFFT posttest than the low support group, these differences were not significant.

HYPOTHESES 1 and 2 PREDICT:

(1) At high levels of MFFT pretest scores, there will be no difference in MFFT posttest scores between high and low support conditions.
(2) At low MFFT pretest levels children in the high support group will have higher MFFT posttest scores than children in the low support group.

Table 2 summarizes the results of multiple regression analysis testing the effects of support condition (Group), MFFT pretest and IQ on MFFT posttest scores. The combined contribution of the foregoing independent variables accounted for 34.5% of the variance in MFFT posttest scores. There was no significant interaction between treatment (high support vs. low support) and MFFT pretest scores for MFFT posttest scores. In addition, there was no significant interaction between support condition and IQ for MFFT posttest. The results indicate that Hypothesis 1 was not supported since at high levels of the MFFT pretest scores, children in the

Table 1

Means and Standard Deviations for IQ, MFFT Pretest and MFFT Posttest Scores
(N = 62)

Variable	High Support (n = 31)	Low Support (n =31)
IQ		
M	109.35	108.26
SD	12.15	11.94
MFFT Pretest		
M	102.35	97.66
SD	18.52	16.13
MFFT Posttest		
M	104.05	95.94
SD	18.81	17.48

Table 2

Mutiple Regression Analyses of MFFT Posttest on Group, MFFT Pretest and IQ
(N = 62)

Source	DF	SS	R^2 change	B	Beta	F
MFFT Pretest	1	2017.3215	.0970	.5555	.5229	8.2856**
IQ	1	708.3040	.0340	.4446	.2878	2.9092
Group	1	322.8062	.0155	44.1079	1.2039	1.3258
Group x MFFT pretest	1	278.0579	.0134	-.2688	-.7743	1.1421
Group x IQ	1	21.2259	.0010	-.1058	-.3190	.0872

Constant = -6.4369

ANOVA	DF	SS	MS	F
Regression	5	7170.9449	1434.1890	5.8905***
Residual	56	13634.5145	243.4735	

R^2 = .3447

**p <.01

***p <.001

high support group had higher MFFT posttest scores than children in the low support group. Hypothesis 2 was not supported, since at low levels of the MFFT pretest, the difference in the scores between children in the high and low support groups on the MFFT posttest remained the same. Figure 2 shows that children in the high support group consistently performed better than the children in the low support group at all levels of MFFT pretest scores. The parallel regression lines representing the support groups suggest that at all levels of the MFFT pretest scores, children in the high support group had MFFT posttest scores that were higher by the same amount than children in the low support group.

In addition, the results indicate that there was no significant main effect for either support condition (Group) or IQ. There was a significant main effect for MFFT pretest scores, F (1,56) = 8.2856, p <.01. MFFT pretest scores accounted for 10% of the variance in MFFT posttest scores. Support condition accounted for less than 2% of the variance in MFFT posttest scores, while IQ accounted for about 3% of the variance in MFFT posttest scores.

HYPOTHESIS 3 PREDICTS:

(3) As MFFT pretest scores increase, children will require fewer prompts in order to reach criterion of three problems solved correctly without assistance; thus, learning rate score will increase as MFFT pretest score decreases.

Table 3 presents the zero order correlations for the relationships among the major variables used in this study. The zero order correlation, presented on Table 3, provide evidence to

Figure 2

Relationship between Support Groups and MFFT Pretest for the MFFT Posttest

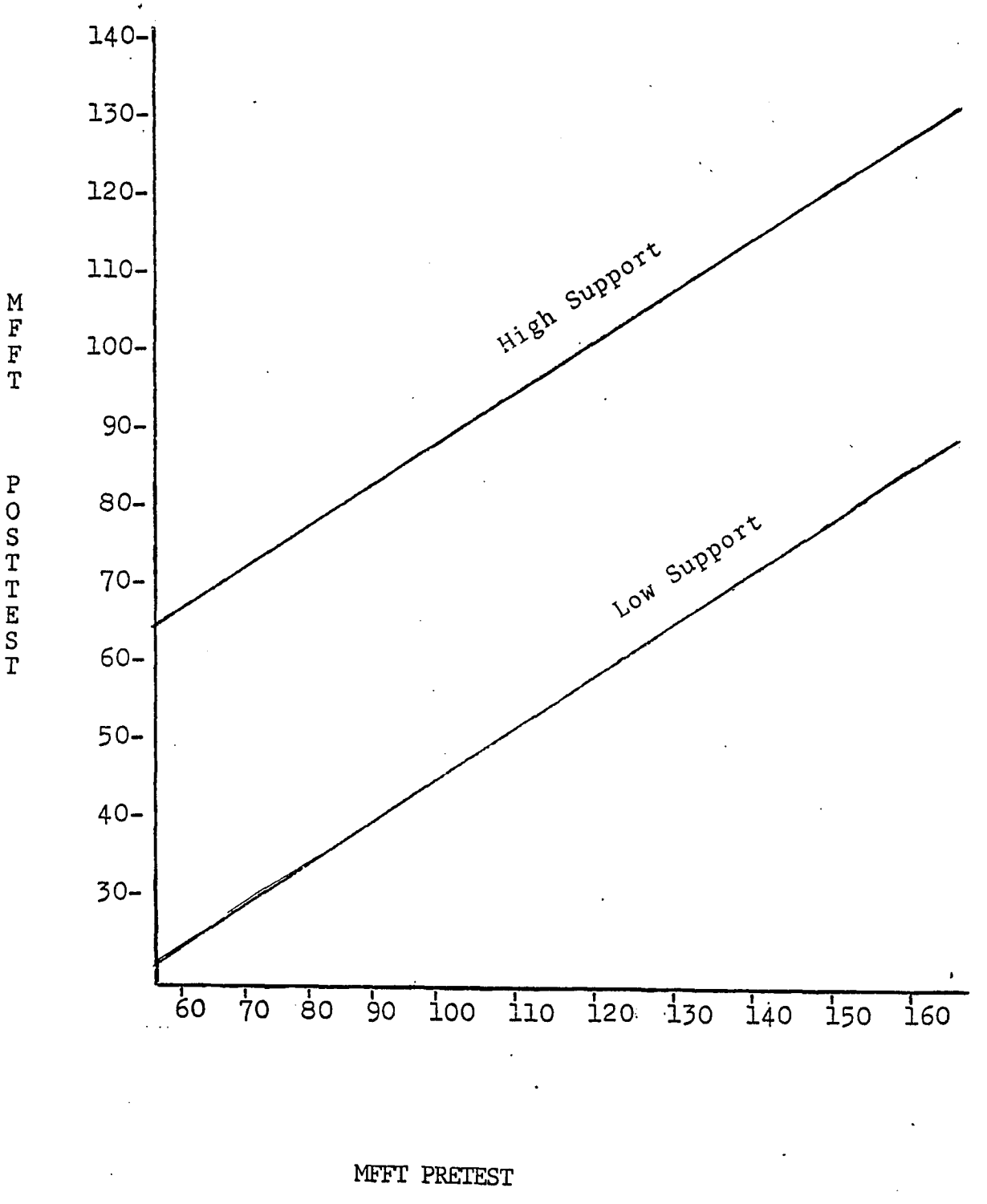


Table 3
Intercorrelations among Independent and Dependent Variables

Total Group (N = 62)

Variable	2	3	4	5
1. Group	.136	.046	-.199	.222*
2. MFFT Pretest	-	.350**	-.381***	.490***
3. IQ		-	-.473***	.402***
4. Learning Rate			-	-.718***
5. MFFT Posttest				-

High Support Group (n = 31)

Variable	2	3	4
1. MFFT Pretest	.302*	-.284	.348*
2. IQ	-	-.452**	.304*
3. Dynamic Maintenance		-	-.747***
4. MFFT Posttest			-

Low Support Group (n = 31)

Variable	2	3	4
1. MFFT Pretest	.402*	-.575***	-.635***
2. IQ	-	-.594***	.510**
3. Static Maintenance		-	-.638***
4. MFFT Posttest			-

*p <.05

**p <.01

***p <.001

support Hypothesis 3. That is, there was a significant relationship between MFFT pretest scores and learning rate, $r = -.381$, $p < .001$. This relationship indicates that 14% of the variance in learning rate scores may be explained by MFFT pretest scores. This finding suggests that children with higher MFFT pretest scores required fewer prompts to reach criterion producing lower learning rate scores than children with lower MFFT pretest scores.

HYPOTHESIS 4:

(4) Learning rate scores will be predictive of MFFT posttest scores over and above MFFT pretest scores and IQ scores.

Table 4 summarizes the results of multiple regression analysis of MFFT posttest scores on learning rate scores, IQ and MFFT pretest scores. This table provides evidence to support Hypothesis 4. The independent variables explained 57% of the variance in MFFT posttest scores. As predicted, learning rate was the best predictor of MFFT posttest scores, $F\ (1,58) = 36.6502$, $p < .001$, explaining 27% of the variance in MFFT posttest scores. MFFT pretest scores accounted for 5% of the variance in MFFT posttest scores, which was significant, $F\ (1,58) = 6.8284$, $p < .01$. However, IQ was not a significant predictor of MFFT posttest scores, and explained less than 1% of the variance.

Further explanation of the findings are provided on Table 3. Table 3 indicates that the zero order correlation between learning rate and MFFT posttest scores was significant, $r = -.718$, $p < .001$. The strength and direction of the relationship indicated that the lower the learning rate score (fewer prompts to reach criterion), the higher was the child's MFFT posttest score.

Table 4

Mutiple Regression Analysis Comparing Learning Rate, IQ and MFFT Pretest Scores as Predictors of MFFT Posttest Scores (N = 62)

Source	DF	SS	R^2 change	B	Beta	F
MFFT Pretest	1	1049.8038	.0505	.2639	.2484	6.8284**
IQ	1	9.8533	.0005	.0390	.0253	.0641
Learning Rate	1	5634.6075	.2708	-.2339	-.6119	36.6502***

Constant = 79.6464

ANOVA	DF	SS	MS	F
Regression	3	11888.5226	3962.8409	25.7762***
Residual	58	8916.9368	153.7403	

R^2 = .57141

**p ≤.01

***p <.001

HYPOTHESIS 5 PREDICTS:

(5) For the high support group, dynamic maintenance scores will be predictive of MFFT posttest scores over and above MFFT pretest scores and IQ scores.

The results of multiple regression analysis, shown in Table 5, indicate that MFFT pretest scores, IQ, and dynamic maintenance scores accounted for 58% of the variance in MFFT posttest scores for the high support group. The dynamic maintenance scores were more predictive of MFFT posttest scores over and above MFFT pretest scores and IQ among children in the high support group, providing evidence to support Hypothesis 5. Of the three independent variables, only the dynamic maintenance scores made a significant contribution to the MFFT posttest scores, F (1, 27) = 27.105, $p < .001$. Specifically, dynamic maintenance scores explained 42% of the variance compared to 2% of the variance for MFFT pretest scores and less than 1% for IQ in MFFT posttest scores among children in the high support group.

HYPOTHESIS 6:

(6) Dynamic maintenance scores for high support group will be more predictive of MFFT posttest scores than static maintenance scores for low support group when IQ and MFFT pretest scores are controlled.

The results of multiple regression analysis provide evidence to support Hypothesis 6. Tables 5 and 6 present the results of data analysis for the high and low support groups, respectively. Overall, the foregoing tables indicate that dynamic maintenance scores more than either static

Table 5

Multiple Regression Analysis Comparing IQ, MFFT Pretest and Dynamic Maintenance as Predictors of MFFT Posttest Scores for the High Support Group (N = 31)

Source	DF	SS	R^2 change	B	Beta	F
MFFT Pretest	1	246.8087	.0233	.1649	.1624	1.5064
IQ	1	49.1036	.0046	-.1206	-.0779	.2997
Dynamic Maintenance	1	4440.9156	.4184	-.8861	-.7363	27.1046***

Constant = 116.6263

ANOVA	DF	SS	MS	F
Regression	3	6190.7057	2063.5659	12.5948***
Residual	27	4423.7711	163.8434	

$R^2 = .5832$

***$p < .001$

Table 6

Multiple Regression Analysis Comparing IQ, MFFT Pretest and Static Maintenance as Predictors of MFFT Posttest Scores for the Low Support Group (N = 31)

Source	DF	SS	R^2 change	B	Beta	F
MFFT Pretest	1	900.6021	.0982	.4170	.3847	5.6641*
IQ	1	162.2750	.0177	.2431	.1660	1.0206
Static Maintenance	1	476.7786	.0520	-.5562	-.3184	2.9986

Constant = 39.8360

ANOVA	DF	SS	MS	F
Regression	3	4876.9243	1625.6414	10.2240***
Residual	27	4293.0493	159.0018	

R^2 = .5318

*$p \leq .05$

***$p < .001$

maintenance, IQ or MFFT pretest scores was the best predictor of MFFT posttest scores. For the high support group, Table 5 indicates that dynamic maintenance accounted for 42% of the variance in the MFFT posttest scores, while MFFT pretest scores and IQ accounted for less than 2% and 1% of the variance in MFFT posttest scores, respectively. With respect to the low support group, Table 6 indicates that static maintenance explained 5% of the variance in MFFT posttest scores. This finding was not significant ($p > .05$). MFFT pretest scores made a significant contribution F (1, 27) = 5.6641, $p < .01$, to MFFT posttest scores, accounting for 10% of the explained variance in the total solution.

ADDITIONAL FINDINGS:

Although no hypotheses were stated, multiple regression analysis was performed in order to examine how well pretest errors and pretest response times were able to predict posttest errors and posttest response times respectively, when compared to other static measures (i.e., IQ and static maintenance), as well as dynamic measures (i.e., learning rate and dynamic maintenance). This analysis was performed to provide information about the components of MFFT scores since MFFT pretest and posttest (Impulsivity Reflectivity Index - IRI) combined mean initial response times and total number of errors.

Table 7 presents the means and standard deviations for errors and response time. The results indicate that regardless of support condition, errors decreased and response times increased between the pretest and posttest.

Multiple regression analysis was performed in order to examine

Table 7

Means and Standard Deviations for Errors and Response Time (N = 62)

Group		n	Errors	Response Times
High Support		31		
Pretest	M		18.10	6.58
	SD		6.40	5.00
Posttest	M		10.97	24.69
	SD		6.66	19.23
Low Support		31		
Pretest	M		19.26	5.35
	SD		6.50	3.51
Posttest	M		13.19	15.35
	SD		6.26	17.25

how well MFFT pretest response time and MFFT pretest error scores were able to predict posttest response time and posttest error scores respectively, when compared to other static measures, such as IQ and static maintenance, as well as, dynamic measures, such as learning rate and dynamic maintenance. Table 8 summarizes the results of multiple regression analysis comparing dynamic and static measures as predictors of MFFT posttest response time. For the total group, the combined contribution of MFFT pretest response time, IQ and learning rate explained 31% of the variance in MFFT posttest response time. Learning rate was a significent predictor of posttest response time, $\underline{F}$ (1, 58) = 8.9200, $\underline{p} < .01$, accounting for over 10% of the variance in posttest response time. IQ and pretest response times were not significant predictors of posttest response times, accounting for less than 1% and 4.5% of the variance in posttest response time, respectively.

For the high support group, the combined contribution of MFFT pretest response time, IQ and dynamic maintenance scores explained nearly 34% of the variance in MFFT posttest response time. Neither pretest response time nor IQ were significant predictors of posttest response times. Dynamic maintenance scores, however, accounted for almost 24% of the variance in posttest response time, which was significant, $\underline{F}$ (1, 27) = 9.7359, $\underline{p} < .01$.

For the low support group, the combined contribution of MFFT pretest response time, IQ and static maintenance scores explained 43.5% of the variance in MFFT posttest response time. IQ and static maintenance scores were not significant predictors of MFFT posttest response time. MFFT pretest response time was a significant predictor, $\underline{F}$ (1, 27) = 8.9235, $\underline{p} < .01$, accounting for more than 18%

Table 8

Multiple Regression Analysis Comparing Dynamic and Static Measures as Predictors of MFFT Posttest Response Time

Source	DF	SS	R^2 change	F	ANOVA	DF	SS	MS	F
					Total Group (N= 62)				
MFFT Pretest Response Time	1	961.0627	.0450	3.7676					
					Regression	3	6580.3183	2193.4344	8.5988***
IQ	1	71.3421	.0033	.2797					
					Residual	58	14795.0799	255.0876	
Learning Rate	1	2275.3822	.1065	8.9200**					
							R^2 = .30785		
					High Support Group (N =31)				
MFFT Pretest Response Time	1	50.4364	.0046	.1852					
					Regression	3	3738.3922	1246.1307	4.5751*
IQ	1	1.0831	.0001	.0040					
					Residual	27	7354.0794	272.3733	
Dynamic Maint.	1	2651.7904	.2391	9.7359**					
							R^2 = .33702		
					Low Support Group (N = 31)				
MFFT Pretest Response Time	1	1666.7160	.1867	8.9235**					
					Regression	3	3886.1701	1295.3900	6.9354**
IQ	1	30.1708	.0034	.1615					
					Residual	27	5043.0165	186.7784	
Static Maint.	1	275.0845	.0308	1.4728					
							R^2 = .43522		

*p <.05
**p <.01
***p <.001

of the variance in posttest response time scores.

Table 9 summarizes the results of multiple regression analysis comparing dynamic and static measures as predictors of MFFT posttest error scores. For the total group, the combined contribution of MFFT pretest error scores, IQ and learning rate explained 65% of the variance in MFFT posttest errors. Learning rate explained almost 43% of the variance in MFFT posttest error scores, which was significant, F (1, 58) = 72.2667, $p < .001$. In addition, MFFT pretest errors accounted for 2% of the variance in MFFT posttest errors, which was significant, F (1, 58) = 3.9140, $p \leq .05$. IQ was not a significant predictor of posttest errors.

For the high support group, the combined contribution of MFFT pretest errors, IQ and dynamic maintenance scores explained 63% of the variance in MFFT posttest errors. Dynamic maintenance explained more than 51% of the variance in MFFT posttest errors, which was significant, F (1, 27) =37.6864, $p < .001$. MFFT pretest errors accounted for 2% while IQ accounted for less than .5%.

For the low support group, the combined contribution of MFFT pretest errors, IQ and static maintenance accounted for 52% of the variance in posttest errors. Static maintenance accounted for 16% of the variance in MFFT posttest errors, which was significant, F (1, 27) = 9.2788, $p < .01$. MFFT pretest errors and IQ did not explain a significant amount of variance in MFFT posttest errors.

In sum, the dynamic measures, learning rate and dynamic maintenance, were better predictors of posttest response time and posttest errors than the static measures used. For the total group, learning rate was the best predictor of posttest response time over and above pretest response time and IQ, as well as, the best

Table 9

Multiple Regression Analysis Comparing Dynamic and Static Measures as Predictors of MFFT Posttest Errors

Source	DF	SS	R^2 change	F	ANOVA	DF	SS	MS	F
					Total Group (N = 62)				
MFFT Pretest Errors	1	59.9474	.0232	3.9140*					
					Regression	3	1694.2621	564.7540	36.8732***
IQ	1	.01891	.0000	.0012					
					Residual	58	888.3347	15.3	
Learning Rate	1	1106.8445	.4286	72.2667***					
							R^2 = .6560		
					High Support Group (N = 31)				
MFFT Pretest Errors	1	26.8525	.0202	1.4866					
					Regression	3	843.2502	281.0834	15.5608***
IQ	1	12.9441	.0097	.7166					
					Residual	27	487.7175	18.0636	
Dynamic Maint.	1	680.7521	.5115	37.6864***					
							R^2 = .6336		
					Low Support Group (N = 31)				
MFFT Pretest Errors	1	6.7402	.0057	.3251					
					Regression	3	614.9921	204.9974	9.8865***
IQ	1	19.6686	.0167	.9486					
					Residual	27	557.8466	20.7351	
Static Maint.	1	192.3972	.1638	7.2788**					
							R^2 = .5235		

*p <.05
**p <.01
***p <.001

predictor of posttest errors over and above pretest errors and IQ. For the high support group, dynamic maintenance was a better predictor of both posttest response time and posttest errors than IQ and pretest response times and errors respectively. Dynamic maintenance was a better predictor of posttest response time and errors for the high support group than static maintenance for the low support group. In addition, regardless of whether the child was in the high or low support condition, response times increased and errors decreased significantly.

SUMMARY OF RESULTS

Hypotheses 1 and 2 examined the effect of scaffolding (high support vs. low support) on the performance of children with varying cognitive styles as determined by their MFFT scores. The results of multiple regression indicate that Hypothesis 1 was not supported since at high levels of the MFFT pretest scores, children in the high support group had higher MFFT posttest scores than children in the low support group. Hypothesis 2 was not supported, since at low levels of the MFFT pretest, the difference in the scores between children in the high and low support groups on the MFFT posttest remained the same. Children receiving high levels of support consistently performed better than children receiving low levels of support, regardless of their cognitive style as determined by their MFFT pretest scores. MFFT pretest scores had a significant effect on MFFT posttest scores, accounting for almost 10% of the variance in MFFT posttest scores. Neither IQ nor support condition had a significant effect on MFFT posttest scores. There was also no

interaction between support condition and MFFT pretest scores. The regression lines representing the high and low support group were parallel, indicating that the difference between the support groups along a continuum was constant. That is, the children in the high support group consistently performed better than the children in the low support group at all levels of MFFT pretest scores.

Hypothesis 3 examined the relationships between MFFT pretest score (cognitive style) and learning rate. The results of multiple regression analysis supported Hypothesis 3, as 14% of the variance in learning rate was attributed to MFFT pretest scores. The direction of the correlation between MFFT pretest scores and learning rate indicated that children who had higher MFFT pretest scores required fewer prompts to reach criterion, and therefore, had lower learning rate scores.

Hypothesis 4-6 examined the predictability of dynamic measures (learning rate and dynamic maintenance) and static measures (IQ, MFFT pretest, static maintenance) on the future performance of children on a multiple choice visual matching task (MFFT posttest). The results of multiple regression analysis supported Hypothesis 4. Learning rate scores were more predictive of MFFT posttest scores, accounting for 27% of the variance in MFFT posttest scores when compared to MFFT pretest scores which accounted for 5% of the variance and IQ which accounted for less than 1% of the variance in the regression solution.

Hypothesis 5 was supported by the results of multiple regression analysis, as dynamic maintenance scores were more predictive of MFFT posttest scores over and above MFFT pretest scores and IQ for the high support group. Dynamic maintenance

accounted for 42% of the variance in MFFT posttest scores, while MFFT pretest scores accounted for 2% and IQ accounted for less than 1% of the variance.

The results of multiple regression analysis confirmed Hypothesis 6, since dynamic maintenance for the high support group was more predictive of MFFT posttest scores than static maintenance, for the low support group, accounting for 42% and 5% of the variance in their respective regression solutions. Thus, dynamic measures were better predictors of MFFT posttest scores when compared to the static measures.

In addition, although no hypotheses were stated regarding errors and response times, for the total group, learning rate was the best predictor of posttest errors over and above IQ and pretest errors, as well as the best predictor of posttest response time over and above IQ and pretest response time. For the high support group, dynamic maintenance was a better predictor of both posttest errors and posttest response times than IQ and pretest errors or response times respectively. Dynamic maintenance was a better predictor of posttest errors and response times for the high support group than static maintenance for the low support group. Finally, for both the high and low support groups, mean initial response time increased significantly and total errors decreased significantly.

CHAPTER V

DISCUSSION

The purpose of the present study was to examine how instruction can best support the child's cognitive style (impulsive or reflective) on a multiple choice task requiring visual discrimination, so that all children, regardless of cognitive style, function at their optimal level. In addition, this study sought to determine the difference between children's performance on a task when given low levels of support and when given high levels of support. It was hypothesized that children who received high levels of support would perform better than children who received low levels of support. In addition, it was hypothesized that there would be an interaction such that differences between high and low support groups on the posttest would be greater for children identified as impulsive (low MFFT scores) on the pretest. This study also sought to extend the research of Brown and her associates regarding the dynamic assessment of learning potential to another cognitive domain. In this way, the child's level of potential development, as well as his/her level of actual development and their relationship could be examined. It was hypothesized that dynamic indices of learning potential (i.e. learning rate and dynamic maintenance scores) would be more predictive of MFFT posttest scores than the static measures (i.e. MFFT pretest scores and IQ scores).

Hypotheses 1 and 2 stated that at high levels of MFFT pretest scores, that is, for a more reflective child, there would be no difference in MFFT posttest scores between high and low support conditions. As MFFT pretest scores decreased and children's cognitive style on the pretest became more impulsive, there would be a tendency for children receiving high levels of support to have higher MFFT posttest scores than those in the low support group. In addition, the difference in scores on the MFFT posttest between high and low support conditions would increase with decreasing MFFT pretest scores. The results do not support these hypotheses. Children in the high support group consistently performed better than the children in the low support group at all levels of MFFT pretest scores.

It was hypothesized that there would be an interaction between the child's cognitive style and the amount of support received. It was assumed that the more reflective children were already using the necessary strategies to perform the task well and therefore would not need as much support nor gain from the support given, as much as the more impulsive children who did not have the necessary strategy to perform the task well. Therefore, it was expected that there would be no differences in MFFT posttest scores for the more reflective children in either group. However, the more impulsive the child was, the more benefit he/she would derive from the amount of support given. This was not supported. The results indicate that all children, regardless of cognitive style, benefitted from the support given. Support appears to be a powerful instructional strategy for all children. Support or scaffolding is so powerful that all children, regardless of cognitive style, improved

significantly on the posttest.

The results support Overton and Newman's (1982) notion that competence is not a fixed characteristic of the child but an emergent one within a particular context. The results also support Vygotsky's (1978) theory that social interaction facilitates the realization of the child's cognitive potential. With support, all children showed significant improvement in their performance on the visual matching task. Children's abilities are not fixed but dependent on context and competence and ability varies with the degree of support they are provided within that context. The context of this research involved the performance of children with varying cognitive styles on a multiple choice visual matching task. The results indicate that both reflective and impulsive children's performance improved significantly due to the training and support provided during the training.

The support or scaffolding provided in this study was like the scaffolding described by Wood et al. (1976) and although intrapsychological functioning was not directly tested, the results may lend support to Vygotsky's theory that social interaction at the interpsychological level leads to independent problem solving at the intrapsychological level. In other words, cognitive functioning first occurs on the social level, between people and the child gradually internalizes this in his or her own development. The results also lend support to Fisher and Bullock's (1984) optimal level hypothesis, which posits the notion that with support a child can advance to the upper limit of his or her processing ability. As Bullock (1983) noted, social support induces the child to perform beyond the highest capabilities that the child could demonstrate

when working independently. With the support that was provided during the test-train-test procedure, even the more impulsive children were able to perform the task without assistance.

These findings also support the research of Budoff (1974) and Feuerstein (1979) who found significant improvement in performance after brief training using a test-train-test procedure. The brief training was what Budoff (1974) termed an "optimizing experience" and what Feuerstein (1979) termed a 'mediated learning experience'. They, like Vygotsky (1978), believed that cognitive growth is a result of the child's interaction with an adult (or more capable peer), who guides the child's problem solving and structures the learning environment to suit the child's needs. The prompting procedure used in this study was adapted from studies of Brown, Campione and their colleagues, and lends itself to use by teachers and/or school psychologists. As Budoff (1974) noted, the pretest scores reflect the child's current functioning ability while the posttest scores reflect the child's optimal level of performance. This test-train-test procedure enables the teacher and/or school psychologist to compare the child's current level of functioning, as represented by his pretest performance, and the child's potential level of functioning, as indicated by his posttest performance. Vygotsky (1966, 1978) defined the difference between the child's pretest or current functioning level and the posttest (following some intervention) or potential level as the distance of the zone of proximal development.

Hypothesis 3 stated that at high levels of MFFT pretest scores (the more reflective the child is on the pretest) the fewer prompts the child would need and therefore, the child's learning rate score

would be lower. The results support this hypothesis. As was noted previously, it was assumed that the more reflective children already possessed the necessary problem solving strategies to perform the task well and therefore would not require as much prompting or support in order to reach the criterion of solving three problems independently. Since the more reflective children received fewer prompts, it was hypothesized that the additional prompting they would receive during the maintenance phase would not result in significant differences between the groups. As was noted earlier, the results indicate that all children regardless of cognitive style improved significantly. This is probably due to the fact that the scaffolding or support that the children were given by the examiner was within the child's zone of proximal development. The children were challenged to some degree by being coaxed to perform, with support, at a more advanced level than their current level as reflected by their pretest scores. Due to the collaboration in this scaffolding procedure, the child's skills and knowledge of what was to be done advanced to a higher level.

Hypotheses 4-6 predicted that the dynamic measures of learning potential, such as learning rate scores and dynamic maintenance scores, would be more predictive of MFFT posttest scores over and above the static meaures used in the study. The static measures in this study consisted of the MFFT pretest scores, IQ scores and static maintenance scores. The results support these hypotheses and lend support to Vygotsky's belief that what children are able to do with the assistance and guidance of others, provides the examiner with diagnostic information beyond that attained by a static measure. The static measures, typically used by Western

psychologists, such as intelligence and achievement tests merely reflect the end result of previous learning and do not provide a sensitive estimate of the child's potential for improvement. The results of this study support this belief. The results also support Budoff (1974) and Feuerstein's (1979) argument for the use of dynamic test procedures, whereby performance is obtained after some form of instruction has been provided. They believed that these dynamic tests were more culture fair measures of ability and intelligence when intelligence is defined as the ability to learn and profit from instruction. In addition, dynamic test procedures such as the ones used in this study, may be more valid measures of a child's ability to solve a visual matching task with a multiple choice format, since they do not rely as much on the child's cognitive style or predisposition to respond impulsively or reflectively.

Another goal of this study was to extend the research of Brown, Campione and their colleagues to another cognitive domain, specifically, visual matching problems. The results support the research of Bryant et al. (1983), where it was found that dynamic measures, such as learning rate and dynamic maintenance, were more predictive of posttest performance than the static measures used, such as pretest and IQ. The graduated prompting procedure made possible the assessment of the child's speed of learning and the child's ability to maintain this learning a day or so later across similar tasks. The individual differences in learning rate and maintenance ability were more important predictors of how much the children were able to profit from instruction in this learning domain than the static measures used. The data also support the

findings of Ferrara et al. (1986) that the higher the IQ of the child, the fewer prompts the child needed to reach criterion.

The data of this study support the summary data in Messer's (1976) review of the reflection-impulsivity literature, that cognitive style is moderately related to IQ and the correlation between IQ and errors is higher than the correlation between IQ and response times. The negative correlation (-.488) between response times and errors on the MFFT pretest also supports Messer's (1976) data reporting a median correlation of about -.48 and Salkind's (1978) preliminary norms for 5 year olds, which indicated a correlation of -.41.

Previous studies have often used a median split procedure to dichotomize groups into impulsives and reflectives and then compare performance. Most interventions have attempted to make impulsives more reflective and in so doing improve their performance on tasks with high response uncertainty. While previous interventions have often increased response times, they have not always been able to decrease errors (Messer, 1976; Readence and Bean, 1978). Most studies also have focused on improving the performance of impulsive children. This study focused on the collaboration of the child and the examiner and resulted in significant improvement for all children regardless of their cognitive style on the MFFT pretest.

EDUCATIONAL IMPLICATIONS and FUTURE RESEARCH

The results of this study, indicate that a combination of modeling, instruction of problem solving strategy and verbal mediation training can significantly decrease errors and increase response times. The training was done in a relatively short amount

of time using both group and individual instruction. These results suggest that teachers could use this as a method of instruction which would help all children, regardless of cognitive style, to become better able to demonstrate their competence and skill in this learning domain. Furthermore, since this method of instruction involves the use of a problem solving strategy regarding multiple choice test formats, it would be interesting to see if this would generalize to improvement in performance on other tasks (besides visual matching) when evaluated with a multiple choice test format. Since the study used the group instructions prior to training to help the children to verbalize aloud during the training, the question of how much the group instruction contributed to differences in performance arises. The inclusion of a control group that does not receive the group instructions could answer the question of how much children improved with just group training.

During the study, it was noted that some children continued to verbalize aloud during the MFFT posttest, while others did not. It would be interesting to see if those who verbalized performed better than those that did not and what factors accounted for it.

Educators may benefit from this study in terms of its support of the conceptual framework of social interaction theory which says that we should not focus primarily on either the child or the environment but rather on the collaboration of the child with his/her environment.

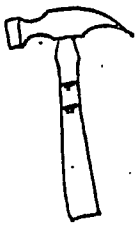
A major concern of school psychologists and educators in general, is how to assess children's ability to profit from instruction. Typically, we use static measures such as intelligence, achievement and aptitude tests and then try to predict

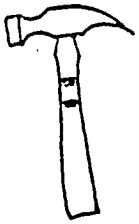
from these results about children's learning potential. In other words, we measure what the child has already learned and then predict what he/she can learn. The results of this study indicate that the dynamic measures provide important diagnostic information which could not be obtained from static measures alone. The additional information not only is more predictive of children's ability to profit from instruction but may uncover potential which was initially not evident due to poor starting levels. This will decrease the possibilities that students who could profit from instruction would be denied that opportunity on the basis of their initial performance on a static measure. In addition, the added information obtained from these dynamic measures may reveal a variety of learning profiles. For example, some children may be fast learners but do not maintain this learning well over time while others may be slow learners but are able to maintain this learning well. If these learning profiles are consistent, perhaps different forms of intervention could be used to suit the different groups of students. Future studies to see if the above noted learning profiles are consistent would be helpful to educators.

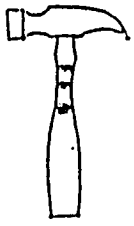
This study has extended the research of Brown and Campione and their colleagues to another learning domain (visual matching). Using series completion and matrices problems, Brown and her colleagues examined how indices of the zone of proximal development relate to traditional IQ scores. Future studies in other learning domains to see if dynamic measures continue to provide additional diagnostic information and are more predictive of children's ability to profit from instruction would contribute to the growing body of literature regarding dynamic assessment procedures. As Vygotsky

(1978) noted, two students who initially perform at the same level within a cognitive domain, may still differ in their ability to profit from instruction within that domain and this additional information may be instructionally relevant. The study of the zone of proximal development and levels of potential has implications for educators. It enables us to look at the processes that are maturing, or what Vygotsky called the 'buds' of development rather than the 'fruits' of development. The results support Vygotsky's notion that teachers ought to teach to the child's upper limits (dynamic measures) rather than the child's lower limits. That is, instruction should be within the child's zone of proximal development and is most powerful when it is geared to the upper boundary of the zone of proximal development.

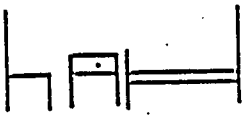
APPENDIX A

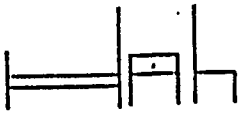


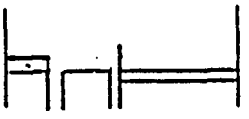


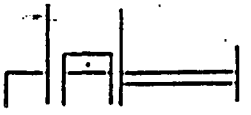


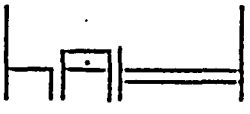
APPENDIX B

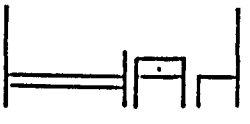












APPENDIX B

Prompts for Appendix B

1. Take your time and look at all the different parts of the picture (examiner points to top picture) and then look carefully at each of these other pictures (examiner points to bottom page). Only one of these (examiner points to the page) looks exactly like this one (examiner points to top page). The others have one part of the picture that is different than the top one (examiner points to top page).

1a. Look at each one of the pictures carefully and see how each one (examiner points to each choice on bottom page) is different than the top one. Only one of these (examiner points to bottom page) looks exactly the same as this one (examiner points to top page).

2. Look at the table (examiner points to table on top page) carefully. Now look at the chair on this side (examiner points to chair on top page) and the bed on the other side. Now look down here (examiner points to bottom page) to find the picture that looks just like this top one (examiner points to top page).

3. Look at the table in the middle (examiner points to table on top of page). It has a dot in the middle. Only some of the pictures here (examiner points to bottom page) have the same kind of table. Now look at the other parts of the picture carefully to see if you can find the one that looks just lik the top picture.

4. Look at the chair next to the table with the dot (examiner points to top picture). You see the chair is on the left side (examiner points to chair on top page) and the chair is facing the table so that if you were sitting on the chair, you would be looking at the table. Find the picture down here (examiner points to bottom page) that is just like this one (examiner points to top page).

5. Look at the top picture (examiner points to top page); it has a chair facing a table and the table has a dot on it. And look at the bed; it is also facing the table and has two lines on it (examiner points to bed on top page). Now look at the ones down here (examiner points to bottom page). Which one looks like that?

BIBLIOGRAPHY

Abikoff, H. (1979). Cognitive training interventions in children: Review of a new approach. Journal of Learning Disabilities, 12, 123- 135.

Agnew, P. and Young, R.D. (1979). Verbal mediation, Cognitive Tempo, and Self Esteem in Normal Active, High Active and Hyperactive Boys. Paper presented at the Biennial Meeting of the Society for Research in Child Development. San Francisco, March, 1979. (ERIC PS010664).

Ault, R.L. (1973). Problem-solving strategies of reflective, impulsive, fast-accurate and slow-inaccurate children. Child Development, 44, 259-266.

Ault, R.L., Crawford, D.E. and Jeffrey, W. E. (1972).Visual scanning strategies of reflective, impulsive, fast-accurate, and slow-inaccurate children on the Matching Familiar Figures test. Child Development, 43, 1412-1417.

Bentler, P.M. and McClain, J. (1976). A multitrait-multimethod analysis of reflection-impulsivity. Child Development, 47, 218-226.

Block, J., Block, J.H. and Harrington, D.M. (1974). Some misgivings about the Matching Familiar Figures test as a measure of reflection-impulsivity. Developmental Psychology, 10, 611-632.

Block, J., Block, J.H. and Harrington, D.M. (1975). Comment on the Kagan- Messer reply. Developmental Psychology, 11, 249-252.

Brannigan, G.G. and Ash, T. (1977). Social judgment in conceptually impulsive and reflective children. Psychological Reports, 41, 466.

Briggs, C.H. (1968). An experimental study of reflection-impulsivity in children. Dissertation Abstracts, 28, 3891-B. (University Microfilms No. 68-1610)

Brown, A.L. and Ferrara. R.H. (1985). Diagnosing zones of proximal development. In J. V. Wertsch (Ed.). Culture, Communication and Cognition: Vygotskian Perspectives. Cambridge University Press.

Brown, R. (1980). The maintenance of conversation. In D. R. Olson (Ed.), The Social Foundation of Language and Thought. New York: Norton.

Bruner, J.S. (1982). The organization of action and the nature of adult-infant transaction. In M. von Cranach and R. Harre (Eds.). The Analysis of Action. New York: Cambridge University Press.

Bryant, N.R., Brown, A.L., and Campione, J.C. (1983). Preschool children's learning and transfer of matrices problems: A study of proximal development. Paper presented at the society for Research in Child Development. Detroit.

Budoff, M. (1974). Learning potential and educability among the educable mentally retarded. Final report, project No. 312312, Grant No. OEG-0-8-080506-4597. Research Institute for Educational Problems. Cambridge, Mass. December.

Bullock, D. (1983). Seeking relations between cognitive and social-interactive transitions. In K. W. Fischer (Ed.), Levels and Transitions in Children's Development. New Directions for Child Development, No. 21. San Francisco: Jossey-Bass Inc.

Campbell, S.B. and Douglas, V.I. (1972). Cognitive styles and responses to the threat of frustration. Canadian Journal of Behavioral Science, 4, 30-42.

Campione, J.C., Brown, A.L., Ferrara, R.A. and Bryant, N.R. (1984). The zone of proximal development: Implications for individual differences and learning. In B. Rogoff and J.V. Wertsch (Eds.), Children's Learning in the "Zone of Proximal Development", San Francisco: Jossey-Bass.

Campione, J.C., Brown, A.L., Ferrara, R.A., Jones, R.S. and Steinberg, E. (In Press). Breakdowns in flexible use of information: Intelligence-related differences in transfer following equivalent learning performance. Intelligence.

Cazden, C. (1979). Peekaboo as an instructional model: Discourse development at home and at school. In Papers and Reports on Child Language Development. Department of Linguistics, Stanford University. No.17.

Cohen S. and Przybycien, C.A. (1974). Some effects of sociometrically selected peer models on the cognitive styles of impulsive children. Journal of Genetic Psychology, 124, 213-220.

Connors, C.K. (1971). Recent drug studies with hyperkinetic children. Journal of Learning Disabilities, 4, 476-484.

Cross, T.G. (1977). Mother's speech adjustments: The contributions of selected child listener variables. In C. E. Snow and C. A. Ferguson, (Eds.) Talking to children: Language Input and Acquisition. Cambridge, England: Cambridge University Press.

Debus, R.L. (1970). Effects of brief observation of model behavior on conceptual tempo of impulsive children. Developmental Psychology, 2,22-32.

Denney, D.R. (1974). Relationship of three cognitive style dimensions to elementary reading abilities. Journal of Educational Psychology, 66, 702-709.

Douglas, V. (1972). Stop, look and listen: The problem of sustained attention and impulse control in hyperactive and normal children. Canadian Journal of Behavioral Science, 4, 259-281.

Drake, D.M. (1970). Perceptual correlates of impulsive and reflective behavior. Developmental Psychology, 2, 202-214.

Egeland, B. (1974). Training impulsive children in the use of more efficient scanning techniques. Child Development, 45, 165-171.

Erickson, L. and Otto, W. (1973). Effect of intra-list similarity and impulsivity-reflectivity on kindergarten children's word recognition performance. Journal of Educational Research, 66, 466-471.

Farkas, E. (1984). Altering test instructions on multiple choice tests: Does it help impulsive kindergarteners? Unpublished paper, The Graduate School and University Center- CUNY.

Ferrara, R.A., Brown, A.L., and Campione, J.C. (1986). Children's learning and transfer of inductive reasoning rules: Studies of proximal development. Child Development,57, 1087-1099.

Feuerstein, R. (1979). The Dynamic Assessment of Retarded Performers: The Learning Potential Assessment Device, Theory, Instruments and Techniques. Baltimore: University Park Press.

Feuerstein, R. and Jensen, M.R. (1980). Instrumental Enrichment: Theoretical basis, goals, and instruments. The Educational Forum, 5, 401-423.

Feuerstein, R., Miller, R., Rand, Y. and Jensen, M.R. (1981). Can evolving techniques better measure cognitive change? The Journal of Special Education, 15, 201-219.

Feuerstein, R., Rand, Y., Hoffman, M., Hoffman, M. and Miller, R. (1979). Cognitive modifiability in retarded adolescents: Effects of Instrumental Enrichment. American Journal of Mental Deficiency, 83, 539-550.

Fischer, K.W. (1980). A theory of cognitive development: The control and construction of hierarchies of skills. Psychological Review, 87, 477-531.

Fischer, K.W. (1983). Developmental levels as periods of discontinuity. In K.W. Fischer (Ed.), Levels and Transitions in Children's Development. New Directions for Child Development. No. 21. San Francisco: Jossey-Bass.

Fischer, K.W. and Bullock, D. (1981). Patterns of data: Sequence, synchrony, and constraint in cognitive development. In K.W. Fischer, (Ed.), Cognitive Development. New Directions for Child Development, No. 12. San Francisco: Jossey-Bass.

Fischer, K.W. and Bullock, D. (1984) Cognitive development in school-age children: Conclusions and new directions. In W.A. Collins (Ed.), Development during middle childhood: The years from six to twelve. Washington, D.C.: National Academy of Science Press.

Flavell, J.H. (1977). Cognitive Development. Englewood Cliffs, N.J.: Prentice-Hall.

Frostig, M. and Horne, D. (1972). Advanced Pictures and Patterns. Cleveland: Modern Curriculum Press.

Griffin, P. and Cole, M. (1984). Current activity for the future: The zo-ped. In B. Rogoff and J.V. Wertsch (Eds.), Children's Learning in the "Zone of Proximal Development". San Francisco: Jossey-Bass.

Hagen, J.W. (1972). Strategies for remembering. In I.S. Farnham-Diggory (Ed.), Information Processing in Children. New York: Academic Press.

Harrison, A. and Nadelman, L. (1972). Conceptual tempo and inhibition of movement in black preschool children. Child Development, 43, 657-668.

Hobbs, S.A., Moguin, L.E., Tyroler, M. and Lahey, B.B. (1980). Cognitive behavior therapy with children: Has clinical utility been demonstrated? Psychological Bulletin, 87, 147-165.

Hoy, E., Weiss, G., Minde, K. and Cohen, N. (1978). The hyperactive child at adolescence: Cognitive, emotional, and social functioning. Journal of Abnormal Child Psychology, 6, 311-324.

Kagan, J. (1965a). Reflection-impulsivity and reading ability in primary grade children. Child Development, 36, 609-628.

Kagan, J. (1965b). Impulsive and reflective children: Significance of conceptual tempo. In J.D. Krumholtz (Ed.), Learning and the Educational Process. Chicago: Rand McNally.

Kagan, J. (1965c). Individual differences in the resolution of response uncertainty. Journal of Personality and Social Psychology, 2, 154-160.

Kagan, J. (1965d). Matching Familiar Figures. William James Hall, Harvard University, Cambridge, Mass.

Kagan, J. (1966). Reflection-impulsivity: The generality and dynamics of conceptual tempo. Journal of Abnormal Psychology, 21, 17-24.

Kagan, J., Moss, H.A. and Sigel, I.E. (1963). Psychological significance of style of conceptualization. In J.C. Wright and J. Kagan (Eds.), Basic cognitive processes in children. Monographs of the Society for Research in Child Development, 28, No. 2, Serial No. 86.

Kagan, J., Pearson, L. and Welch, L. (1966). Modifiability of impulsive tempo. Journal of Educational Psychology, 57, 359-365.

Kagan, J., Rosman, B.L., Day, D., Albert, J. and Phillips, W. (1964). Information processing in the child: Significance of analytic and reflective attitudes. Psychological Monographs: General and Applied, 78, No. 1 Whole No. 578.

Klein, G.A., Blockovich, R.N., Buchalter, P.S. and Huyghe, L. (1976). Relationship between reflection-impulsivity and problem solving. Perceptual and Motor Skills, 42, 67-73.

Loper, A.B. and Hallahan, D.P. (1980). A comparison of different statistical procedures for determining the relationship between cognitive tempo and reading achievement. The Journal of General Psychology, 102, 89-97.

Luria, A.R. (1959a). The directive function of speech in development and dissolution - Part I: Development of the directive function of speech in early childhood. WORD, 15, 341-352.

Luria, A.R. (1959b). The directive function of speech in development and dissolution - Part II: Development of the directive function of speech in pathological states of the brain. WORD, 15, 453-464.

Luria, A.R. (1961). The Role of Speech in the Regulation of Normal and Abnormal Behavior. New York: Liveright.

Maccoby, E.E., Dowley, E.M., Hager, J.W. and Degerman, R. (1965). Activity level and intellectual functioning in normal preschool children. Child Development, 36, 761-770.

McKinney, J.D. (1973). Problem-solving strategies in impulsive and reflective second graders. Developmental Psychology, 8, 145.

McKinney, J. D. and Bannerjee, C. (1975). Concept attainment by reflective and impulsive children as a function of memory support. Perceptual and Motor Skills, 41, 417-418.

Meichenbaum, D. and Burland, S. (1979). Cognitive behavior modification with children. School Psychology Digest, 8, 426-433.

Meichenbaum, D. and Goodman, J. (1969). Reflection-impulsivity and verbal control of motor behavior. Child Development, 40, 785-797.

Meichenbaum, D.H. and Goodman, J. (1971). Training impulsive children to talk to themselves: A means of developing self-control. Journal of Abnormal Psychology, 77, 115-126.

Messer, S. (1970). Reflection-impulsivity: Stability and school failure. Journal of Educational Psychology, 61, 487-490.

Messer, S.B. (1976). Reflection-impulsivity: A review. Psychological Bulletin, 83, 1026-1052.

Metropolitan Readiness Tests. (1974). New York: Harcourt Brace, Jovonovich.

Mussen, P.H., Conger, J.J., Kagan, J. and Huston, A.C. (1984). Child Development and Personality. New York: Harper and Row.

Orbach, B. (1977). Impulsive cognitive style: Three modification techniques. Psychology in the Schools, 14, 353-359.

Overton, W.F. and Newman, J.L. (1982). Cognitive development: A competence-activation/utilization approach. In T. M. Field, A. Huston, H.C. Quay, L. Troll, and G. E. Finley, (Eds.), Review of Human Development. New York: John Wiley and Sons.

Palkes, H., Stewart, M. and Kahana, B. (1968). Porteus Maze performance of hyperactive boys after training in self-directed verbal commands. Child Development, 39, 817-826.

Pedhazur, E.J. (1982). Multiple Regression in Behavioral Research. Second Edition. New York: Holt, Rinehart and Winston.

Plomin, R. and Buss, A.H. (1973). Reflection-impulsivity and intelligence. Psychological Reports, 33, 726.

Readence, J.E. and Baldwin, R.S. (1978). The relationship of cognitive style and phonics instruction. Journal of Educational Research,72, 44-52.

Readence, J.E. and Bean, T.W. (1978). Modification of impulsive cognitive style: A survey of the literature. Psychological Reports, 43, 327-337.

Readence, J.E. and Searfoss, L.W. (1976). The impulsivity-reflectivity dimension of cognitive style. Reading World, 10, 88-96.

Rogoff, B., Malkin, C. and Gilbride, K. (1984). Interaction with babies as guidance in development. In B. Rogoff and J.V. Wertsch (Eds.), Children's Learning in the "Zone of Proximal Development". San Francisco: Jossey-Bass, Inc.

Salkind, N.J. (1978). The Development of Norms for the Matching Familiar Figures Test. Bailey Hall, Univ. of Kansas, Lawrence, Kansas, 66045.

Saxe, G.B., Gearhart, M. and Guberman, S.R. (1984). The social organization of early number development. In B. Rogoff and J.V. Wertsch (Eds.), Children's Learning in the "Zone of Proximal Development". San Francisco: Jossey-Bass, Inc.

Schwebel, A.I. and Bernstein, A.J. (1970). The effects of impulsivity on the performance of lower-class children on four WISC subtests. American Journal of Orthopsychiatry, 40, 629-636.

Siegel, A.W., Kirasic, K.C. and Kilburg, R.R. (1973). Recognition memory in reflective and impulsive preschool children. Child Development, 44, 651-656.

Swensen, A. (1983). Toward an ecological approach to theory and research in child language acquisition. In W. Fowler, (Ed.), Potentials of Childhood. Vol. 2. Lexington, Mass.: D.C. Heath.

Vane, J.R. (1968). The Vane Kindergarten Test. Archives of the Behavioral Sciences, No. 24. Brandon, Vermont: Clinical Psychology Publishing Co.

Vygotsky, L. (1962). Thought and Language. New York: Wiley Press.

Vygotsky, L. (1978). Mind in Society; The Development of Higher Psychological Processes. (M. Cole , V. John Steiner, S. Seribaer, and E. Souberman, Eds.). Cambridge, Mass: Harvard University Press.

Ward, W.C. (1973). Disadvantaged children and their first school experiences: Development of self-regulatory behaviors (PR-73-18). Princeton, N.J.: Educational Testing Service.

Weinberg, R.A. (1969). The effects of different types of reinforcement in training a reflective conceptual tempo. Dissertation Abstracts, 29, 2578-A. (University Microfilms No. 69-1560).

Weiner, A.S. and Berzonsky, M.D. (1975). Development of selective attention in reflective and impulsive children. Child Development, 46, 545-549.

Weithorn, C.J. (1980). The relationship of language development to individual differences in cognitive performance emerges high activity level children. In R. Knights and D. Bakker (Eds.), Treatment of Hyperactive and Learning Disordered Children. Baltimore: University Park Press.

Weithorn, C.J. and Kagen, E. (1978). Interaction of language development and activity level on performance of first-graders. American Journal of Orthopsychiatry, 48, 148-159.

Weithorn, C.J. and Kagen, E. (1979). Training first graders of high-activity level to improve performance through verbal self-direction. Journal of Learning Disabilities, 12, 82-88.

Weithorn, C.J. and Kagen, E. (1984). Verbal mediation in high-active and cognitively impulsive second graders. Journal of Learning Disabilities,17.

Weithorn, C.J., Kagen, E. and Marcus, M. (1984). The relationship of activity level ratings and cognitive impulsivity to task performance and academic achievement. Journal of Child Psychology and Psychiatry, 25, 587-606.

Wertsch, J.V. (1979). From social interaction to higher psychological processes. Human Development, 22, 1-22.

Wertsch, J.V. (1984). The zone of proximal development: Some conceptual issues. In B. Rogoff and J.V. Wertsch (Eds.). Children's Learning in the "Zone of Proximal Development". San Francisco: Jossey-Bass, Inc.

Wood, D., Bruner, J.S. and Ross, G. (1976). The role of tutoring in problem solving. Journal of Child Psychology and Psychiatry, 17, 89-100.

Wozniak, R.H. (1972). Verbal regulation of motor behavior - Soviet research and non-Soviet replications. Human Development, 15, 13-57.

Zelniker, T. and Jeffrey, W.E. (1976). Reflective and impulsive children: Strategies of information processing underlying differences in problem solving. Monographs of the Society for Research in Child Development. Vol.41, No.5., Serial No. 168.

Zelniker, T., Jeffrey, W.E.. Ault, R. and Parsons, J. (1972). Analysis and modification of search strategies of impulsive and reflective children on the Matching Familiar Figures Test. Child Development, 43, 321-335.

Zelniker, T. and Oppenheimer, L. (1973). Modification of information processing of impulsive children. Child Development, 44, 445-450.

Zelniker, T. and Oppenheimer, L. (1976). Effect of different training methods on perceptual learning in impulsive children. Child Developmenmt,47, 492-497.

Zelniker, T., Renan, A., Sorer, I. and Shavit, Y. (1977). Effects of perceptual processing strategies on problem solving of reflective and impulsive children. Child Development, 48 1436-1442.