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Effects of Visual Skills Training on Impulsive Children's Piagetian Competencies

by

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ABSTRACT

A review of the literature has shown that both an understanding of individual variation in cognitive performance and the ability to offer individualized instruction are not provided by the general constructs of theories of cognitive development. The identification of intermediary processes and an integration of cognitive processes, developmental individual differences and environmental effects might result in guidelines for remediation of specific problems in learning and development.

Cognitive style dimensions have emerged from the individual difference tradition and are examples of intermediary process constructs. Of primary interest in the present study is: (1) the dimension of reflection-impulsivity (R-I), which refers to an individual's tendency to reflect or not reflect before responding to problems that contain response uncertainty, operationalized by the Matching Familiar Figures Test (MFF); and (2) Piagetian concepts of classes and relations as measured by the 64-Item Groupements (64-I). A second, related, cognitive style dimension of field-independence-dependence (F-I-D) was included to enhance the reliability of subject selection and was measured by the Children's Embedded Figures Test (CEFT).

Impulsive children have been shown to be unable to use certain Piagetian concepts available to their more

reflective peers. Since cognitive styles have been shown to be modifiable, this study attempted to assess whether training impulsive children in the skills of reflectivity would facilitate the expression of Piagetian competencies. This study thus addressed the question of whether there is a relation between the domains of reflection-impulsivity and selected Piagetian competencies.

After determining initial levels of competence on the three measures, impulsive children (N = 56, M = 7.0 years) were randomly assigned to training or attentional-control groups. Training to criterion in three fundamental visual information processing skills that underlie reflectivity was provided in small groups outside the classroom. Results indicated significant training effects on the 64-I and a trend towards a reduced error rate on the MFF.

Evidence was provided to suggest that there is a relation between the domains of R-I and Piagetian competencies and that efforts aimed at increasing both reflectivity and Piagetian competencies are feasible. Implications for testing and training and further research are discussed.

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CHAPTER I

INTRODUCTION

Satisfactory explanations of human cognitive development have been obstructed by the dilemma that while, on the one hand, there seems to be enough constancy in human behavior to infer universal constructs such as structures, schemes, and rules; on the other hand, the variability in behavior among individuals also warrants attention and explanation. If individualized instruction, designed to address specific problems in learning and development, is to be effective, the cognitive processes involved will need to be understood at a more basic level. Precise prediction of individual performance would require a theory that accounts for individual differences and environmental effects as well as for the more universal constructs.

Significant theoretical and empirical effort has been expended in an effort to understand the general nature of cognitive development as well as individual differences and environmental effects. How the three fit together has received much less attention. The study of individual differences in cognitive developmental processes is needed if we are ever to have a model at the level of the individual subject. Since some cognitive processes are malleable, increasing their flexibility of expression may enhance developing cognitive competencies.

Probably the most comprehensive effort to understand cognitive development has been made by Jean Piaget. Research within the Piagetian framework has focused primarily on the identification of universal patterns of structural development underlying children's knowledge and behavior. The primary concern, then, is how humans, in general, acquire knowledge. This characteristic of Piagetian theory limits both its applicability in the single case as well as its ability to generate educational prescriptions.

Piaget's theory is described as being structuralist and constructivist (Pascual-Leone, Goodman, Ammon & Subelman, 1980; Brodzinsky, Siegel & Golinkoff, 1981; Smock, 1981). Cognitive structure refers to inferred organizational properties of mental processes that underlie human thought and behavior. The constructivist concept implies that children have an important role in determining their own cognitive development through a continuous process of organizing and reorganizing experience. This self-regulated restructuring--both qualitative and quantitative--leads to the modification of existing schemes of thought. Although cognitive structures change with age, cognitive functions, such as assimilation, do not. These are the central processes by which adaptation to the environment is accomplished and by which development, transformation and refinement of cognitive structures take place, thus leading to equilibration. Content, in contrast to structure or function, comprises the

data collected about the environment. Examples of content are visual images, verbal language concepts, or abstract symbols. Cognitive content is thus the only directly measurable element in the system. Both structures and functions are inferred from these measurements.

Although a large amount of research has been generated by investigators outside Geneva on many aspects of Piaget's developmental stages, these findings have typically not been incorporated into the theoretical formulation (Case, 1978; Brainerd, 1978). Many variables have been shown to affect performance quality. These variables include task, situational and organismic factors such as type of instructions and sex of subject (Neimark, 1981). If an understanding of any particular individual's cognitive development or unique performance on a specific task is ever to be reached, universal structures as well as mediating process accounts are needed.

In addition to research related to Piagetian concepts, there has also been an increased interest in the cognitive processes involved in memory and learning. Examples are the mnemonic strategies being taught to mildly retarded populations (Brown & Barclay, 1976) and Sternberg's (1977) work with geometric analogies. With the combined influence of the Piagetian perspective and an increased interest in individual differences, attempts at the formulation of process theories of learning and development are being attempted

more frequently (Federico, 1980). As Federico states:

> Many recently published texts emphasize the mental mechanisms mediating performance. (e.g., J.R. Anderson, 1976; Spiro & Montague, 1977...). It seems at the same time the previously distinct perspectives of educational psychology and cognitive psychology may have converged. Among the reasons for this phenomenon are (1) many experimental psychologists have shifted their interests from limited laboratory studies to practical educational considerations; (2) much research and theoretical interest has been generated by Jean Piaget's (1936/1952), (1945/1951) concepts of cognitive development; and (3) numerous studies reflect an increased attention to individual differences not for discriminating among people, but for prescribing instructional treatments as a function of cognitive characteristics (Kogan, 1971; Rigney & Towne, 1970; Seidel, 1971). (p. 9)

Two of the more prominent approaches that have emerged in an effort to delineate the process/mechanisms involved in learning and memory involve the use of aptitude-treatment-interaction (ATI) and human information processing theory. The search for interaction between stable trait aptitudes and fixed treatments has not yielded improved instructional prescriptions, partly because of the high degree of vari-

ability of aptitude configurations both within and among students as well as the practical difficulties of doing this type of research in a school setting (Egeland & Schrimpf, 1978). The human information processing approach, on the other hand, seems to be most useful in accounting for the ability to deal with familiar, well-learned mental operations (Lachman, Lachman & Butterfield, 1979). It provides a way of conceptualizing underlying mechanisms of cognition and attempts to describe intellectual processes. This type of "process-tracing" has not addressed developmental or individual difference issues to any great extent. Information processing research and theorizing have generally been limited to investigating the sequential nature of information-seeking that leads to judgments or decisions (Lachman et al., 1979)and the tasks and methods used have not stressed prediction and control (Willis, Blow, Cornelius & Baltes, 1983).

A few investigators have begun to address the need to integrate process, developmental and individual difference variables. For example, investigators from the human information processing perspective have been showing interest in a large body of research from the individual difference tradition on cognitive styles (Federico, 1980; Calfee & Hedges, 1980). Developmental psychologists have also begun to show interest in cognitive style. Both Pascual-Leone et al. (1980) and Case (1974) have argued that problem-solving

performance is a function of the interaction between the child's competence or operational level and a group of task and organismic variables, including the child's cognitive style.

This comparatively recent attention to the cognitive processes involved in learning, memory, and cognitive development, as well as individual differences, has not failed to attract the interest of educators. Their aims would eventually be to develop both individualized instructional approaches as well as remediation methods to enhance children's learning options. Elementary school journals, learning disability journals, and special education publications are including discussions of cognitive styles and their relevance to academic learning (Blackman & Goldstein, 1982).

Despite the interest being shown, there have been relatively few investigations of the relationship between children's cognitive style and the development and use of Piagetian competencies. Some effort is being made toward establishing a relationship between certain cognitive style dimensions and several Piagetian cognitive developmental tasks. For example, spatial perspective-taking and conservation have both been shown to be related to the cognitive style dimension of reflection-impulsivity. It has been suggested that reflectivity facilitates an earlier entrance into, and a faster development through, the transition

period for these Piagetian competencies. The functional relationship between spatial perspective-taking and conservation on the one hand, and reflection-impulsivity on the other, is not understood at present (Brodzinski, 1982). In addition, several investigators have noted positive relationships between field independence and selected aspects of formal operational thought (Linn, 1978; Neimark, 1975).

One explanation put forward that addresses this emerging relationship between cognitive style variables and aspects of concrete and formal operational thought depends on the competence-performance distinction (Overton & Newman, 1982). From this perspective, success on a task is determined, not by competence alone, but also by certain circumstances that prevent competence from manifesting itself. For example, the cognitive styles of field-independence-dependence and reflection-impulsivity should only be an advantage in situations where field effects, or a cautious, analytic problem-solving approach, are central aspects necessary for success on the respective task (Brodzinski, 1982). Many types of variables can be shown to affect task performance.

Neimark (1981), in an attempt to establish a relationship between aspects of cognitive style and indices of cognitive development, expands on this competence-performance distinction and offers an explanation with

implications for future research. She proposes that individual difference variables such as cognitive style play an artifact role in the assessment of cognitive developmental level. They obscure competence. This interference with competence, that cognitive style causes, is due to similarities in the measurement of these variables. She found both cognitive style and Piagetian measures to be ambiguous in task instructions and expectations. They provide stimulus situations with little structure, a variety of alternative responses and no clear criteria for selection. It is situations like these that heighten individual variability and lead to the belief that typical Piagetian measures provide a biased assessment of true competence.

One way of dealing with possible bias introduced by cognitive style is by the use of a training study. If, through training, subjects could be made less impulsive or field-dependent, this might decrease or eliminate the source of bias resulting from their cognitive style and theoretically improve their performance on selected Piagetian tasks. Cognitive styles have been shown to be modifiable (Messer, 1976).

Although results have been mixed, there is evidence that demonstrates the modifiability of cognitive style factors by a number of training methods, including perceptual analytic-type training (Messer, 1976). These methods are more firmly established for impulsivity, the tendency to

respond before reflecting on the validity of one's solution hypotheses in problems that contain response uncertainty (Kagan & Kogan, 1970). There are, however, a growing number of studies that show field-dependence, the inability to perceive objects as discrete when they are located in a perceptually embedding context) to be modifiable as well (Witkin & Goodenough, 1981). If, through perceptual-analytic training, it can be shown that impulsive children's competencies with the use of Piagetian concepts increase, an important inferential link between reflectivity and aspects of such developing competencies may be established. A training study may also contribute important information regarding the sufficient conditions of training.

In summary, a growing number of investigators have observed significant relationships between reflection-impulsivity and conservation behavior (Barstis & Ford, 1977), spatial perspective-taking (Brodzinski, 1980, 1982), and perceptual decentration (Grant, 1976). Generally, impulsive and field-dependent children are not as competent with the use of Piagetian concepts in comparison to their reflective and field-independent peers. Although these studies have yielded promising results, little is known about the nature of the relationship between cognitive style variables and developing cognitive competencies. How does reflection-impulsivity affect the manifestation of competence? Can training in cognitive style contribute to

successful performance? Is this performance decrement superficial? These are but a few of the unanswered questions.

The purpose of this study is fourfold. The first objective is to determine whether impulsive children's Piagetian competencies can be enhanced by training in visual information-processing skills that underlie reflectivity.

The second objective is to provide support for the notion that there is a connection between the domains of reflection-impulsivity and selected Piagetian competencies. If it can be demonstrated that performance modification in the cognitive style domain transfers to the domain of Piagetian problem-solving, then support for the notion that these visual information processes underlie both domains will have accrued. The discovery of such relationships would provide a better understanding of the educational needs of impulsive children. By providing fundamental information about the development of cognitive competencies, educational psychologists can assist in program development that more closely matches the needs of individual children.

The third objective of this study is to determine whether the conditions reported in the literature (Egeland et al., 1976), under which such processes and strategies have been trained, are appropriate for a contemporary Calgary sample of children. If information regarding the degree of modifiability and the conditions under which such processes and strategies can be trained or optimized is

obtained, then a better understanding of the sufficient conditions of training will have been acquired. The final objective is to evaluate the short-term durability of any training effects. Informal observation during training may also suggest factors which appear to program effectiveness and durability and therefore seem to warrant further investigation.

Specification of the limitations of this study as well as delimiting the domains it is intended to focus on is necessary for several reasons. These include: (a) construct measurement problems within the area of cognitive style; (b) difficulties associated with interpreting the results of training studies; and (c) antistructuralist efforts to disprove Piagetian theory.

At present there is no highly reliable measure of the cognitive style dimension of reflection-impulsivity. Selecting impulsive children is difficult because measurement of impulsivity is particularly unstable. This high degree of variability in scores, derived from the only claimed measure of impulsivity, the Matching Familiar Figures Test (MFF), makes detection of treatment effects difficult.

Training studies pose difficulties when attempting to interpret results. For example, in the present study, direct measurement of the children using the trained perceptual-analytic skills during the solution of the training or

transfer tasks will not obtained. The skills children actually use during any of the problem-solving cannot be determined from the data obtained in this study. Neither does the study contribute to the understanding of other potentially successful types of training; for example, those using different sensory modalities. A number of issues have been raised regarding the interpretation of training studies (Brown & Campione, 1978).

Although young children can be trained to use effective strategies, once trained they frequently revert to their immature strategies when no longer explicitly constrained to use the training. The meaning of this regression may be uninterpretable without direct measures to examine individual differences in the use of the training, because such training may be very effective with some subjects and not with others. It may be that durability, as an indication of instructional effects, is informative only if it is considered in conjunction with direct measures of problem solution processes, independent of criterion performance (Belmont & Butterfield, 1977).

This study will provide training in skills that underlie reflectivity for a group of impulsive children. If these children subsequently answer more Piagetian classes and relations problems correctly, it may be possible to infer some connections between the domains of reflection-impulsivity and selected Piagetian concepts. That is, the

processes that underlie reflectivity may also be prerequisites for some aspects of Piagetian problem-solving or, alternately, the two domains may share component or related processes.

However, even if training is successful, because of the reasons cited above, the present investigation can only suggest an area that is worthy of further study. The processes taught during training are only one possible set of processes that seem to be required for successful performance on both the training (reflection-impulsivity measure) and transfer task (Piagetian measure) and only a narrow sample of Piagetian competencies was investigated.

CHAPTER II

REVIEW OF SELECTED LITERATURE

The following review summarizes literature on several perspectives of cognitive style. Particular emphasis is placed on its developmental nature, its educational implications, and issues related to its modifiability. In the present context, cognitive style will be limited primarily to the dimension of reflection-impulsivity.

Work on the emerging relationship between cognitive style and Piagetian constructs of cognitive development will also be reviewed. The nature of Piagetian cognitive competencies and the growing literature showing children to be at a disadvantage in displaying competence depending on their cognitive style are included. Primary emphasis will be placed on the period of concrete operations.

The literature review will also suggest that, although the original conceptualization of cognitive style dimensions was bipolar with no negative values being attached to persons falling at either end of the continuum: Subjects who tend to be reflective and field independent have significant adaptational and educational advantages in our society. Issues related to the modifiability of these dimensions will be discussed. These will include comparisons of types of training, problems with subject identification, durability, and generalizability of effects.

Recent investigators have devised a variety of techniques for the study and training of cognitive processes. See Haywood, Burns, Arbitman-Smith and Delclos, 1984, for work which includes the application of concepts from Feuerstein, Piaget and other developmentalists within a cognitive education program for preschoolers. Samuels (April 2, 1986, personal communication) notes an unpublished study which adapted concepts from Feuerstein to the cognitive process training of elementary school-age children conducted at Ontario Institute for Studies in Education. Because the current study was concerned primarily with relationships between reflection-impulsivity and the expression of Piagetian competencies in the young, elementary school-age child, this review will be limited to cognitive styles, their modification and relationships between cognitive styles and Piagetian concepts.

Approaches to Cognitive Style

Cognitive styles have emerged to fill a void between an individual's response to items on ability and aptitude tests and the actual score obtained on such measures. Although psychological testing has traditionally been used to categorize people according to a variety of abilities and aptitudes, the internal processes or mental mechanisms that underlie such classifications have not been specified. The role of intermediate cognitive processes and the effects of

personality variables on cognitive task performance need examination. With the increased specification of mediating variables such as cognitive style, adapting instruction to individual differences should be more feasible.

In the years between 1970 and 1976, Messick (cited in Goldstein & Blackman, 1978) identified five and then 19 separate approaches to the analysis of cognitive style. The domain has generated constructs that vary widely from one another and come from quite different theoretical traditions. Some originate from research on adults; others originate from research on children; and they vary from constructs close to the ability domain to constructs that seem closer to cognitive strategies or preferences. The breadth of this domain has led to the term "Cognitive Style" being used to refer to very different modalities of psychological processing, causing confusion to would-be readers of the field.

Cognitive Style Definitions

A general definition of cognitive style is that it represents a relatively stable self-consistent mode of adaptation that mediates the way in which the individual processes information. Two conceptions of cognitive style that have received a large amount of attention by investigators are reflection-impulsivity (R-I) and field-independence-dependence (F-I-D).

Reflection-Impulsivity

Kagan and his associates (Kagan, Rosman, Day, Albert & Phillips, 1964; Kagan & Kogan, 1970) define impulsivity as "the degree to which a subject reflects on the validity of his solution hypotheses in problems that contain response uncertainty." This dimension is also known as cognitive or conceptual tempo. The principal measure of the dimension is the Matching Familiar Figures Test (MFF). The MFF provides both response time and error scores (Kagan, Rosman, Day, Albert & Phillips, 1964).

Field-Independence-Dependence

The second cognitive style dimension of interest was defined by Witkin and his associates (Witkin, Dyk, Patterson, Goodenough & Karp, 1962) as the ability to perceive objects as discrete when they are located in a perceptually embedding context. The children's measure of this dimension is the Children's Embedded Figures Test (CEFT)(Witkin, Oltman, Raskin & Karp, 1971).

Cognitive Process Terminology

The following definitions relate to terms that appear in the literature on individual differences in cognition. Because of the comparatively flexible use of terms in this area, cognitive style may overlap with, or incorporate, aspects of the following, more specific terms.

Cognitive Control

Originally introduced by Klein (cited in Goldstein & Blackman, 1978), "cognitive control" refers to hypothetical delay and control processes that channel the expression of needs appropriately, depending on the situation. A more recent worker in this area is Santostefano (1978), who is studying several dimensions of cognitive control that seem similar to the previously mentioned cognitive style dimensions of reflection-impulsivity and field-independence-dependence. They appear to have a more biological flavor. Examples are focal attention, field articulation, essentially the same as Witkin's concept (Goldstein & Blackman, 1978) and body schema-tempo regulation. While many of the cognitive controls overlap with other cognitive style dimensions, they are not identical.

Assembly and Control Processes

These terms are used to refer to the higher order strategic processes involved in the organization, reorganization, and monitoring of the components of performance. Executive control processes, executive functions, or routines are used similarly, but the implication is that they provide the individual with volitional control over various cognitive routines that are used in problem solving. These processes are considered metacognitive.

Cognitive Strategies

The use of the term strategy has become conceptually confusing. Gerber (1983, p. 259) has suggested that the term 'strategy' be used for "...the skillful, deliberate, and coordinated use of problem solving tactics. Tactics...are skills, clusters of related skills, or expeditious procedures associated with solving specific types of problems." He also states that comparatively independent skill clusters and algorithms organized by training a "general case" concept for a class of tasks may form a necessary but not sufficient basis for strategic behavior. To be strategic includes a metacognitive component or a deliberate, conscious use of skills in contrast to rote rule following.

Learning Styles Versus Learning Strategies

Schmeck (1983), from a compatible but slightly different perspective than writers in the area of cognitive style (Messer, 1976), uses the terms learning strategies and styles. For him, a learning strategy is a pattern of information processing activities used to prepare for an anticipated test of memory, whereas a learning style is a predisposition to adopt a particular learning strategy, regardless of the specific demands of the learning task. A style is simply a strategy that is used with some cross situational consistency.

Problems with Cognitive Style Research

Many problems in cognitive style research are related to design and measurement issues. The majority of studies with the reflection-impulsivity construct as a variable have relied on only one flawed measure to quantify the dimension. These problems make interpretation and generalizability of results difficult.

Design and Measurement Problems in Reflection-Impulsivity Research

Reflection-impulsivity has primarily been operationalized by the MFF. Using a sample of second and fifth graders, Egeland and Weinberg (1976) investigated the short-term stability of MFF scores. Canonical correlations and test-retest correlations were approximately .65-.75. The χ^2 analyses indicated that approximately 45% to 70% of the subjects classified as impulsive or reflective at time one were classified in the same way at time two. By selecting extreme groups, the percentage of subjects misclassified at time two was reduced. The MFF consistently classified reflectives more reliably than it did impulsives. One possible explanation put forward by Egeland et al. (1976) regarding instability of impulsive scores is that since children become more reflective with age it may be that impulsive children are in an unstable transitional state and this is reflected in their MFF scores. Alternately, as consistent with Block, Block and Harrington (1974), impul-

sives are described as "fearful and inhibited, with little margin of adaptability" (p. 629) in situations with a high degree of response uncertainty. It may be that impulsive children are anxious initially in the test situation and therefore feel "an urgency to escape [the] pressuring circumstance" of the task. On retest, they have had time to adapt and they may feel more comfortable and so feel freer to take more time problem solving and make fewer errors.

In a brief report by Ault, Mitchell and Hartman (1976), the methodological problems caused by certain statistical characteristics of the MFF are addressed. The low reliability of error rates causes frequent errors of classification. There are regression effects in repeated measures designs not employing a control group, and statistically insignificant effects in small sample studies are found when error rate is manipulated. The common practice of dichotomizing the continuous variables of latency and errors by median splits results in a loss of statistical power as well. The use of median splits also has the effect of neglecting the other two groups (fast accurates and slow inaccurates). These findings suggest the necessity for a control group in studies using repeated measures designs, appropriate sample sizes, the consultation of norms to prevent sample-specific subject identification as well as controlling for age. They also indicate that unless the experimenter is specifically interested in error and latency

individually, a composite score may be helpful and that alternatives to median splits should be explored.

Alternate Forms (MFF) and Alternate Measures

The development of additional instruments is needed to give investigators increased flexibility in the selection of experimental designs. Cairns and Cammock (1978) developed a more reliable version of the MFF after item analysis of thirty MFF-type items. Twenty items were selected that were suitable for boys and girls in the seven-to-eleven-year age range. The items were found to be of equivalent difficulty and the authors suggest that the MFF 20 may be divided into two comparable halves, sufficiently equivalent for pretest and posttest research purposes pending the development of an appropriate twenty-item form. Although the MFF-20 is an improvement, enhanced reliability with young impulsive children will probably require 20 items and therefore many more items (alternate 20-item forms) are necessary for repeated measures designs.

Schleser and Thackwray (1983) describes the MFF as a gross measure of impulsivity. It does not yield specific cognitive deficits associated with impulsive behavior. It is unlikely that a single measure can uniquely or completely define multidimensional phenomena such as cognitive style constructs (Pellegrino & Goldman, 1983). To achieve a more complete understanding of reflection-impulsivity, the proto-

typical tasks associated with the dimension, tasks that show high levels of intercorrelation, need to be identified. Analyses of these intercorrelated tasks, in an effort to define more completely a set of processes or skills comprising the construct, are also necessary. A variety of basic cognitive processes, including memory, attentional and coding processes, have already been suggested.

Because of the limited availability of alternate forms of the MFF, other cognitive tests are frequently used along with it. The CEFT has been used as an additional visual information processing task to enhance the validity of the MFF. As a measure of children's selective scanning and disembedding abilities, the CEFT has been used to assess training effects on skills and abilities essential to traditional academic learning (Moore & Cole, 1978; Egeland et al., 1976). Reliability estimates range from .83 to .90 and are comparable to those obtained from the adult Embedded Figures Test. No sex effects were found.

Because the relationships between cognitive styles and performance measures have not been mapped, the relationship between the dimensions of cognitive style and behavior remains unclear. New measurement instruments that are directed at relationships between cognitive style and behavior might clarify some of these issues.

Construct Validity of Reflection-Impulsivity

Block, Block and Harrington (1974) have questioned the construct validity of reflection-impulsivity on a number of grounds. In Kagan's original conceptualization, latency was emphasized as the more central quality, and yet large unspecified weight was given to response accuracy as well. As these authors note, response errors are only a partially correlated consequence of a short response latency. They found latency to have an inconsequential relationship to other variables, while accuracy was related to a number of other important variables. They also objected to the excess meaning researchers tend to ascribe to the reflection-impulsivity dimension. The evaluation of how much variance is separately contributed by errors and response time, as well as the excess meaning often attributed to the term remain serious problems with the construct. Kagan and Messer's (1975) reply to these criticisms was to state that the Block et al. findings may be valid for preschool children as long response times are not accompanied by lower error rates. Wright and Vlietstra (1977) note that it is the negative correlation between errors and latency that contributes to the construct's validity. When speed and accuracy are so related, the class of tasks are of the type having a large number of initially promising solutions or having an attractive or dominant response which is likely to be incorrect. These tasks produce more variance between

impulsive and reflective responding. The type of problem in which the primary difficulty is with the planning, monitoring, and execution of sequential steps does not optimally separate reflectives from impulsives. In these tasks the primary feature is that speed and accuracy are positively correlated. These are described by Wright and Vlietstra as power tests where the time aspect is not of such central concern.

Another factor that has been identified as central to the construct of reflection-impulsivity is response uncertainty (Margolis, Leonard, Brannigan & Heverly, 1980). These investigators found that with six-year-old children the greater the degree of response uncertainty inherent in a test, the more effective the test would be as a predictor of children's impulsivity. This finding may be at least as important as the traditional negative correlation between latency and error scores. Tasks that contain response uncertainty are referred to both in the definition of the construct, as well as in a great many studies in the literature on reflection-impulsivity. It would, therefore, seem important for any measure of reflection-impulsivity to have a high degree of response uncertainty.

Variance Contributed by Chronological and Mental Age

Discriminating the unique trait variance contributed by the construct of reflection-impulsivity when developmental

variables such as chronological and mental age and ability constructs are uncontrolled has proven difficult. Achenbach and Weiz (1975) found that R-I as measured by the MFF is correlated with chronological and mental age. They note the difficulty in drawing valid inferences about the dimension unless it can first be demonstrated that a relationship remains significant after the common correlation with chronological or mental age is controlled. Their subjects were preschool children and, as previously noted, the construct may not be stable or present with very young children. They also failed to find evidence of independent contribution to hypothesis forming behaviors, but findings from Mitchell and Ault (1979) do indicate that the MFF is significantly related to the evaluation process, a component of problem-solving, rather than to hypothesis generation. These findings suggest that reflection-impulsivity is differentially related to various aspects of problem-solving. The need to control for the influence of age is also suggested.

Finally, there continues to be a dispute regarding the discrimination of cognitive style from general ability. Messick (1976) notes:

> Cognitive styles bear on the manner in which behavior occurs as opposed to the content. They represent superordinate processes in contrast to an ability which usually refers to a fairly

> limited area. Cognitive styles seem to organize lower level strategies and problem-solving operations which may include abilities. (From Federico, 1980).

Attempts at Construct Analysis of Cognitive Style Measures

Snow (1980), in an effort to clarify the relationship among commonly used cognitive reference tests, has provided preliminary correlations between several tests and factors. Although a limited number of studies were used, the results suggest the reflection-impulsivity construct is not bivariate. He pictorially shows where the two cognitive style measures, the MFF and the Embedded Figures Test, fall in relationship to other cognitive tests and constructs such as Gc (crystallized ability), Gf (fluid ability), and Gv (spatial ability). His analysis has produced a description of the MFF as essentially a perceptual-speed matching test. Fast-accurate subjects are seen as showing high perceptual-speed ability, while impulsives and slow-inaccurate subjects are seen as showing low perceptual-speed ability. Reflectives, on the other hand, were described as probably using a third type of approach that is slower and more analytic. Snow would tentatively place reflectives nearer to Gv and Gf and, although he notes that the construct seems to be more than bivariate, he also notes that this is a confusion often ignored in the literature.

He also agrees, with regard to the F-I-D construct, with Witkin (1973) that field-independence is, in essence, measuring what appears to be measured by the Wechsler block design, object assembly, and picture completion subtests. These subtests usually fall into Gv and Gf clusters. Snow, however, does not take into account some of Witkin's data showing field-dependent individuals to be more socially skilled and to have a better memory for faces.

In a related vein, Carroll's (1983) Concordance of Selected Cognitive and Cognitive-Related Factors classifies tests of perceptual speed like the MFF under the Gv factor called general visual perception. Under the category "Miscellaneous Affective-Cognitive Factors", he has two factors, Attention and Carefulness, which seem related to both R-I and F-I-D. The underlying operations that comprise reflective and field-independent behaviors have received some support, with regard to their academic relevance, from a psychological test manufacturer.

A recent test developed by Woodcock and Johnson (1977) called the "Woodcock-Johnson Psycho-Educational Battery" has a cluster called Perceptual Speed. It is comprised of a combination of two subtests. Spatial Relations, which appears to be a simplified CEFT, and Visual Matching, which is similar to the MFF using numbers rather than drawings of objects. As the authors note, Perceptual Speed was most highly correlated with Mathematics Aptitude and Written

Language Aptitude. In their description and interpretation of the cluster, each subtest appears to be a power as well as speed test. The cluster is seen to be a measure of visual-perceptual fluency and accuracy. It is also noted that organized, analytic response strategies are necessary for proficient performance. The battery has been suggested as a possible replacement to the WISC-R. The fact that it includes a Perceptual Speed cluster suggests a growing awareness of the importance of cognitive style type factors.

Reflection-Impulsivity

Of primary interest to the present investigation is the dimension of cognitive style called reflection-impulsivity. Possible factors in the dimension's aetiology, the development of strategic attentional skills as well as the dimension's developmental correlates will now be considered.

Etiology

The etiology of the dimension of reflection-impulsivity remains unclear. The roles of genetic transmission, child-rearing practices, socioeconomic influences and other potential causes of reflectivity or impulsivity have been infrequently investigated. For example, certain groups of children that are socially disadvantaged, both educationally and intellectually, tend to be more impulsive (Messer, 1976; Duryea & Glover, 1982). Some evidence has been put forward

by Salkind (1977), who found support for a child's latency score on the Matching Familiar Figures Test to be consistently related to his or her parents' latency in the expected direction. Salkind reasoned that because latency is not an obvious component of task performance, similar behaviors between parents and biological children may be a result of genetic transmission. No relationship was found for error rate, and Salkind reasoned that error may be more a function of task specificity, difficulty or instructional variables. It also seems that accuracy may be more susceptible to factors such as parental demands and social pressures, since the nature of committing an error is more easily observable and imitatible than the latency associated with the task.

Goldstein and Rolins (1983) were looking for variables which predict the quality of information transmission in both members of the parent-child dyad. They examined the contribution of cognitive style (R-I) to the quality and level of mother-child interaction during a teaching-learning task. Forty mother-child dyads comprised four groups with cognitive style match or mismatch; the children were grade 2 males. Reflective mothers provided more strategy-level verbal instructions by hierarchically organizing the pictures in the experimental task. Moreover, reflective mothers used more demonstrations (organization) with the stimulus cards, while impulsive mothers tended to point at individual cards.

There were no significant differences in the mothers' use of feedback, approval, or disapproval. Reflective mothers used an instructional style which emphasized the categorical nature of the task and their children were more strategic and remembered and clustered more items regardless of the child's own cognitive style. The results suggest a relationship between cognitive style and the quality of mother-child interaction.

Attentional Strategy Development

Before addressing developmental aspects of reflection-impulsivity, development of selective-attention and scanning strategies, the domains from which individual differences in style emerge, needs explanation. There is a clear developmental trend in how children learn to allocate their attention. Young children, before about 7 years of age, do not adapt their attention to task demands. They do not effectively filter out irrelevant information. For example, Lane (1979) found that young children allocated no more attention to a high-payoff task than to a low-payoff task. The ability to attend to relevant material and to ignore the irrelevant, that is, to selectively allocate attention, occurs primarily between about 7 and 10 years of age. Thus, children acquire information-collecting behaviors or strategies, which are critical components of information processing competence.

Wright and Vlietstra (1975) have characterized the trend towards information processing competence as development from stimulus-controlled exploration, which is more passive, to logic-controlled search, which is active and resembles work in that it is goal oriented. Impulsivity is seen as comparable to stimulus-controlled exploration, while reflectivity is comparable to logic-controlled search. The trend towards increasing reflectivity as a child grows older seems to parallel the trend from exploration to search. Stimulus-controlled exploration is seen in more unfamiliar situations and is more disconnected, transient, and playful. It seems to be dominated by the most interesting environmental features at any moment rather than by purpose or logic and lacks continuity or selectivity based on informational content. It seems to be a process of serial habituation of attention to the most interesting or novel features in the area being explored.

Logic-controlled search behavior, in contrast to stimulus-controlled exploration, occurs later and in more familiar situations. It is more organized, persistent, and goal-directed. This logical search strategy of selecting information is more under the control of the intentions of the child and the necessities of the situation or task. It is accompanied by an awareness of the consequences of the actions taken. A child engaged in search is better able to selectively attend to those stimuli that are relevant to the

demands of the task and to ignore competing irrelevant stimuli. Finally, it is deliberate and slow in nature, organized, and logically focussed.

From preschool to early grade school years children's visual exploration becomes more organized and exhaustive as well as controlled. It is the coordination of organized, exhaustive scanning with logical search which facilitates the ability to selectively allocate attention. There may be a lag between attainment of strategies for gathering relevant information and acquisition of the ability to use these strategies where they are appropriate. This lag may be related to conceptual development (Brown, 1978).

Experimental support for the notion of sequential acquisition of visual information processing competence has been provided by Vurpillot (1968). It is notable that in Vurpillot's research the development of scanning strategies and visual differentiation seem to parallel the developmental components of reflectivity. In a task very similar to a simpler version of the MFF, the kind of information normal children of different ages retained from a stimulus and the kind of strategy they used to make comparisons, as well as the basis on which they made their decisions, was examined by recorded eye movements. She found that as children got older they began to develop more adult-like criteria for establishing identity or difference. Not until six years of age did children scan thoroughly. Before six they stopped

scanning arbitrarily and made judgments on only part of the available information. Even older children did not always scan thoroughly. On the whole, they used the same criteria of identity and difference as adults and the improvement came between six and nine years because of a more systematic use of the ideal scanning strategy. As Vurpillot states, there are a succession of stages in the execution of a task of comparison:

> In the first stage the children have no definite criteria of 'same' or 'different'; they scan the pictures at random and their answers are not related to the information collected...In a second stage they define sameness by the existence of a common element and difference by the absence of a common element; at this stage no spatial frame of reference seems to play a role and the visual scanning is limited to a part of the stimulus...In a third stage the definitions of same and different become adult criteria and the comparisons are articulated in a frame of reference. But this frame is still very limited in space as well as time; it includes only the elements that can be scanned and memorized in a few seconds. In a fourth stage there appears a systematic strategy of scanning--the comparisons already made as well as those still to be performed. (p. 649)

In summary, as children age, they increasingly move from partial, passive, nonstrategic scanning or exploration to more systematic, exhaustive, active search. Wright and Vlietstra (1977) have noted that stimulus-controlled exploration resembles the information-collecting behavior of the impulsive child: whereas logic-controlled search resembles the information-collecting behavior of the reflective child. As noted by Vurpillot (1968), Piaget's theory predicts an increase with age of the extent in time and space of the range of perceptual activity. Maturity of information-collecting skills may provide at least a partial explanation for the differences observed between reflectives and impulsives. Despite the overall normative change with increasing age from impulsive-like behaviors toward reflective ones, the relative standing of individual children on the R-I dimension appears to be fairly stable over time (Zelniker & Jeffrey, 1979). The R-I dimension seems to consist of a set of preferences, abilities, and biases and, as originally conceptualized, is orthogonal to intelligence. However, it probably contributes to the development of a number of abilities that comprise intelligence such as concept formation, problem-solving, and the use of strategies.

Developmental Correlates of Reflection-Impulsivity

Performance of the reflective child resembles that of a chronologically older child, while the impulsive child's performance has often been compared with that of younger children. The developmental nature of R-I has been studied by several researchers. Kagan and Kogan (1970) found that MFF errors decrease, while latency increases during the years between 5 and 11. Cairns (1978) failed to find support for some of these trends. While noting a significant decrease in errors, there was a nonsignificant trend towards increased latency over the years from 5 through 13. Finally, in a large compilation of data reported in previous studies on approximately 2,846 children between the ages of 5 and 12, Salkind and Nelson (1980) found a significant decrease in errors and increase in latency as children got older. These findings indicated that during the years between 10 and 12 error rate became more stable and latency increased. These findings suggest that error rate does decrease till around 12 years of age.

Reflection-impulsivity also seems to affect the acquisition of certain developmental skills. The majority of findings indicate that the significant difference between reflectives and impulsives lies in their visual information processing skills. It is these early information-collecting skills that form the basis for the acquisition of later skills. Wright and Vlietstra (1975) and a number of other

investigators have attempted to specify these differences. On the one hand, impulsives at any age appear more drawn to perceptually salient cues in the environment. Reflectives, on the other hand, are increasingly seen to be more advanced in several areas of development including systematic search. Both Kagan (1966 b) and Katz (1971) report reflectives prefer the more developmentally mature response, which is to choose form rather than the more perceptually salient stimulus characteristic of color.

Differences in Style of Processing between Reflectives and Impulsives

Reflectives have been found to possess superior visual analytic skills and tend to score higher on the performance subtests of intelligence measures (Wright & Vlietstra, 1977; Messer, 1976). In the verbal subtests reflectives tend to score only slightly higher than impulsives, suggesting that it is with the visual problem-solving processes that the cognitive style exerts its influence.

Empirical support for the notion that visual information processing skills differ between reflectives and impulsives has come from several investigations that have implicated visual search or scanning behavior as a primary source of these differences. Drake (1970) was investigating the question of whether the different response latencies of impulsives and reflectives represent differences in cognitive approach to the task and whether these differences vary

with age. Reflective and impulsive grade 3 children differed in their approach to the solution of MFF items from the beginning of task performance. Using both the standard MFF, and several simpler modified versions, as well as recorded visual fixations, impulsives were found to make very few detailed comparisons across figures and perform relatively brief global scanning. They also looked at the standard and the alternatives less frequently.

Drake (1970) also investigated adult approaches to the task and concluded that adults were more reflective than children and more systematic and exhaustive in their scanning. There seemed to be one of two strategies operating. The first strategy involved looking at differences between variants and the standard and choosing a particular variant when no difference was detected between it and the standard. The second strategy involved looking for differences between variants and the standard in order to eliminate each deviant variant until one variant remained which will be exactly like the standard. Only the second strategy allows for a perfect solution to the task. What seemed to distinguish the reflective adult from all others was the consistently successful application of the second strategy.

Zelniker and Jeffrey (1976) investigated the hypothesis that impulsive children differ from reflective children in the strategy they choose to process information. They used a

variety of tasks including matching, grouping, recall and concept attainment together with different ages of children and found impulsive children's typical inferior performance may be due to their global-processing strategy being incompatible with the more detailed analysis required for most tasks.

Siegelman (1969) was attempting to identify the characteristic-orienting and observing behavior of impulsive and reflective 9-year-old children on the MFF. She measured frequency and duration of observing responses. Impulsives were found to use a combination of less extensive scanning and an inefficient strategy frequently comprised of choosing the first plausible alternative.

Additional correlates of the reflection-impulsivity dimension have also been studied. Briefly, these studies indicate that impulsivity affects a variety of aspects involved in problem-solving. Lawry, Welsh and Jeffrey (1983) looked at progressively more difficult problems on the Raven's SPM in an investigation of the range of performance of the cognitive tempo groups. They found differences between reflectives and impulsives only when the problems became more difficult. Other aspects of problem-solving that are negatively affected by impulsivity have included strategy selection, concept identification, recognition memory and metamemory (Adams, 1972; Nuessle, 1972; Siegel, Kirasic & Kilburg, 1973; and Borkowski, Peck, Reid & Kurtz, 1983).

Finally, past studies have found differences in activity level with impulsives being more active. However, this has not held up within a normal population of children. Moore, Haskins and McKinney (1980) found no significant differences between impulsives and reflectives on a variety of classroom behaviors. This has led the authors to recommend a restricted use of the terms to apply to cognitive behavior only. Aspects of their behavior rating scale may have biased their results, although the investigation's subject sample was carefully selected.

Impulsive children's performance has been behind that of their reflective age mates on the problem-solving tasks used in the reviewed research. Research has indicated that the deficit that impulsivity represents is not only the visual skill of search and scanning but also the development and effective deployment of visual information processing strategies.

Field-Independence-Dependence

This section will review the cognitive style dimension of field-independence-dependence, including a brief account of its etiology and developmental correlates. As a construct it resembles R-I but has received greater empirical and theoretical attention. In the 1981 revision of their theory of cognitive styles, Witkin and Goodenough make reference to an enlarged dimension of individual differences. They also

acknowledge two separate and related components of field-independence-dependence: cognitive restructuring and perception of the upright. In the present study, F-I-D refers to cognitive restructuring only and not to perception of the upright or the more general dimension.

Etiology

Research and theoretical work has been more extensive on F-I-D than on R-I and more is known about the sources of developmental and individual differences. However, examination of field-independence-dependence literature is beyond the scope of this review. Biological and genetic determinants have also received attention; however, results have been inconclusive. It is apparent, as indicated by a great number of investigations, that environmental variables contribute significantly to the development of this dimension. A broad range of variables, from training studies aimed at improvement of restructuring skills, to child-rearing practices, to cultural factors have implicated environmental concomitants. A combination of socialization practices, cultural influences and ecology all seem to play a part in the development of a field-independent or field-dependent cognitive style. (Witkin & Goodenough, 1981).

To the extent to which a person relies on external referents or relies on self-referents may influence the development of processing information from the field. This

information processing style may determine whether the person will restructure the field or yield to the field's dominant properties. The cross cultural literature lends support. In societies which encourage autonomy from parental and social authority while children are growing up, more people evidence field independence in perception of the upright and competence in cognitive restructuring. This is in contrast to societies where conformity is emphasized.

Developmental Correlates

Unlike that of the R-I dimension, the developmental course of F-I-D is firmly established within a more general developmental theory, that of psychological differentiation. The typical course in individual development is from a field dependent to a field independent manner of functioning. Field-independence-dependence develops until about mid-teen years, and individual differences in restructuring ability can be found at every age as early as kindergarten. Although the evidence is difficult to interpret, pronounced sex differences do not appear to emerge until adolescence (Witkin & Goodenough, 1981). Restructuring skills seem to consolidate in prepubertal years and a person's designation on the field-independence-dependence continuum at age ten tends to be highly correlated with a person's designation at age fourteen.

Relationship between R-I and F-I-D

Some investigators have noted similarities between R-I and F-I-D. Witkin and Goodenough (1981) note that a modest relationship has been found, but that the nature of this relationship is not clear. They comment that the less structured controls of relatively field-dependent people may play a role in their more rapid "impulsive" responding. Reflectives are significantly more field-independent than impulsives. Differences in concept attainment strategies characteristically used by field-dependent and field-independent people may also contribute to differences in MFF performance.

In a longitudinal study by Neimark (1975) on problem solving, R-I and F-I-D were found to measure a slightly different aspect of behavior. Field-independence appears to be more complex and to develop later in childhood than reflectivity. These style effects were seen as at least partially additive and that two aspects of task approach involved in cognitive style enhanced problem solving and progress towards formal operations. These were the tendency to control response until information is properly assessed and an analytic approach which seeks task-appropriate informational features despite misleading or more salient cues. Neimark notes that this probably indicates an active versus passive approach to a task. In several studies they are used jointly and along with other measures as assessment

devices for visual information processing skills found to be necessary components for traditional academic achievement (Egeland et al., 1976; Moore & Cole, 1978).

Although the relationship between field-independence-dependence and reflection-impulsivity remains unclear, both measures require perceptual-analytic skills. Both measures also contain response uncertainty and require scanning and analysis of a visual field. The ability to perceive objects in a perceptually embedding context, that is, to cognitively restructure stimuli as well as reflecting on the validity of solution hypotheses, may contribute independently to successful problem-solving (Neimark, 1975).

Summary of Two Approaches to Cognitive Style

The study of individual differences between problem-solving approaches in children has, to a significant extent, been dominated by Kagan's construct of "cognitive tempo" or reflection-impulsivity. Although many attempts have been made to clarify the nature of this construct, as operationalized by the MFF, it remains ambiguous. The dynamics of reflection-impulsivity, its generalizability, and whether it does, in fact, have either broad personality or behavioral correlates, is still in question. Even in the problem-solving sphere, conditions under which speed and/or accuracy differences manifest themselves are not understood. The extent to which task difficulty or amount of analytic

reasoning required affects a reflective or impulsive style, and whether this characteristic is manifested primarily in tasks requiring visual matching or in the majority of problem-solving tasks, is also unclear.

In spite of conceptual and assessment problems, MFF performance has been found to correlate fairly well with a variety of important variables related to the problem-solving situation, academic achievement, and, more recently, measures of Piagetian competencies. It is these emerging relationships between dimensions of cognitive style and Piagetian competencies that are of primary interest to the present study. Before examining this small, but growing literature, some explanatory conceptualizations of how cognitive style exerts its influence will be considered.

Mechanisms of Cognitive Style's Influence

The manner in which cognitive styles exert their influence has generated a variety of plausible conceptualizations. Three of the most promising of these models are summarized below.

Attentional Capacity Model

A conceptualization which addresses effects of individual differences and which suggests additional commonalities between reflection-impulsivity and field-independence-dependence has been put forward by Case (1974)

from the context of the more general developmental theory of Pascual-Leone. Passivity in a person's approach to problem-solving, is described in terms of M-power. This construct refers to mental effort or energy, capacity, or space. It has also been compared to the concept of working memory. A person's success in problem-solving is seen as the tendency to utilize all available M-power. M is an organismic developmental construct which may be measured by the number of different schemes that an individual's M can weigh in a single mental operation (Pascual-Leone et al., 1980). Certain subjects are seen as habitually low M-processors. If the opportunity exists, they will deal with problems in the simplest manner possible, involving the least effort. They are expected to do poorly on problems where some simple solution is available but the more adequate solution requires an analytical approach of reducing a global stimulus into subelements.

Another correlated factor listed by Case (1974) that affects a subject's chance of solving certain problems is the relevance given to cues from the perceptual field versus other sources such as task instructions. In other words, this is the tendency to give weight to salient but misleading cues. Individual differences in these areas are seen as consistent across time and many tasks. This conceptualization bears obvious similarities to efficacy of strategy selection and the R-I dimension. Case believes a

combination of both utilization of M-power and a tendency to give weight to salient but misleading cues provides an explanation of the operation of F-I-D on problemsolving.

Competence-Activation/Utilization Model

Overton and Newman (1982) present this model as an attempt at integration of the competence model which is comprised of the abstract, general form of the individual's knowledge in cognitive domains, and the activation/utilization model which would involve psychological processes as well as task and situational factors. A competence theory, for example, that of Piaget, is seen to explain the constancy of behavior across different environments and individuals but is not seen as sufficient to explain the variability of human behavior. Cognitive style would be an activation/utilization factor. Variables may serve either one or both of these functions. In an investigation that serves to illustrate this model, Stone and Day (1980) found with noncompetent, latent, and spontaneously competent groups of children, on a formal operations task, that the competent group performed significantly better on a test of field-independence.

Overton and Newman (1982) interpret Stone and Day's (1980) results as indicating that F-I-D plays a utilization function because the latent group and the noncompetent group were not differentiated. If F-I-D served an activation

function, the latent group's performance would have been affected. Their model would assert that cognitive style factors inhibit or facilitate performance on selected Piagetian tasks. To the extent that a variable is effective both at the time of latent competence and continues to be effective over a significant length of time, it can be said to have both an activation and utilization function.

Metamemory, Strategy Transfer Model

Another conceptualization of the mechanism underlying the influence of cognitive style has been presented by Borkowski et al. (1983), who studied impulsivity and strategy transfer. Addressing the question of why differences in strategic behavior accompany differences in cognitive tempo, the authors studied the relationship between cognitive tempo and metamemory during the acquisition, generalization, and maintenance of a cognitive strategy. Reflective children were found to maintain and generalize the strategies more effectively and to possess a higher level of metamemory. These authors suggest that the impulsive child's deficits in metamemory will probably prove difficult to remediate. This deficit tends to bring about failures in strategy use in situations that call for the transfer and generalization of previously acquired strategies.

Relationships between Cognitive Style and Piagetian Concepts

Another interesting group of correlates of cognitive style that is beginning to emerge is centered on Piagetian cognitive competencies. This group of studies has found various dimensions of cognitive style, especially the dimensions of R-I and F-I-D, to be related to Piagetian concepts.

In a study by Grant (1976), the cognitive style dimension of reflection-impulsivity was related to performance on visual illusions. Grant hypothesized a relationship between Piaget's construct of perceptual activity and performance on the MFF. Piaget (cited in Grant, 1976) used the generic term "perceptual activity" to represent the set of active semi-reversible processes: for example, visual transportation, transpositions and anticipatory sets, that characterized the perception of older children and adults. Early perceptual functioning or primary perception is believed to be centration-dominated. The young child or perceptually immature individual views the stimulus display in one or two quick glances. Grant also cites Vurpillot (1968), noting that global perception leads to many distortions of details and errors of omission on discrimination tasks. Results of Grant's study, were equivocal. Using visual illusions to assess the subject's perceptual attentional skills, the MFF error score was found to be significantly related to perceptual activity for fourth graders only. Results for third graders, even though they

showed comparable levels of perceptual activity to the fourth graders, were significantly less accurate on the MFF. A possible explanation put forward by Grant is that the third graders, even when they had adequate perceptual-attentional skills, could not transfer those skills to the more complex MFF items. Thus, MFF items seem to demand both perceptual comparative operations (checking the details of the standards and variants) and conceptual programming operations (organizing the visual search and systematically deploying attention in the quest of the one variant that matches the standard). Therefore, possession of the perceptual attentional skills would not necessarily lead to solution of the MFF items.

According to Piaget, being aware of the invariant aspects of the properties of objects in the face of transformation is a central prerequisite for the acquisition and later development of logical thought. The preoperational child has a tendency to center his or her attention on one detail or aspect of an event or problem and seems unable to shift attention to other aspects of a situation. The inability of preoperational children to decenter their perception keeps them from solving the conservation problem.

This principle of decentering is what Piaget believes describes all of the changes which complete entry into the period of concrete operations. With the onset of concrete operations, the rigid, static, irreversible structures

typical of preoperational thought organization begin to be more flexible, mobile, and most importantly, decentered and reversible. Many researchers have hypothesized that cognitive style variables are important factors in Piagetian thought processes (Ginsberg & Opper, 1979).

Some studies have shown the ability to ignore irrelevant perceptual cues to be of central importance. Gelman (1969) hypothesized that the child may in some way be able to conserve if it were not for his or her strong tendencies to attend to stimulus changes rather than to quantitative attributes. Five-year-old children who failed conservation tests were given discrimination learning training. The hypothesis was supported in that children given training on relevant quantitative relationship cues showed increased conservation skills. Wallach and Wall (1967) gave 6- and 7-year-old children experience with reversibility. This experience resulted in number conservation and the authors suggest the success may have been due to the children being led to stop using misleading cues.

Pursuing possible relations between cognitive style and cognitive developmental level, Berzonsky, Ondrako & Williams (1977) attempted to account for the differential effectiveness of an instructional film in modifying six- to seven-year-olds' life concepts. He hypothesized that variability in the development of non-animistic reasoning is related to

differences in children's conceptual tempo. Since a major difference between reflectives and impulsives seems to concern visual processing strategies, reflective-animistic children might show greater gains from an instructional film than impulsive-animistic children. Reflectives were not found to be significantly more affected by training. Non-animistic reasoning is representative of a higher level of cognitive development, and, although reflectives were more advanced in their conceptions of life, they did not benefit more from training as predicted. Berzonsky et al. suggested that the high variability of the reflective group may have contributed to the failure to find differences.

Brodzinsky (1982) also investigated developmental changes in the relationship between R-I and the Piagetian concepts of spatial perspective-taking and conservation behavior in children at 4, 6, and 8 years of age. The relationship between spatial perspective taking and R-I changed from being unrelated in the 4-year-old group to 6-year-old impulsive children scoring significantly lower on the perspective taking tasks and making more ego-centric errors with shorter latencies. There was a nonsignificant trend for impulsivity to be related to conservation with 6-year-olds. At 8 years of age the relationships changed again and became stronger with regard to conservation. Brodzinsky also found that the emergence of a reflective problem-solving style at 6 years of age facilitated the expression

of operative spatial skills at 8 years of age. The converse was not true, suggesting a unidirectional relationship between cognitive style and selected Piagetian competencies.

Further support for the role of individual differences in the expression of Piagetian competencies is provided by DeLisi (1983). F-I-D was found to affect the acquisition and utilization of spatial operations.

Finally, Linn (1978) investigated the type of "conflicting information" that contributes to differential performance of field-independent and field-dependent adolescents on the separation of variables schema. Field-dependents were unable to use the separation of variables schema when a screen concealed part of the task apparatus and thereby introduced "conflicting information." Training was given on the schema in a second experiment and this did not help performance. Linn suggests the possibility that training which deals with selection of information from conflicting contexts rather than training Piagetian competencies might affect performance on Piagetian tasks. What these studies suggest, then, is that a reflective and field-independent style and the subskills these dimensions incorporate facilitate the use of selected Piagetian competencies. The nature of the relationship and the manner in which these cognitive styles exert their influence is not fully explained.

Educational Implications and Modifiability of Cognitive Styles

In the past few years a relatively large body of literature has emerged documenting the observation that the impulsive child, when compared to the reflective one, displays a lower level of academic achievement as well as lower performance on a range of problem-solving tasks. Haskins and McKinney (1976) found that MFF errors were correlated with academic achievement at 7, 9, and 11 years of age and accounted for 21%, 12%, and 23% of the variance in achievement test scores respectively. For MFF latency this relationship was found with 11-year-olds only and accounted for 11% of the variance in achievement test scores. Reflection-impulsivity has been shown to be a predictor of academic achievement as well (Barrett, 1977). Differences in R-I identified in grade 4 are predictive of differences in academic achievement in grades 5 and 6 and children identified as reflective scored significantly higher at all grade levels (4, 5, and 6) than impulsives.

In apparent contrast to the significance of cognitive tempo noted above, a recurring theme suggesting the non-evaluative nature of cognitive style variables can be detected in the literature. Researchers in the area stress that at each end of the continuum of the bipolar variables of R-I and F-I-D certain strengths are apparent. The implication is that these strengths are of equal value. Indeed, the original conceptualizations of these dimensions were

intended to be nonevaluative. As Wright and Vlietstra (1977) suggest, the difference is, in part, a product of cultural bias and, in part, a consequence of the kinds of tasks used to assess cognitive style. They have speculated that impulsives are more playful, creative, curious, socially responsive, expressive, exploratory, and attentive to salient stimulus features.

Very little research supports this position; however, there is some. Rollins and Genser (1977) devised a task that favors the impulsive approach to problem solving. They also offer an interesting interpretation of R-I differences. Basically, their position is that the problem solving style most suitable in any given situation depends on the particular task that is being addressed. Their approach would be to teach children to differentiate tasks and adopt the appropriate skills or strategy. The task that favors the global approach of the impulsive is one in which the number of possible solutions is large, too large to systematically examine all of them, so the heuristic of looking first for likely solutions has the advantage. As Rollins and Genser note, the general approach of trying the more probable solutions first is frequently used by adults in their day-to-day lives. For example, the adult will typically look for a lost item in highly probable places before initiating a systematic search through all the logically possible places. The reason this strategy is chosen more frequently is that

it has the chance of yielding the problem solution more quickly if the person's hunches are correct. These authors believe there are many important everyday situations in which the impulsive approach is the best one. Similarly, Zelniker and Jeffrey (1976) found when a correct solution could be achieved with little analysis of stimuli into their components, as in their global task, impulsives were actually more efficient.

Wright and Vlietstra (1977) described extreme reflectivity as handicapping as well. They speculatively characterized the reflective child as resisting socialization pressures to risk error in order to respond faster and to be rigidly using an inefficient, excessively thorough and safe search routine to a point well past the point of diminishing returns.

All this may be true. However, there is a large body of literature indicating the negative effects of impulsivity on traditional academic learning. It goes without saying that there are negative consequences that accompany difficulty in achieving at school. As Kogan (1980) states, the two dimensions are not really equivalent because the relative advantage of impulsives in global processing is considerably smaller than the relative advantage of reflectives in analytic or detail processing. An illustrative example is the finding of Satterly (1976) that, after intelligence has been statistically controlled, field independence seems to

be related to performance in mathematics. Extreme field independence was found not to be an advantage in mathematics learning; rather it was found that highly field-dependent behavior restricts attainment levels. It is well known that failure to succeed with at least moderate levels of mathematics is increasingly seen as a limitation to a growing number of vocational options. Consistent with this view are the findings of Linn and Swiney (1981), which suggest that there is a component of F-I-D that is part of Piagetian formal reasoning. Formal reasoning was found to overlap a recently identified component of F-I-D (familiar field) and with two factors of general ability (crystallized ability, and general fluid visualization ability).

It seems reasonable to take a flexible approach to problem solving and to be able to determine which tasks would need a particular strategy, hopefully one that is already available to the problem solver. Since a significant proportion of academic tasks requires a reflective approach, it is fortunate that cognitive tempo appears to be modifiable under a variety of conditions.

Training Methods for Modifying Children's Cognitive Styles

Several types of training methods have been used to modify cognitive impulsivity and the information processing strategies associated with it (for reviews see Denny, 1973b; Messer, 1976; Readence & Bean, 1978; Duryea & Glover, 1982;

and Thompson, Teare & Elliot, 1983). Although the effects of these attempts at training have been inconsistent, the pattern of results has led investigators towards greater specificity in the identification of the "active ingredients" of successful training. This section will trace the development of training programs, from the initial attempts that were aimed at delaying the response of the impulsive child, to later attempts at modification of the impulsive child's attention deployment strategies and, finally, to an examination of some recent refinements in training programs aimed at modification of the information processing strategies of the impulsive child.

Response Delay

Early attempts at modification of an impulsive cognitive tempo focused on delaying response times. Methods used to achieve a delayed response included reinforcement, modeling (observing a reflective person) and direct instruction. While all three methods have been somewhat effective in delaying response times, effects upon error rate have been equivocal (Briggs & Weinburg, 1973; Denny, 1972a; Kagan, Pearson & Welch, 1966a; Messer, 1976). These findings are supportive of Wright's recommendation that "we need to concentrate on measuring and bringing under stimulus control, the kinds of distinctive orienting and observing behaviors that would presumably be characteristic of

subjects attempting to take in and process only relevant stimulus information" (cited in Denny, 1973b).

The inconsistent effects of response delay methods seemed to suggest that children trained to delay their response times were unable to use the additional time to lower their error rate on match-to-standard tasks (e.g., the MFF). Subsequent efforts, by some investigators, focused upon changing the attention deployment strategies of impulsive children on such tasks. The previously mentioned findings of Siegelman (1969) and Drake (1970), who identified differences between reflective and impulsive children's visual information processing strategies, provided a basis for these later training programs.

Attention Deployment Strategies

Modeling Combined with Self-Instruction

Modeling an adult completing a series of training items while verbalizing a reflective problem-solving strategy was successful in reducing errors and increasing response latency, although no generalization to classroom or academic tasks was found (Meichenbaum & Goodman, 1971). The reflective strategy emphasized examining and eliminating all incorrect alternatives before answering, progressing slowly and carefully, and coping with and correcting errors without becoming upset and distracted. While modeling a reflective strategy, combined with self-instruction of the strategy,

has been held up by many (Denny, 1973b; Zelniker & Jeffrey, 1979) as a most promising approach to training, there are still a number of unresolved problems with the method.

While the method did lower error rates and lengthen response times, it is difficult to consider these changes as true modifications of cognitive tempo when there were no accompanying changes in tasks generally thought to be affected by a subject's impulsivity (Denny, 1973b; Gerber, 1983; Schleser & Thackwray, 1983). Denny suggests the importance of establishing true changes in contrast to changes in task specific response sets. He has noted at least three facets of what he calls "cognitive representation to be indicative of true changes: understanding the essential nature of the behaviors being trained, the production of symbolic mediators of the behaviors being trained, and the self regulation of the child's overt behavior through these mediators. This issue will emerge in a slightly different form (metacognition) in a later section of this review.

A major alternative, to the modeling self-instructional approach, that also attempts to modify the impulsive child's attention deployment strategies is based upon teaching visual information processes thought to underlie reflectivity.

Visual Information Processing Skills

The visual information processing training approach used by Egeland (1974) was also based on the findings of Siegelman (1969) and Drake (1970). Egeland focused on teaching impulsive children more efficient search strategies and scanning techniques rather than the task approach skills emphasized by Meichenbaum and Goodman (1971). Although there is some overlap in the two methods, only Egeland's visual information processing skills training is comprised of exercises and materials designed to encourage the child to attend to the relevant features of the discriminative stimulus with extensive practice on a variety of match-to-standard tasks. Egeland's (1974) training method found both experimental groups to have achieved a lower error rate and longer response times on the Matching Familiar Figures test in comparison to a no-treatment control group. The difference between the two experimental groups was that one received rule and strategy instruction along with the training materials, and the other received response delay instructions along with the same training materials. Of the two experimental groups, only the group which received the rule and strategy instruction evidenced durable gains at a two month posttest and generalization to a reading comprehension subtest of the Gates-MacGinitie Reading Test. An unexpected result, however, was the no-treatment control group's significant improvement on the reading comprehension

subtest. Although results seem very promising, there are a number of unresolved problems with this approach as well. These problems include the psychometric flaws of the MFF (Ault et al., 1976) and failure to clearly identify the "active ingredients" of training.

Several investigators have followed what might be called the perceptual-analytic training approach to the modification of impulsive children's information processing strategies. Perceptual-analytic type training includes combinations of: visual scanning, distinctive feature discrimination, analytic relationships, detail matching and possibly other visual information processing skills. Orbach (1977) found both visual detail scanning instruction and distinctive feature discrimination instruction resulted in significantly fewer errors on the MFF. Latency to first response was longer for the visual detail scanning strategy. These results indicated that the distinctive feature strategy was more efficient because it yielded fewer errors and could be accomplished more quickly.

Isakson and Isakson (1978) provided impulsive children with training, in analytic relationships, detail recall and detail matching, which resulted in a significant decrease in errors and a nonsignificant increase in latency to first response on the MFF. Clearly the ability to lower impulsive children's error rate has improved with the use of training methods aimed at modifying attention deployment strategies.

The fact that results are neither robust, consistent, highly generalizable or clearly linked to particular training program components has led investigators to continue their attempts to identify the factors that contribute to this pattern of results.

Recent Refinements and Continuing Issues

The influence of the revival in cognitive psychology (Federico, 1980), the notions of Jean Piaget (Ginsburg & Opper, 1979) and the writings of Ann Brown on metacognitive and generalization issues (Brown, 1978; Brown & Campione, 1978) can be seen in recent investigations of the modification of impulsive children's information processing strategies. Such modifications are now being referred to as cognitive strategy or cognitive process training. Recent investigators are also paying closer attention to subject variables (e.g., mental and chronological age), the content of training programs and instructional methods, including attention to metacognitive variables.

Self-Instructions: Clinical-Developmental Approach

In a series of studies Schleser & Thackwray, 1983; Schleser, Meyers & Cohen, 1981; Nichol, Cohen, Meyers & Schleser, 1982) investigated the nature and role of the impulsive child participant in impulsivity treatment programs. They systematically evaluated content of self-

instructions (specific versus general strategy), cognitive developmental level (preoperational versus concrete-operational) and the role of active rehearsal (techniques of directed discovery or fading versus didactic, passive instruction). Although their subject selection criteria are not clearly specified and it seems they did not use an extreme group of impulsive children, their results are informative.

Concrete operational children who were taught a general strategy, requiring active participation made more overall correct choices, on both the training (MFF) and transfer task (spatial perspective taking). Only concrete operational children in the general strategy, directed discovery condition improved on the generalization task. It was suggested that the process of abstracting specific information from a general rule required functioning at a cognitive level that was too difficult for impulsive preoperational children as they do not have the prerequisite cognitive skills. Concrete operational children are able to identify and separate form from content. Specifically, the concrete operational children could distinguish the nature of the instructional procedure as well as the content of instruction, whereas the preoperational child grasped content only. The preoperational child appeared to be unable to extract and/or apply the plan put forward in the directed discovery method (Schleser & Thackwray, 1983).

A somewhat surprising outcome was that children in the general strategy group showed a moderate but nonsignificant improvement in error rate on the training task (MFF) in comparison to significant gains on the generalization task (spatial perspective-taking) (Schleser et al., 1981). Schleser and Thackwray (1983) explain this unexpected finding by noting that children in the general strategy condition were able to adapt their strategy to a generalization task but when adapting their skills to the training task were not as efficient as those children who learned the specific strategy for solution of training task. Findings from this group of studies would seem to indicate, instructional method, program content and, most significantly, cognitive level or age of the child participant must be considered in order to address weak or inconsistent training effects and their limited generalizability.

Metacognitive Approach

Although there are differences in the concepts, some of the issues A. Brown addresses in her 1978 article on metacognition are reminiscent of issues Denny (1973b) addresses with the concept of "cognitive representation." Executive control processes or metacognitive functions are thought to develop along with skill acquisition. These processes are considered important because they may provide the individual with some volitional control over different cognitive

routines needed for problem-solving (Gerber, 1983). A recent refinement in the modification of impulsive children's information processing skills incorporates the concept of metacognition.

The Borkowski et al. (1983) study was not directed towards reducing impulsivity. It does, however, represent an innovative approach to cognitive strategy training with impulsive children. Organizational strategies were taught to impulsive children in training sessions spaced throughout the school year. This procedure allowed children to experience distributed practice of the strategies. A metacognitive component was incorporated as well. Children received feedback regarding the efficacy of the strategies. Children were also urged to use their newly learned strategies the next time they were administered the experimental tasks. Results indicated significant training and maintenance effects, as well as generalization to another type of task. Results also suggested that impulsive children have metamemorial deficits.

One final issue appears to be converging lines of evidence suggesting the importance of age or cognitive developmental level for influencing training outcome. A previously noted example is the problem with obtaining generalization of trained skills when subjects are preoperational children (Schleser & Thackwray, 1983). The difficulty is that there do seem to be important benefits to be

gained from early intervention.

If a child, because of socialization practices and patterns of reinforcement or certain biological factors, begins to emphasize particular processing systems and de-emphasizes others, with the passage of time remediation becomes more difficult. The effect of cognitive styles appears to be cumulative. Early intervention with carefully selected cognitive processes (e.g. visual information processing skills) may contribute to the more balanced development of certain abilities (Pascual-Leone et al., 1980; Witkin & Goodenough, 1981).

Although cognitive training with the young child presents more problems with both achieving and maintaining gains as well as accomplishing generalization, it is important to start early with perceptual-analytic type training. Because these types of skills are lower level cognitive activities, maintaining the student's interest can be problematic. With increasing age this problem is heightened.

From the neuropsychological literature there is evidence that receptive-perceptual processes (e.g. perceptual-analytic type skills) are more important in grades 1 and 2. Visual and auditory expressive skills and expressive motor processes seem to be more dominant by about grades 4 and 5 (Gaddes & Spellacy, 1977; Mattis, French & Rappin, 1975; Gaddes, 1984). Intervention before the

receptive-perceptual processes are consolidated would probably be easier.

Any potential remediation program aimed at perceptual-analytic type information processes in impulsive children is faced with the difficulty of being appropriate to a very limited age range. If the child is too young, the training, while appropriate in terms of perceptual process development, may be difficult to establish at high levels, especially if the cognitive level of the impulsive child are not taken into account. On the other hand, if the child is too old, maintaining the child's attention on training lower level cognitive processes may be unrealistic.

Summary

A large body of evidence has accumulated that suggests that the impulsive child is at a disadvantage academically. Both impulsive and field-dependent children were seen to be more in need of professional, educational help (Pascual-Leone et al., 1980). Alternate conceptualizations of how cognitive styles exert their influence, as well as design and measurement problems characteristic of the area, were examined. Most importantly, support for the notion that a reflective problem-solving style and field-independence facilitates the expression of selected Piagetian competencies was offered.

Investigations that suggest cognitive-style is malleable were reviewed. Inconsistent results appear to be typical of the impulsivity modification literature. In more recent investigations, factors that seem to contribute to a successful training outcome are receiving more attention, and refinements in training research were noted.

If certain cognitive styles do hamper children in their expression of Piagetian concepts, there would be additional implications for education. Although an examination of the literature on the significance of Piagetian concepts for education is beyond the scope of this review, Piagetian theory and its implications for instruction in reading and mathematics has received attention from educators. These relationships remain very interesting but unclear. There are few empirical studies that clarify the relationship between a child's performance on concrete operational tasks and reading and mathematics readiness or performance. Although for present purposes the following notion has been greatly oversimplified, there have been some who would suggest Piagetian competencies are the foundation upon which the acquisition of knowledge rests (Smock, 1981). For example, the absence of number and quantity conservation was directly related to poor mathematics performance; similarly, operativity has been found to be an important factor in tasks that have high cognitive demands (Arlin, 1981).

If these notions are valid, then the range of disadvantage that impulsive children experience in their early years of academic instruction, would seem to include difficulty with the expression of selected Piagetian concepts. Training aimed at modifying impulsivity with a view towards facilitating the expression of Piagetian concepts is worthy of increased research attention.

CHAPTER III

RATIONALE AND HYPOTHESES

The literature review has suggested a number of important findings regarding cognitive style research, its methodological and construct validation problems, its correlates, and its emerging relationship to selected aspects of Piagetian problem-solving notions. The educational implications of the cognitive style dimension of reflection-impulsivity, as well as selected approaches to its remediation, have also been noted.

An examination of the research and of educational materials and programs suggest the need for greater knowledge of intermediary cognitive processes. Among the areas where they are needed are at the interface between the domains of traditional aptitude constructs, on the one hand, and the constructs of formal developmental theory on the other. Another area that needs exploration and development of intermediary constructs is at the interface between personality and cognition. Here, constructs such as adapting, selecting and shaping (see Sternberg, 1985) are needed that reflect the influence of motivation and attitude on cognition. This research is necessary because existing constructs are not at a level of analysis or specificity sufficiently powerful to guide individual remediational prescriptions.

In the last 20 years investigation of reflection-impulsivity, and to an even greater extent, field-independence-dependence, has been highly active. Since the emphasis in the present study is on the R-I dimension, the following summarizes the important aspects of this dimension.

1. The principal measure of R-I (the MFF) has only fair reliability (.65-.75).
2. The median-split approach to subject selection is used to enhance reliability of subject classification. This leads to a loss of statistical power and ignoring of the other two groups (fast-accurates and slow-inaccurates)
3. Norms have been developed which allow experimenters to classify subjects more reliably.
4. There is a need to demonstrate unique variance when mental and chronological age are controlled.
5. The dimension is probably not stable at preschool ages.
6. The term impulsivity, commonly used to refer to a global characteristic, is misleading because evidence shows it to be principally relevant to cognitive tasks. The popular connotation of the term implies overt behavior.
7. Construct analysis has indicated that R-I is not a bivariate construct. It incorporates at least one and possibly two additional factors.

8. Two variations in approach to altering the attention of deployment strategies of impulsive children have been particularly successful and repeatedly replicated. These are perceptual-analytic type training and general problem-solving/self-instructional training.

Because of weaknesses summarized above, the mechanisms of how the R-I dimension exerts its influence, as well as how a person becomes reflective or impulsive, are not as clearly understood as is desirable. However, a large body of converging evidence has established the dimension's existence. Comparisons of reflective and impulsive children on a wide range of variables such as academic performance, the attention-concentration subtests of the WISC-R, and, more recently, on Piagetian tasks, have demonstrated that impulsives perform more poorly when compared to their reflective peers.

Some recent correlational findings linking cognitive style and Piagetian concepts are those of Brodzinski (1982). In an examination of the possible causal developmental linkage of reflection-impulsivity and spatial perspective taking, support was found for the notion that reflectivity facilitates earlier development and use of spatial perspective taking competence. Evidence also indicates that the influence of R-I on Piagetian tasks is selective.

Approaching the problem from another direction, Linn (1978) reports experiments which attempted to clarify the type of task that elicits an interaction between cognitive style and Piagetian formal thought processes. She found that field-dependent children perform the separation of variables schema only in a situation with no embedded information. Training on the separation of variables schema did not improve performance. This indicates that training in formal thought processes is not a sufficient condition to alter cognitive style influence.

Although the evidence for a relationship between cognitive style dimensions and Piagetian competencies is growing, it remains primarily correlational. Bryant (1981) notes that the strengths and weaknesses of correlational and training experiments are complementary, even though there is something inherently artificial in training experiments. This perspective would maintain that just because some techniques succeeded in training certain skills, these same techniques may have nothing to do with the natural causes that normally lead to the development of such skills. He cites conservation training experiments as an example of training a skill with "active ingredients" in the training experiment having nothing to do with real life causes. He explains that the training experiment does not determine if A and B are related in real life; however, the correlational evidence suggests this connection.

The skills of reflectivity involve the relative organization of children's visual exploration. Reflectives pause to look over every stimulus figure in greater detail on a match-to-standard task (e.g., MFF) and make many more comparisons of homologous parts. In contrast, the young child's, as well as the impulsive child's, exploration is "captured" by novel stimuli, leading to global, inefficient exploration and a premature response.

During the early school years, attention, which was previously involuntary, becomes voluntary and can now be deliberately used by the child (Vygotsky, 1962). This shift allows a more cautious, systematic, analytic, problem-solving approach. The impulsive child falls behind in making this shift. The visual information processing skills of distinctive feature discrimination, awareness of part-whole, hierarchical relationships and systematic, exhaustive visual scanning have been found to underlie reflectivity and to comprise important skills a child needs in order to be effective in processing visual information (Egeland & Schrimpf, 1978).

Similarly, Piaget and Inhelder (1969) have noted that when children make the transition from preoperational to concrete operational thought the transition is characterized by decentering. While previously the child deployed his or her attention in a very limited manner, now the exploration of configurations involves efficient eye movements and

shifting fixation points in a systematic way. To describe the transition to concrete operations as the acquisition of a systematic approach for guiding exploration is consistent with the types of cognitive competencies that evolve during this period (Vandenburg, 1984).

The Piagetian classes and relations competencies represent the supraordinate structures which are said to organize all directed thought during the period of concrete operations (middle childhood)(Hooper, Brainerd & Sipple, 1975). That is, the other subsystems, including classification and seriation, are rooted in the development of the logic of both classes and relations (Arlin, 1981).

Although the concept of domain needs to be described with greater specificity (Campione, Brown & Ferrara, 1982), it has some explanatory value for relations between cognitive processes. Although a complete process-task analysis of both the domains of reflection-impulsivity and Piagetian classes and relations concepts would provide at least some of the needed specificity, these are not available. However, the two domains appear to have some shared features.

There is theoretical as well as empirical support for the notion of a relationship between the two domains. On a theoretical level it has been suggested that problem-solving performance is a function of the interaction between a child's operative level and a group of task and organismic

factors, including the child's cognitive style (Pascual-Leone et al., 1980; Case, 1974). From this perspective, incorrect assumptions regarding problem-solving, which involve a low energy, a passive approach and the tendency to give weight to salient but misleading cues, characterize the effects of cognitive style on problem-solving. Brodzinski, 1982; Barstis and Ford, 1977; Grant, 1976; Neimark, 1975 have all observed significant relationships between reflection-impulsivity and the expression of selected Piagetian competencies.

Even though there is beginning to be evidence of a relationship between cognitive style factors and the expression of Piagetian competencies, little is known about the nature of the relationship. Is the relationship malleable? If so, to what degree and what are the conditions under which specific styles of information processing can be trained? Furthermore, is the impulsive child's suggested performance decrement in selected Piagetian competencies superficial or is the expression of such competencies aided by the possession of visual information processing skills that underlie reflectivity?

If by training impulsive children in the skills of reflectivity, the expression of Piagetian competencies is enhanced, it may be possible to demonstrate that a relationship exists between the two domains. In addition, one aspect of this relationship is that reflectivity informs selected

Piagetian competencies. Thus, it may be possible to infer a set of shared components or connections between reflection-impulsivity (as measured by the MFF) and Piagetian classes and relations concepts (as measured by the 64-I). The following hypotheses were thus put forward.

H_1 On the immediate posttest significant differences exist between experimental and control groups with the population mean for the experimental group being: (a) higher on the 64-Item Groupement measure; (b) higher on the CEFT; and (c) lower for error scores and longer for latencies on the MFF.

H_0 On the immediate posttest there will be no difference between experimental and control groups with the population mean for the experimental group being equal to that of the control group on the: (a) 64-Item Groupement measure; (b) CEFT; and (c) MFF.

H_2 On the delayed posttest significant differences exist between experimental and control groups with the population mean for the experimental group being: (a) higher on the 64-Item Groupement measure; (b) higher on the CEFT; and (c) lower for error scores and longer for latencies on the MFF.

H_0 On the delayed posttest there will be no difference between experimental and control groups with the population mean for the experimental group being equal to that of the control group on the: (a) 64-Item

Groupement measure; (b) CEFT; and (c) MFF.

CHAPTER IV

METHOD

This study attempted to address four issues. The first was to determine if the visual information processing skills that underlie reflectivity might be related to the cognitive skills needed for the expression of selected Piagetian concepts. The second was to determine whether interventions aimed at improving the impulsive child's skills in reflectivity may improve his or her performance decrement in Piagetian skills. As a result of data obtained in the study, it was also possible to replicate Egeland et al.'s (1976) study with Canadian children. The final issue was to determine the short-term durability of training effects.

Design and Procedure

In order to address the issues stated above, the following procedures were undertaken. The study involved a pretest-treatment-posttest-delayed posttest design with subjects randomly assigned to an experimental or attentional-control group. The study sample group of children were: (1) selected on the basis of their scores on two cognitive style measures and one Piagetian measure; (2) either trained to criterion on three visual information processing skills (treatment) or taught language arts skills from their normal curriculum (attentional-control); (3) reassessed on all

measures immediately after training; and (4) assessed again on all measures two months after cessation of training.

Four females and one male administered the battery of tests for all phases of the study. All were either Educational Psychology or Psychology graduate students. To enhance intertester reliability, and to ensure a standardized test administration, each examiner was individually trained and supervised in practice administrations of the measures by the experimenter prior to testing study sample children. All were blind as to subject assignment.

Three certified elementary school teachers served as program tutors. Each teacher/tutor taught both types of group, with each group comprised of 4 to 5 children.

The regular classroom teachers of the children in the study were given a description of the study and a general description of the training program. To ensure that the regular classroom activities would not affect study outcomes, the classroom teachers remained blind as to a child's group assignment.

The program used in the study, "Learning to Look and Listen: A Visual Information Processing Training Program (VIP) required that children be taught for 20 to 30 minutes each school day. The experimental group met with one teacher/tutor for approximately seven weeks until every child reached criterion. Criterion level was defined as two

successful demonstrations of each skill and the program tutor's positive evaluation that the child had acquired the skill. Children in the attentional-control group left their classroom for the same amount of time as the children in the experimental group. The experimenter met with program tutors once or twice per week to answer questions and to prepare in detail the following week's lessons.

Subjects

All children between the ages of 6.5 and 7.5 from four Calgary public system elementary schools in mixed working and middle-class areas were available for the study. This age group was chosen because they are more likely to be in a transitional state in their cognitive development--that is, they are developing from preoperational to concrete operational thought. It has been suggested that cognitive style differences are more likely to emerge during transitional periods (preoperational to concrete operational) and may be more easily modified before such competencies are fully consolidated (Brodzinsky, 1982; Overton & Newman, 1982). These 207 children received forms requesting parental permission to participate in the study. One hundred and eighty forms were returned granting permission. From these 180 children, 64 met the criteria for the study sample.

Sample Selection Procedures

The first criterion for selection of the study group required that children score above 13 errors and below 9.3 seconds mean latency to first response on the MFF, which corresponds to norms for impulsive 7.0-year-olds (Salkind, 1978). To simplify further discussion, a detailed description of the measures is included in the next section. All 180 children for whom parental permission forms had been obtained were individually administered two practice items and one half the items on the MFF-20. The result of this test provided a group of 84 children which were classified as impulsive.

The second selection cut required that the study group be in approximately the average range of intelligence. The reflection-impulsivity dimension is not highly correlated with verbal intelligence (Kagan, 1966); however, it does appear to be related to nonverbal or performance measures of intellectual functioning. Restricting the range of performance scores would tend to mask individual differences in cognitive style dimensions. It is, therefore, suggested that investigators control only for verbal intelligence scores (Messer, 1976).

The Peabody Picture Vocabulary Test-Revised (PPVT-R) correlates favorably with vocabulary subtests of individual intelligence tests. It has been used as a verbal intelligence screening device in other investigations of

cognitive style effects (Kendall & Wilcox, 1979). The PPVT-R was administered to all 84 children classified as impulsive. Those children approximately 1.5 standard deviations above and below the mean on the PPVT-R were excluded from the study in an effort to control for the effects of IQ on problem-solving. The result of this test provided a group of 71 children who were impulsive and approximately within the normal range of intelligence.

After the administration of the MFF-20 items and the PPVT-R the 71 children identified as impulsive, and within the specified verbal IQ cutoffs, were administered the CEFT individually, using standard instructions and procedures. This measure was used as an additional visual skills assessment in order to increase the reliability of subject classification as well as to provide another basis for the assessment of treatment effects. A score below the mean for 7-year-olds was required. In reviewing CEFT scores, it was evident that no subjects so far selected were able to solve a large number of embedded figure problems. This indicates the test may be too difficult for 7-year-old impulsive children from Calgary. It provided no additional information regarding the level of visual skills beyond that provided by the MFF. No subjects were rejected on the basis of CEFT performance.

A further criterion required that subjects score below 52 out of a total possible of 64 correct on the Piagetian

measure (64-I). As this was the measure of interest in assessing training transfer effects, it was important that a child's score allow enough ceiling to show effects. Therefore, a cutoff point was set approximately two standard deviations below the ceiling at 51 correct. Those children who achieved a score below 52 remained in the study sample, which now comprised 64 children. Of these, six children moved out of the geographical area during the time of the study and one had to be rejected because of emotional and behavioral problems. In order to have an equal number of subjects in the experimental and control groups, one subject was randomly eliminated from the control group. In the final sample, of 56 children there were 33 females and 23 males. Thirty-four were grade two children and 22 were in grade one. Their mean age was 7.0 and their mean verbal IQ was 98. Although the number of males and females in the experimental and control groups were not equal, Messer (1976) and Kogan (1983) have both noted in their reviews of the literature on the reflection-impulsivity dimension that the data indicate no consistent sex differences in response latency or error during the elementary school years. The age, gender composition and verbal IQ of subjects in the two groups are presented in Table 1.

TABLE 1

Summary of Age, Verbal IQ and Sex

	Experimental		Control	
	M	SD	M	SD
Age	6.98	.29	7.02	.30
Verbal IQ	98.40	11.60	97.40	19.10
Sex				
Males	10		13	
Females	18		15	

Measures

Matching Familiar Figures Test (MFF)

The primary index of the reflection-impulsivity dimension is the MFF (Kagan et al., 1964). It is a match-to-standard perceptual recognition task in which the child is asked to select from six highly similar variants a single drawing that is identical to the standard drawing. Errors MFF(E) and latency MFF(L) to first response are recorded.

As indicated in Chapter II, the reliability of the MFF is low to moderate and only one version is presently available. Cairns and Cammock (1978) sought to improve the reliability of measurement of the reflection-impulsivity dimension and developed the MFF-20. They began with an initial item pool provided by researchers active in the area, including Kagan and Zelniker. Cairns and Cammock improved the level of discriminatory power of the individual items. The MFF-20 has been suggested for repeated measures designs because it may be split into two halves of equivalent difficulty and achieved a coefficient alpha of .69 for errors and .92 for latency with a 7-year-old group children. Both the MFF-20 and the MFF were used in the present study in order to obtain the necessary number of items for repeated measurement. In further discussion the designation MFF will be used to refer to both split halves of the MFF-20 and the standard MFF items.

Children's Embedded Figures Test (CEFT)

The instrument which was designed to measure field-independence-dependence in children is the Children's Embedded Figures Test (Witkin, Oltman, Raskin & Karp, 1971). It is a visual-spatial problem-solving test requiring a child to locate a simple figure embedded in a more complex one. The CEFT measures the extent to which perception of part of a stimulus field is influenced by the entire field, or the ability to overcome embedded contexts in perception. Other workers have noted that it measures analytic problem-solving skills (Neimark, 1975). Reliability estimates range from .83 to .90. Although the CEFT has been used to determine field-independence-dependence, along with the Rod and Frame Test, recent evidence has suggested these tests measure different aspects of the construct (Witkin & Good-enough, 1981). The CEFT has been used by investigators in conjunction with the MFF as an additional measure of the visual information processing skills that enhance academic learning.

Logical Groupements Measure (64-I)

The clinical method of assessment used by Piaget has been frequently criticized as vague and susceptible to many interpretations (Ginsburg & Opper, 1979). The 64-I is a quasi-standardized set of sixty-four binary choice items; half of which assess logical classes and remainder assess

logical relations (Hooper, Brainerd & Sipple, 1975). It was developed in order to produce a more standardized method of assessing Piagetian competencies. The reliability ranges from .62 to .91.

The 64-I was used in the present study to determine a child's competence with the Piagetian concepts of classes and relations. Because half of its format is visual stimuli (circles and triangles) on sheets of paper, its format is more similar to the MFF and CEFT than traditional Piagetian measures. It has been suggested that similarity in format between measures increases the likelihood of detecting the effects of cognitive styles on Piagetian competencies (Brodzinski, 1982; Neimark, 1981).

Training Program

As noted previously, two main approaches to training have reliably modified conceptual tempo. These are perceptual-analytic and self-instruction techniques combined with training problem-solving strategies adapted from Meichenbaum (1977). The training program used in the present study is of the perceptual-analytic variety. Children were taught visual information processing (perceptual-analytic) skills for 20 to 30 minutes each school day for approximately seven weeks until they reached criterion. A criterion level was defined as two successful demonstrations of each skill and the program tutor's positive evaluation

that the child had acquired the skill. The following is a brief description of the program.

"Learning to Look and Listen: A Visual Information Processing Training Program" (VIP) was developed by Wozniak and Egeland (1975a). They reasoned that some children who do poorly in school, particularly those with intelligence within the normal range, may do poorly, at least in part, because they have not yet developed the ability to process visual information encountered in the classroom (in a workbook, on a blackboard, on the printed page) effectively. As part of a long-range research project designed to test the implications of this supposition, a detailed program of training and transfer of three fundamental visual skills (systematic scanning, sensitivity to dimensional differences and part-whole analytic ability) was developed. It is a programmed text giving detailed instructions and example dialogue for these three skills. Unit 1 of the program focuses on increasing the child's sensitivity to hierarchical structure of visual displays. The child is taught the concepts "part", "whole" and the nature of the "part-whole" relationship. Teaching also includes how to analyze a whole picture in terms of successive levels of parts and wholes and to synthesize a whole picture from a collection of parts. In addition, the subjects are shown that something at one level of a hierarchy is a whole and may at a still higher level be a part of a more inclusive whole.

In Unit 2, the child is taught to organize deployment of attention across the surface of the visual display. Both systematicity and exhaustiveness of visual scanning are taught. The child's attention is drawn to the overall configuration of the display and he or she is shown how to use contiguity and a starting and ending point, to plot a path to follow in looking at each aspect of an array. The child is taught to preorganize movement from one object to another (in a picture or around physical space) through identification of the configuration in which the objects are placed, choice of starting and ending point and selection of a path before moving.

Unit 3 exposes the child to a carefully designed succession of feature constructs between objects involving a progressively greater number of dimensions of difference including form, size, spatial organization, number, and so on. The child is taught how to describe these differences, how to encode them mnemonically using an imagery procedure, and how to employ feature analysis in combination with systematic attentional development in hierarchical analysis to solve match-to-sample and recall problems.

Attentional-Control Group

Attempts were made to equate the experimental and control groups for the nonspecific effects due to participation in an experiment, including being removed from the

classroom daily and receiving special attention. Therefore, the attentional-control group met in small groups outside the classroom for 20-30 minutes per day. In an effort to ensure that the small group activities were as prescribed, all sessions were audio recorded and monitored.

Normal curriculum activities appropriate for this age group were used. These activities were suggested by the regular classroom teachers and were in the language development area. Activities included listening to stories, making up stories, vocabulary building and phonics instruction. Visual types of curriculum activities were avoided so as not to confound any potential training effects. Although the attempts listed above were made, the two groups were not entirely comparable because the attentional-control group subjects were doing normal school work.

Posttests

Immediately upon completion of training, children were retested with the same three measures that comprise the battery (MFF, CEFT, and 64-I). Children were also given a certificate showing they had successfully completed the program.

There was a delayed posttest with the same measures two months after completion of training. This was administered in order to assess maintenance of training effects. A summary of the events, measures and criteria for the present

study are presented in Table 2.

As a result of tests conducted, the following sets of data were available. The cognitive style data consisted of MFF(E), MFF(L) and CEFT scores, while the cognitive development data were comprised of the Piagetian measure (64-I) scores. These were obtained both prior to and immediately after treatment and again two months later for both the treatment and control groups. The analysis of results is presented in Chapter V.

TABLE 2

Visual Information Process Training Study: Summary of Events, Measures and Criteria

Pretest			Program	Posttest	Posttest
			EXPERIMENTAL GROUP**		
			initial n=32		
	Subject Selection Criteria		Criteria	Dependent Measures	Dependent Measures
initial n=		final n=	2 Correct Demonstrations Per Skill	MFF CEFT 64-I	MFF CEFT 64-I
207	Parental Permission Obtained	180	- Distinctive Feature Discrimination - Systematic Scanning - Part-Whole Hierarchical Relationships		
180	MFF* Error Scores >13 Latency Scores 9.3 sec.	84			final n=28
			** Subject attrition: 4 (Geographical moves: 3; Emotional disturbance: 1)		
			CONTROL GROUP***		
84	PPVT-R I.Q. Scores =±1.5 S.D.	71	initial n=32		
71	CEFT* Scores < 10	71	Criteria	Dependent Measures	Dependent Measures
71	64-I* Scores < 52	64	Instruction in Normal Language Development Curriculum - Grade 1 and Grade 2	MFF CEFT 64-I	MFF CEFT 64-I
	* Dependent Measures		*** Subject attrition: 4 (Geographical moves: 3; Random subject deletion: 1)		final n=28

CHAPTER V

RESULTS

The literature reviewed in Chapter 2 indicates that:

1. the construct of cognitive style has at least sufficient validity to justify its inclusion in any set of factors used to predict achievement;
2. certain kinds of cognitive style deficits (e.g. impulsivity) are likely to inhibit school learning;
3. children with certain cognitive styles (e.g., impulsive, field-dependent) have difficulty with the expression of selected Piagetian competencies; and
4. cognitive style deficits may be improved by the use of appropriate instructional programs and materials.

Another area of study--namely, that of Piagetian developmental notions--suggests that the underlying skills of concrete operations also affect the ability of children to process information that is necessary for school achievement. Although such studies claim to shed light on cognitive processing of information, their use for developing individual instructional programs is limited because the concepts are too general. The effects of direct training in selected aspects of concrete operations, including the subsequent positive transfer of training to other types of cognitive tasks, have been difficult to specify (Clements, 1984;

Pascual-Leone et al., 1980). If the processes of one domain (cognitive style) can be shown to educate the other (Piagetian capabilities), then support for some connections between the two sets of processes may have been provided. In this study, the attempt was made to train a group of impulsive seven-year-olds in distinctive feature discrimination, part-whole hierarchical relations and systematic scanning, which are reflective skills. The question was: would this training also affect the expression of Piagetian competencies? If so, the Piagetian tasks would be further defined and at least one possible instructional intervention to improve the impulsive child's performance in selected Piagetian tasks will have been provided.

The primary goals of this study were to:

1. test a group of children using pretests in reflection-impulsivity (MFF), field-independence-dependence (CEFT) and Piagetian classes and relations (64-I) in order to identify a sample of impulsive children and to collect baseline data;
2. provide a program of instruction which would develop skills in distinctive feature discrimination, part-whole hierarchical relations and systematic scanning (VIP training);

3. administer posttests in reflection-impulsivity (MFF), field-independence-dependence (CEFT) and Piagetian classes and relations (64-I) to determine what gains might be found; and
4. administer a set of delayed posttests in reflection-impulsivity (MFF), field-independence-dependence (CEFT) and Piagetian classes and relations (64-I) to determine if gains were maintained.

To facilitate a discussion of the results the hypotheses are restated. Hypothesis 1 stated that there would be differences between the experimental and control groups in the direction of improved performance, immediately after training, on all the dependent measures (64-I, CEFT, MFFE, MFFL). Hypothesis 2 stated that there would be differences between the experimental and attentional-control groups in the direction of improved performance on all the dependent measures at a delayed posttesting session.

The first stage of the analysis consisted of a two-way multivariate analysis of variance (MANOVA) with repeated measures (see Winer, 1971) in order to determine if Hypothesis 1 was supported. The independent variable was experimental or control group membership. The dependent variables were the 64-I, CEFT, MFFE, and MFFL scores. BMDP4V, a MANOVA with repeated measures computer program in BMDP Statistical Software (Dixon, 1981) was used for the analysis. This type

of analysis has an advantage that under certain conditions, especially when the dependent variables are interrelated, it may reveal differences not shown in separate ANOVAs. When responses to dependent variables are considered in combination, group differences can sometimes become apparent. For the purpose of this study a significance level of p .05 was accepted. According to Tabachnick and Fidell (1983), the MANOVA assumes multivariate normality and homogeneity of dispersion matrices. The present sample did not meet the assumption; however, Tabachnick and Fidell note the MANOVA is robust with respect to failure to meet these requirements. The authors also suggest the use of an equal N for experimental groups and a large enough sample size as precautions. Initial levels (pretest scores) on the dependent measures may also be problematical; however, they did not differ significantly between groups (see Table 3).

The purpose of this analysis is to test whether mean differences between groups are likely to have occurred by chance. The question is, do the independent variables of experimental versus control group assignment and time of testing, that is, pretest, posttest, delayed posttest, produce reliable differences in the dependent variable means (Tabachnick & Fidell, 1983)? The MANOVA indicated a significant main effect group membership (experimental versus control children) of $F(4,51) = 2.77$ $p = .037$. Thus, the experimental group performed significantly better on the

TABLE 3

Means and Standard Deviations for Pretest Scores of Cognitive Style and Piagetian Measures

	Pretest			
Group	64-I	CEFT	MFFE	MFFL
Experimental (N = 28)				
M	43.04	6.79	18.18	1.84
SD	5.61	4.00	2.95	.41
Control (N = 28)				
M	43.18	7.11	19.43	1.86
SD	5.51	3.40	4.30	.30

NOTE: 64-I = Piagetian Measure
CEFT = Children's Embedded Figures Test
MFFE = Matching Familiar Figures Test Errors
MFFL = Matching Familiar Figures Test Latency (transformed)

combination of dependent measures summing over all testing sessions. A significant main effect for testing session (repeated measures factor) was also revealed $F(8,47) = 9.89$ $p = .000$. This indicates that, as a whole, group children improved over time and was interpreted to reflect continuing cognitive development as well as retest (practice effects) common to both groups. The testing session by group interaction was non significant at $F(8,47) = .72$ $p = .67$--that is, there was no differential effect of group membership in combination with testing session. This finding indicates that the growth curves for the two groups on the dependent variables were roughly parallel, as can be seen in Figures 1-4.

When a significant MANOVA was obtained, in order to determine which dependent measures reflected treatment effects, further analyses by two-way ANOVA, with repeated measures, were performed. The results of these analyses are presented in Table 4. (1) No significant differences were found with respect to the Piagetian measure (64-I) $F(1,54) = 2.87$ $p = .10$. The findings do, however, suggest a trend for children who received VIP training to solve more Piagetian problems correctly than the children who received no training (see Figure 1). (2) Nonsignificant differences between groups were found for scores on the CEFT, $F(1,54) = .64$ $p = .43$. Both the experimental and attentional-control group children solved more items correctly after cessation

TABLE 4

Summary of the Two-Way Univariate Analysis of Variance Repeated Measures on Cognitive Style and Piagetian Scores

Source	df	SS	MS	F	P
Groups					
64-I	1,54	156.214	156.214	2.87	.096
CEFT	1,54	21.428	21.428	.64	.426
MFFE	1,54	172.024	172.024	3.84	.055
MFFL	1,54	.406	.406	.72	.399
Testing Session					
64-I	2,54	281.571	140.786	5.51	.000*
CEFT	2,54	99.298	49.649	6.94	.000*
MFFE	2,54	895.226	447.613	21.42	.000*
MFFL	2,54	7.364	3.682	15.96	.000*

* Significant at the .001 level.

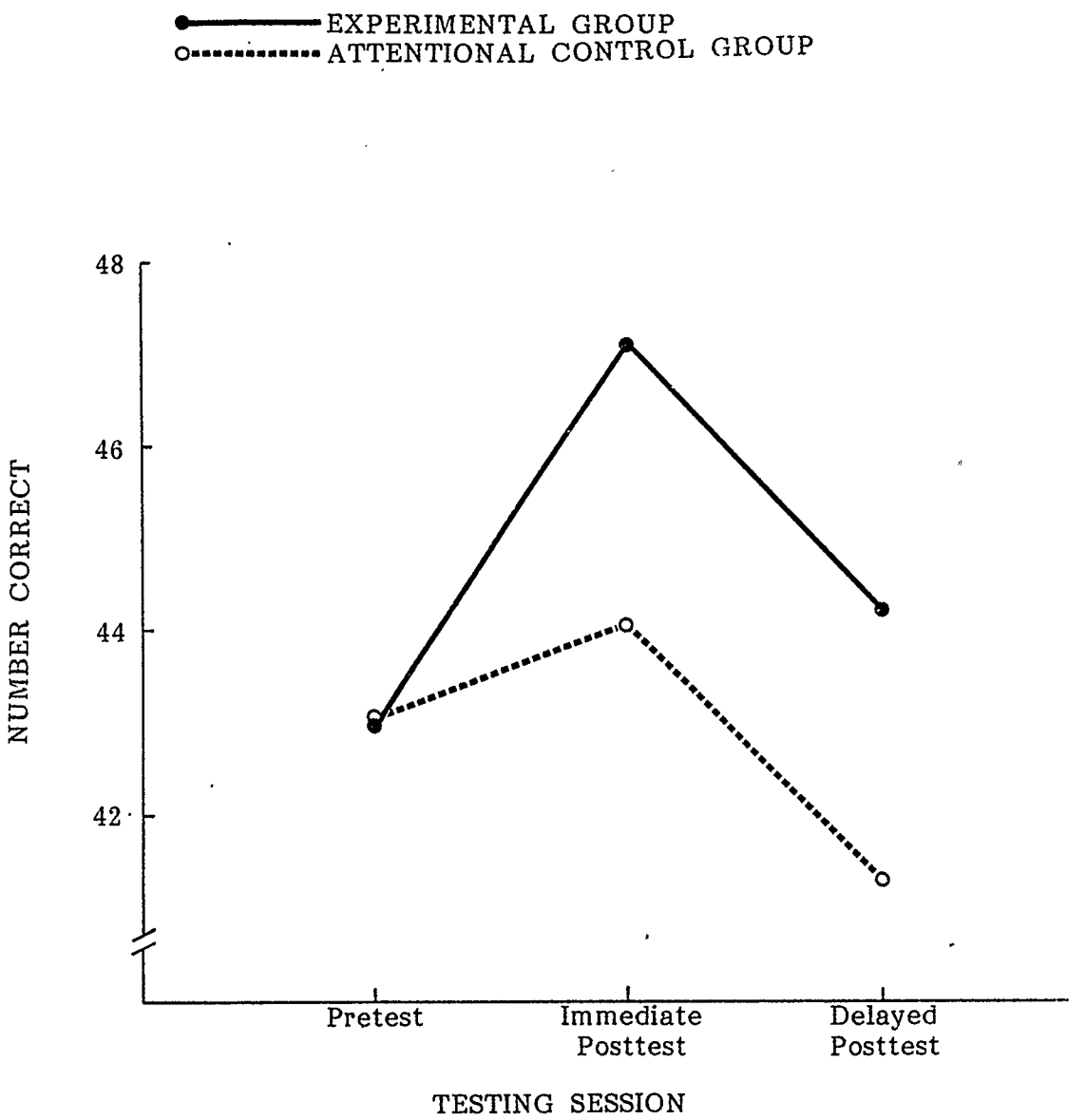

Figure 1. Mean number of correct items on the 64-Item Groupements for experimental and control group at each testing session.

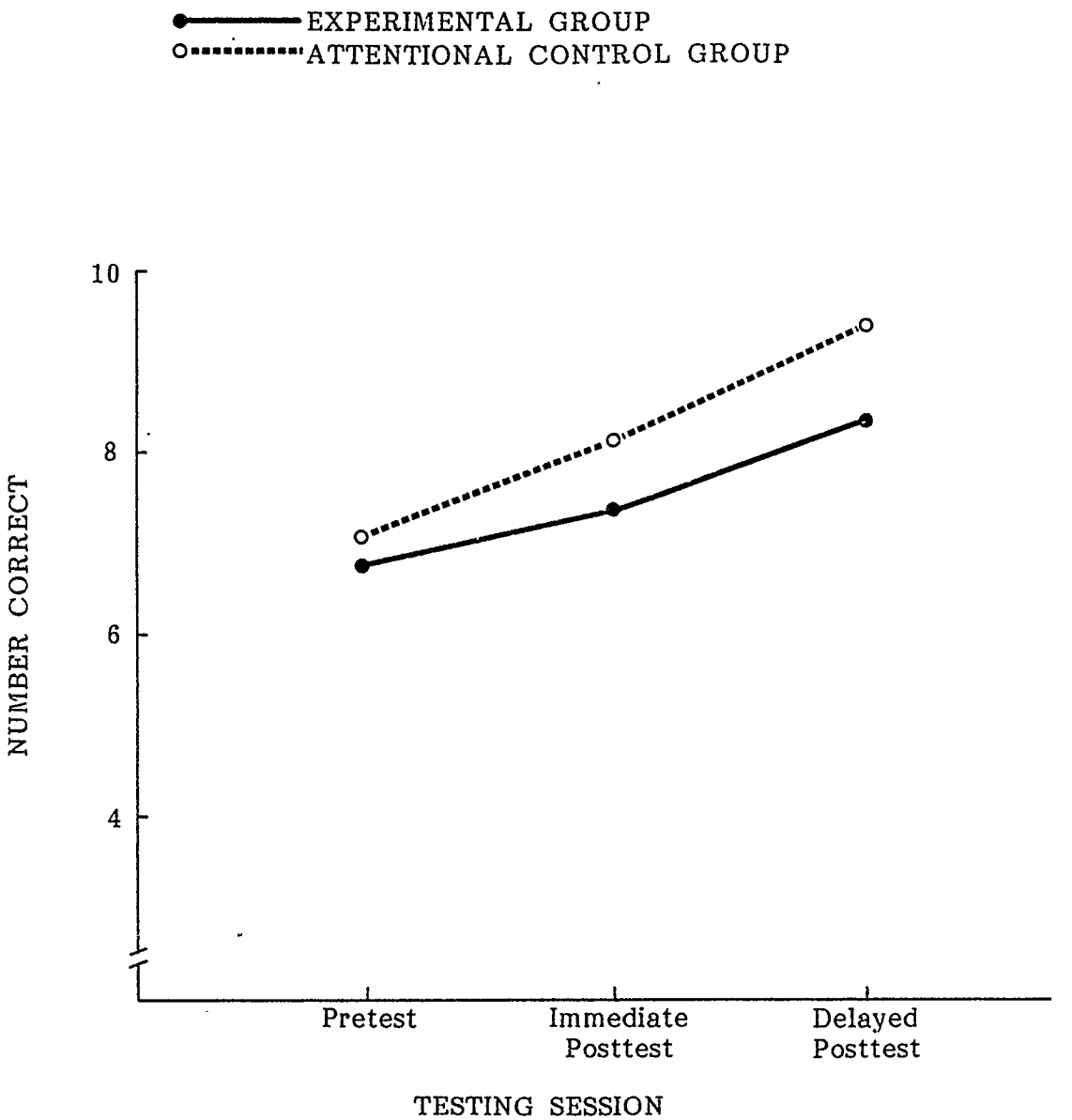

Figure 2. Mean number of correct items on the Children's Embeded Figures test for the experimental and control groups at each testing session.

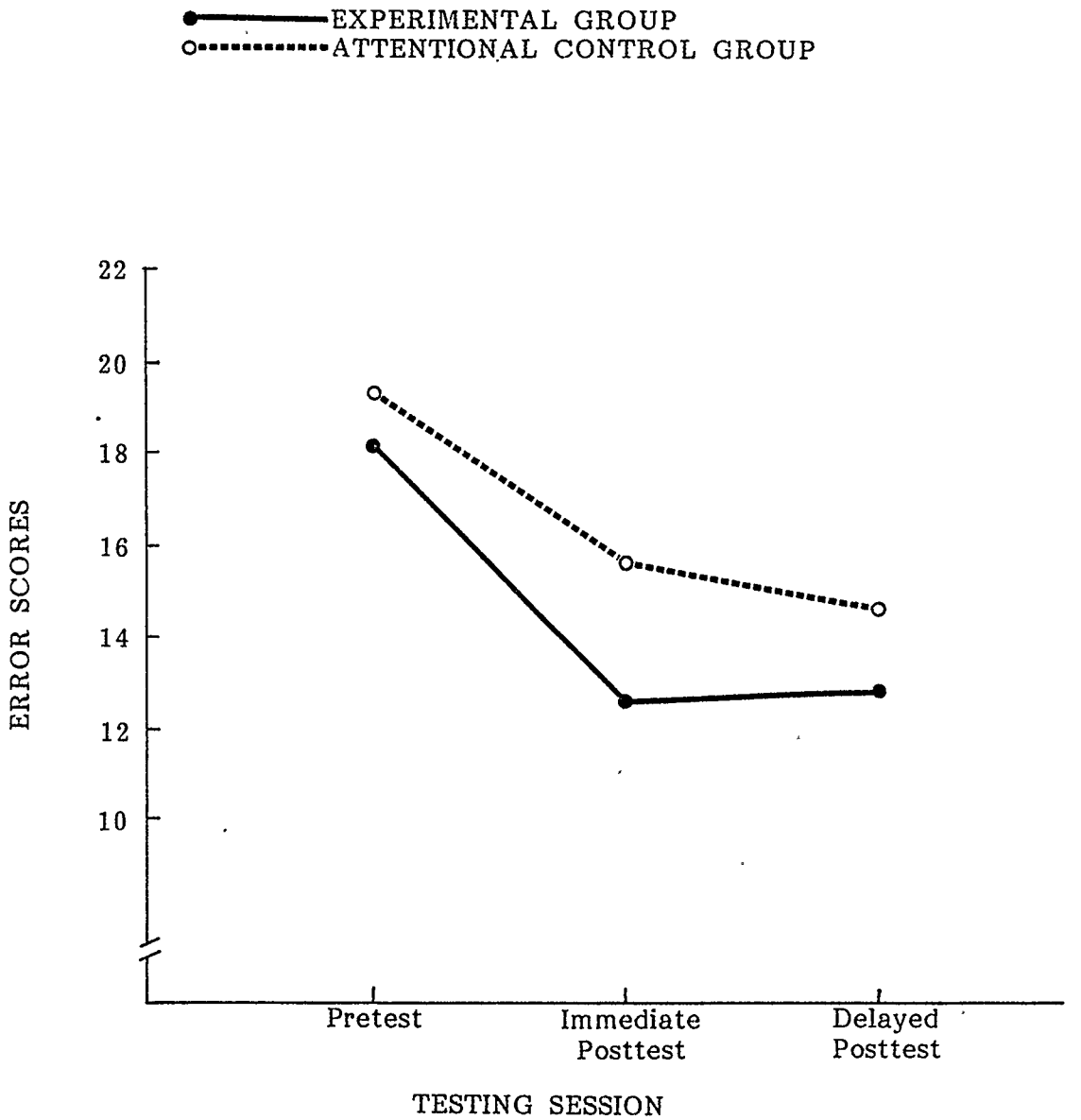

Figure 3. Mean error scores on the Matching Familiar Figures test for experimental and control group at each testing session.

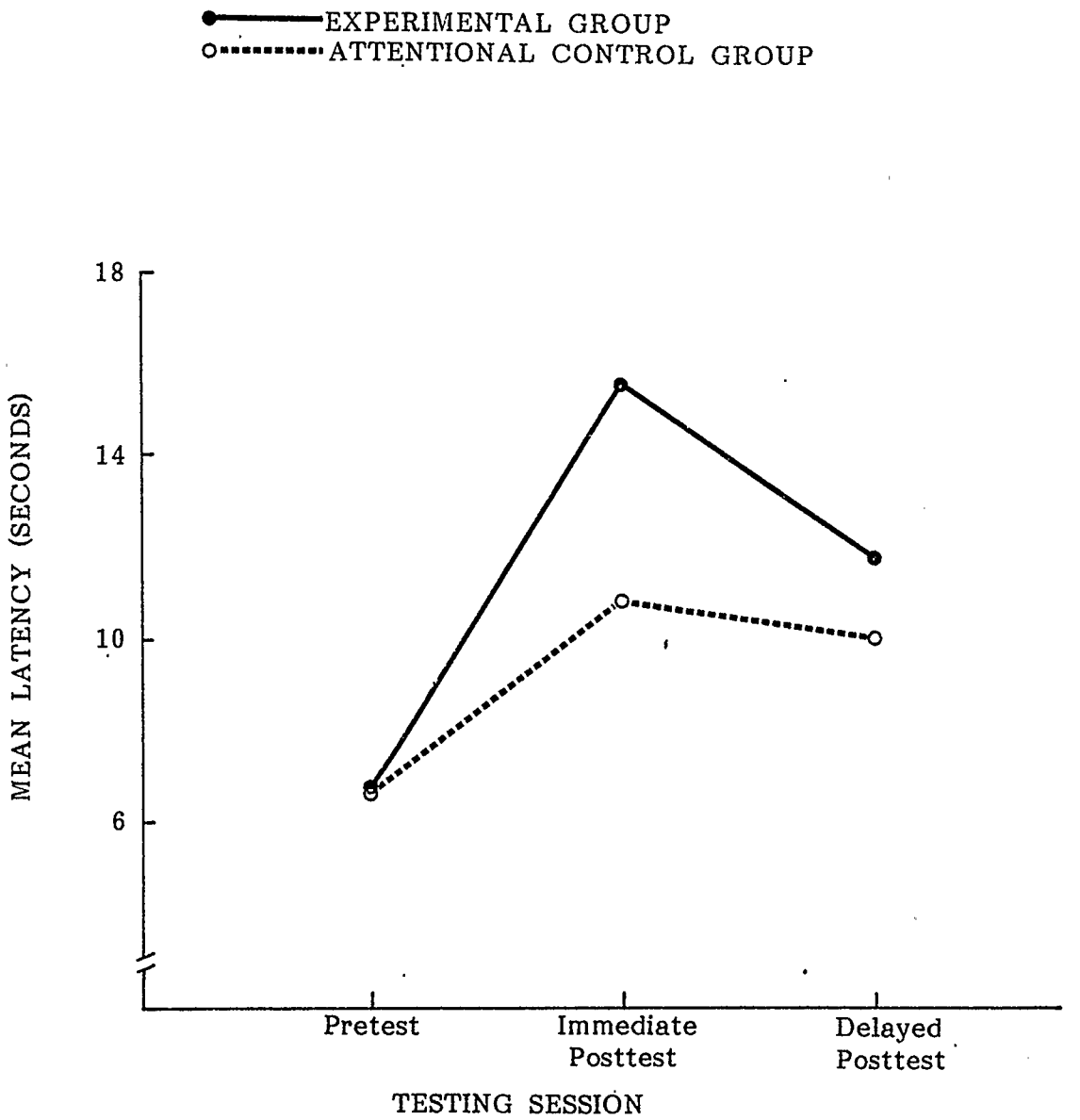

Figure 4. Mean latency to respond on Matching Familiar Figures test for experimental and control group at each testing session

of training. This finding suggests improvement may be the result of retest (practice) effects and is consistent with the findings of Willis et al. (1983), who found that the repeated posttesting involved in the assessment of training maintenance may yield retest effects in a test-naive population (see Figure 2). (3) Differences between the experimental and control group on MFFE, $F(1,54) = 3.84$ $p = .06$ approached significance. Children who received VIP training made fewer errors on the MFF than children who were in the attentional-control group (see Figure 3). (4) Non-significant differences between groups were found for scores on MFFL, $F(1,54) = .72$ $p = .40$. All analyses on MFFL were performed on logarithmically transformed scores to correct for possible skewness in the distribution of scores. These results appeared because both experimental and attentional-control group children slowed down their response time (latency) on the MFF. The experimental group children slowed down more (see Figure 4).

In summary, training improved lower level perceptual analysis skills, Matching Familiar Figures Test error rate (MFFE) and the expression of Piagetian competencies in classes and relations (64-I) was marginally facilitated as well. Response latency (MFFL) did not appear to be affected by VIP training. Higher level perceptual-analytic skills necessary for successful solution of the CEFT were not appreciably affected by treatment. Therefore, alternate

Hypothesis 1 received partial support. The experimental group performed better than the control group overall. Improvement was primarily reflected in two of the dependent measures, the Piagetian 64-I and MFF error rate.

The second stage of the analysis required an examination of data resulting from the delayed posttesting session in order to determine if Hypothesis 2 was supported. As stated previously, the MANOVA (p. 96) and ANOVAs (Table 4) showed no interaction between group membership and testing session, suggesting there was neither differential improvement nor deterioration over time (delayed posttest) for one group in comparison to the other. An examination of means (see Tables 5 and 6 and Figures 1 and 3) shows that, even though the experimental group performed better at both posttests than the control group on the 64-I and MFFE, their gains had deteriorated somewhat at the two-month delayed posttest. These findings suggest that treatment effects were somewhat diminished by time. Therefore, Alternate Hypothesis 2 is partially supported. The means of the two dependent measures that have shown nonsignificant trends in the predicted direction (64-I and MFFE) continue at an improved, although somewhat diminished level, in comparison to the controls at delayed posttest. This is in contrast to the other dependent measures (Matching Familiar Figures, latency and Children's Embedded Figures Test), which at no time evidenced treatment effects.

TABLE 5

Means and Standard Deviations for Posttest Scores of Cognitive Style and Piagetian Measures

	Posttest			
Group	64-I	CEFT	MFFE	MFFL
Experimental (N = 28)				
M	47.18	7.36	12.61	2.42
SD	5.89	4.27	5.49	.78
Control (N = 28)				
M	44.18	8.11	15.64	2.23
SD	5.06	3.43	5.69	.56

NOTE: 64-I = Piagetian Measure
CEFT = Children's Embedded Figures Test
MFFE = Matching Familiar Figures Test Errors
MFFL = Matching Familiar Figures Test Latency (transformed)

TABLE 6

Means and Standard Deviation for Delayed Posttest Scores of Cognitive Style and Piagetian Measures

	Delayed Posttest			
Group	64-I	CEFT	MFFE	MFFL
Experimental (N = 28)				
M	44.25	8.29	12.82	2.31
SD	6.06	4.13	5.18	.59
Control (N = 28)				
M	41.32	9.36	14.61	2.18
SD	7.13	4.25	6.11	.51

NOTE: 64-I = Piagetian Measure
CEFT = Children's Embedded Figures Test
MFFE = Matching Familiar Figures Test Errors
MFFL = Matching Familiar Figures Test Latency (transformed)

To obtain a more accurate assessment of training effects, without the potentially masking effect of the pretest scores that were included in the previous MANOVA, a third stage of the analysis was undertaken. Since the purpose of this investigation was to test effects of treatment, the essential question is whether posttest scores vary between the experimental and control groups. It has been suggested that the posttest scores alone are a suitable dependent variable (Cronbach & Furby, 1970). The inclusion of scores obtained prior to treatment is seen as unnecessary and may produce a masking effect which works against detecting change after treatment. Other developmentalists have used posttest scores when evaluating change (Willis, Blieszner & Baltes, 1981; Nesselroade, Stigler & Baltes, 1980; Hofland, Willis & Baltes, 1981; Willis et al., 1983). It is for these reasons that a second MANOVA was undertaken. BMDP4V was again used for the analysis.

To obtain an initial assessment of training effects, a 2(Experimental, Attentional-Control) x 2(Testing Session: Immediate Posttest, Delayed Posttest) MANOVA with repeated measures was conducted. This analysis resulted in significant treatment ($F4,51) = 3.41$ $p = .015$, and test session $F(4,51) = 6.72$ $p = .000$, main effects. Since the Treatment x Testing Session interaction was not significant, the treatment main effect suggests that training was maintained across posttest sessions. An examination of means (see

Tables 4 and 5 and Figures 1-4) shows that, although treatment effects decreased somewhat at delayed posttest, the training effect was still demonstrated.

Univariate 2 (Treatment) x 2 (Testing Session) ANOVAS with repeated measures were again conducted to examine training effects separately for each measure (see Table 7). Significant treatment effects were found for the Piagetian measure, 64-I ($p = .02$). Marginal treatment effects were indicated for cognitive style: MFF(E) ($p = .08$). This indicates that without the masking effect of pretreatment scores, significant treatment effects emerge on Piagetian scores. Children who received VIP training solved more Piagetian problems correctly than did the children in the attentional-control group. The probability of rejecting a true null hypothesis under the additional analysis would be .06 and.08 respectively for MFF error rate. Although this is higher than the .05 level adopted, it does not represent an excessive amount and can be used as an indicator of a trend. This trend moved from $p = .06$ to $p = .08$ as a result of excluding pretreatment scores. These results appeared because the gains made by the experimental group children on MFF error rate remained almost the same across posttests, while control group children improved slightly across posttest sessions. Although control group children continued to improve, their performance never did attain the level achieved by children in the experimental group.

TABLE 7

Summary of the Two-Way Univariate Analysis of Variance Repeated Measures on Cognitive Style and Piagetian Immediate and Delayed Posttest Scores

Source	df	SS	MS	F	P
Groups					
64-I	1,54	246.036	246.036	5.46	.023*
CEFT	1,54	23.223	23.223	.80	.376
MFFE	1,54	162.723	162.723	3.15	.081
MFFL	1,54	326.747	326.747	1.91	.173
Testing Session					
64-I	1,54	234.321	234.321	8.14	.006**
CEFT	1,54	33.223	33.223	9.94	.003**
MFFE	1,54	4.723	4.723	.40	.527
MFFL	1,54	126.650	126.650	3.68	.060

* Significant at the .05 level

** Significant at the .01 level

In summary, the findings suggest that treatment facilitated the expression of Piagetian classes and relations concepts and marginally reduced cognitive tempo error rate. Children's Embedded Figures Test performance and cognitive tempo latency were not affected by treatment. The findings also suggest that treatment was more effective for facilitating the expression of Piagetian competencies than for remediating impulsivity as measured by performance on the MFF.

Post Hoc Analyses

Post hoc analyses using the Neuman-Keuls test (Ferguson, 1981) were performed in order to evaluate the magnitude of change across testing sessions (pre-post-delayed posttest) for each dependent measure summing across groups. These tests indicated significant differences between pre- and immediate-posttest means $p < .01$ for all dependent measures except the CEFT. For differences between the pre- and delayed posttest means all comparisons were significant $p < .01$ with the exception of the 64-I data. Differences between immediate- and delayed posttest comparisons were significant $p < .01$ for the Piagetian measure (64-I) and the CEFT only.

An exploratory MANOVA, with four outliers removed, along the lines of deviant case analysis as discussed by Ross (1981), was performed as a further evaluation of

treatment effects. Outliers were chosen from behavioral-personality descriptions provided by teacher-tutors. All of these children had come to their tutor's attention due to absence from school and study group. They also displayed a variety of unusual behavioral-personality characteristics. Some examples included, constantly touching the other children, often being very tired, frequently not wanting to participate and being silent or withdrawn. Generally, the deletion of these cases affected the multivariate and two marginally significant univariate tests. The overall multivariate test moved from $F(4,51) = 2.77$ $p = .04$ to $F(4,47) = 3.56$, $p = .01$. The MFFE went from $F(1,54) = 3.84$, $p = .06$ to $F(1,50) = 8.32$, $p = .01$, and for the Piagetian measure from $F(1,54) = 2.87$, $p = .10$ to $F(1,50) = 2.98$, $p = .09$. These findings would appear to suggest the children identified as outliers were not typical of the present study sample and may belong to another population. This finding also suggests that children who attended school more regularly and therefore were available for their group sessions and were relatively free from problematic-behavioral-personality characteristics were more able to benefit from VIP training.

Exploratory, follow-up analyses of the main effect for treatment, as reflected in Piagetian scores (64-I), were performed. In order to better understand the nature of the difference between the experimental and attentional-control groups, a discriminant analysis was performed on immediate

posttest data to determine if specific subtests of the 64-I could aid in discriminating between the two groups. Groupements 1 (Primary Addition of Classes) and Groupements 3 (Bi-univocal Multiplication of Classes) were marginally significant at contributing to the separation of the two groups $F(1,54) = 2.86$ $p = .09$ and $F = 3.47$ $p = .07$. These effects did not maintain for a discriminant analysis performed on the delayed posttest data. Piagetian skills may be differentially affected by treatment, although this must remain speculative because the data do not fit the requirements for this test. A larger number of subjects would be required. This finding, however, is consistent with the previously mentioned finding that Piagetian skills are differentially affected by cognitive style factors (Brodzinski, 1982).

Summary

The results have provided partial support for the aims of this study. Of major importance is the finding that the expression of Piagetian competencies increased as predicted. The first MANOVA included pretreatment (pretest) scores which partially masked training effects and resulted in a marginally significant trend of improved performance due to training. A second MANOVA performed on posttest scores alone revealed a significant training effect. Children who received VIP training made fewer errors on the Matching

Familiar Figures Test. Results were marginally significant. There was no significant effect of training on the latency score of the MFF. That is, both experimental and attentional-control groups took longer to respond to MFF items across testing sessions. There was also no effect of VIP training on Children's Embedded Figures Test performance. Both groups improved across testing sessions, suggesting a retest (practice) effect.

Post hoc analyses suggested (a) children who attended more training sessions and were relatively free from problematic behavioral-personality characteristics were more able to benefit from VIP training; (b) the major gains in performance occurred at immediate posttest. Because there was no interaction of the main effects of group membership (treatment versus control) and testing session (pretest-post-delayed posttest), no direct comparisons of delayed posttest performance are indicated. Stated another way, performance curves for both groups, across all dependent measures and testing sessions are roughly parallel. An examination of means reveals a mixed pattern of effects across dependent measures at the delayed posttest. Finally, an exploratory discriminant analysis revealed two subtests of the Piagetian measure were primarily the subtests best able to discriminate between groups.

CHAPTER VI

DISCUSSION

The present study was an attempt to provide a next step in the search for the qualities that define cognitive impulsivity. It also attempted to establish a link between the cognitive style dimension of reflection-impulsivity and the expression of selected Piagetian competencies. The use of a transfer of training paradigm was an attempt to extend current efforts to understand the relationship between reflective skill acquisition and selected Piagetian classes and relations competencies in the elementary school age child. It it can be demonstrated that increased reflectivity facilitates Piagetian competencies, evidence will have accrued to suggest a connection between the processes that underlie both domains.

An approach related to that outlined above has been put forth recently by Feuerstein (1980) as well as others interested in cognitive process training or "thinking skills" training (Haywood et al., 1984). From this perspective an extremely important part of growing up is learning culture-specific ways of generalizing experience through what Feuerstein has termed "mediated learning." If mediated learning is insufficient, the necessary fundamental "cognitive functions" fail to develop. Feuerstein and others have developed programs for cognitive education for use

primarily with adolescents. Sternberg (1985) has also recently developed a cognitive process training program for use with university students comprised of three basic kinds of skills: metacomponential, performance-componential and component skills of knowledge acquisition, retention and transfer. While all three programs have a common goal which is to improve intellectual functioning by training underlying information processing components; their theoretical bases, component skills, target populations, degree of emphasis upon motivational factors, as well as their scope of intervention differ. The present study's intervention program (VIP) is very limited in scope, appropriate for use with young children and is derived from a developmental-individual difference perspective.

The first part of the following discussion refers to the data from the Piagetian measure (64-I) and represents the most important aspect of the present investigation. The remaining outcomes of this investigation were replications of previous researches. Implications from tests of the first hypothesis will be discussed first.

Findings at Cessation of Training

Number of Items Correct (64-I)

The first part of the first hypothesis predicted that, as a result of training, there would be a gain in the number of correct items on the 64-I at the immediate posttest.

Previous studies have noted that cognitive impulsivity is negatively related to the performance of selected Piagetian competencies (Brodzinski, 1982; Grant, 1976; Barstis & Fold, 1977). In a rare training study, Schleser et al. (1981) trained impulsive children in general problem-solving strategies that included a self-instruction technique. Training generalized to a Piagetian spatial perspective-taking task if the child was concrete operational. Proceeding from the opposite direction, Linn (1978) trained field-dependent adolescents on the skills required to solve a Piagetian task and found training did not generalize to cognitive style.

The most important contribution of the present study is that the data provide evidence that there is a link between increased levels of reflectivity and Piagetian competencies. The present data support the notion that VIP training facilitates the expression of Piagetian competencies by impulsive children. When impulsive children are trained in skills that underlie reflectivity (distinctive feature discrimination, part-whole hierarchical relations, and systematic scanning), they are able to solve significantly more Piagetian classes and relations problems. If further investigations support the cognitive style-Piagetian link, additional implications for the range of disadvantage experienced by impulsive children will have accrued.

There is already a large amount of evidence demonstrating that impulsive children are at a disadvantage when their performance on a wide range of cognitive tasks is compared to their reflective peers. Evidence is beginning to accrue that Piagetian tasks are one more group of cognitive tasks that children with particular cognitive styles (e.g. impulsive, field-dependent) experience difficulty with. Although these notions are speculative, if development from preoperational to concrete operational thought is constrained, such a limitation may contribute to learning problems. Piagetian competencies have been associated with a child's readiness to learn the complex tasks involved in academic learning. Reading and arithmetic, as well as increased ability on a variety of cognitive tasks, are associated with greater Piagetian competencies (Arlin, 1981; Gholson & Beilin, 1979; Clements, 1984).

That selected Piagetian competencies appear to be affected by cognitive style is not altogether unexpected, considering the general nature of these information processing styles. Cognitive styles are types of behavior that concern the efficiency of mental processes. They are intimately involved in intellectual operations but do not constitute a unitary, intellectual function because they do not have a specific end-product. Because of their general nature, such processes affect a wide range of cognitive behavioral end-products (Lezak, 1983).

To establish whether this connection between reflection-impulsivity and Piagetian classes and relations concepts is valid requires further investigation. In a preliminary study, error is especially difficult to control and is unavoidable. It is not possible to interpret the results of a single study with certainty.

Perhaps the greatest difficulty with the present investigation is the use of the MFF. Specification of the information processing components of performance on the MFF is not complete. At one level memory, attentional, coding retrieval and conceptual processes may contribute to MFF performance. At another level, incorrect assumptions in problem-solving, inferior information-collecting behaviors, lack of knowledge of rules, concepts, skills and strategies have all been mentioned as contributors to MFF performance. There is a need for adequate instruments for assessing the specific processes underlying both reflection-impulsivity and Piagetian competencies. The relationship between the visual information processes taught in the VIP Program and reflection-impulsivity has therefore not been thoroughly mapped.

Further sources of error prevent an interpretation of the results with certainty and limit their generalizability as well. Reflection-impulsivity appears to account for 20% or less of the variance in cognitive task performance. The other sources of variance require examination before an

increased understanding of an impulsive child's decrement in problem-solving can be approached. No direct measurement of children using the VIP skills during the solution of Piagetian problems was obtained. It is, therefore, not possible to determine if the children actually used the skills to solve problems. The nonrandom selection of participating schools, the unspecified environmental effects of different schools and classrooms and the unpredicted subject withdrawal from the school and training program point to the need for a tentative interpretation of the results.

Finally, in addition to the sources of error listed above, there is another limit to the generalizability of the present study's results. Teaching separate skills or subskills does little to facilitate the child's cognitive development as a whole. Cognitive development involves more than a sequence of stages which can be reduced to logical structures and then further reduced to competence with particular Piagetian tasks. Improving performance on Piagetian tasks with a view towards claiming to have induced cognitive development is not the intent of this investigation.

Error Rate (MFF(E))

The second part of Hypothesis 1 stated that there would be a decrease in error rate on the MFF as a result of training in distinctive feature discrimination, part-whole, hierarchical relations, and systematic scanning. Results

from Egeland (1974) and Egeland et al. (1976) have been mixed in that only the first study significantly decreased error rate on the MFF as a result of perceptual-analytic type training. However, the majority of studies, which have provided training in visual information processing skills, have successfully reduced error rate on the MFF (Cullinan, Epstein & Silver, 1977; Isakson & Isakson, 1978; Zelniker, Jeffrey, Ault & Parsons, 1972; Orbach, 1977). Significant differences between the Egeland (1974) and Egeland et al. (1976) investigations were: (a) that the earlier study taught a specific strategy for solving match-to-sample problems to educationally normal children, while the later study taught more general level visual information processing skills to teacher-identified children who were experiencing educational problems, and (b) that the latter study had a slightly higher tutor/pupil ratio. The findings of both Egeland and Egeland et al. are consistent with Schleser et al. (1981), who found that only a specific match-to-sample training procedure yielded a significant reduction of the error rate on the MFF. Schleser et al. also provided one tutor per child.

In the present study, there was a nonsignificant trend for impulsive children who received VIP training to achieve a lower error rate on the MFF. These results are consistent with the findings of Egeland et al. (1976) and Schleser et al. (1981) in that general level skills training is

apparently only marginally effective in improving MFF error rate. However, there may be ways to enhance training effects on MFF(E) error rate and still teach skills that are general enough to be applicable to several types of problems.

Informal observations made during training may help identify important variables that can contribute to enhanced training effects and which may be examined more systematically later on. Training research, in contrast to correlational, is especially important in the study of cognitive processes that are relevant for education. The educational researcher is concerned with the degree of malleability, as well as the conditions under which such information processing skills can be optimized.

The following suggestions are speculative and are derived from both observations during the present study and the contemporary training literature. It appears that impulsive children need more direct instruction as to the importance or relevance of using the VIP skills. Increasingly, investigators are beginning to stress the need for including a 'metacognitive' component (Barclay & Hagan, 1982; Brown, 1978). It is also suggested that, in comparison to other studies, the higher tutor/pupil ratio used in the present study may not be beneficial (Egeland, 1974; Egeland et al., 1976; Schleser et al, 1981). Finally, it is also apparent that the program requires sustained effort, and acquiring the skills is definitely a challenge for young,

impulsive children. The use of incentives is suggested.

Latency (MFF(L))

The third part of Hypothesis 1 refers to the predicted increase in latency scores on the MFF, on the immediate posttest, as a result of training in the three VIP skills. That is, although no special training component was included, children's mean latency to first response was expected to increase. Both Egeland (1974) and Egeland et al. (1976) indicated significant increases in latency after visual skills training, with and without, specific instruction to delay response.

As is seen in Tables 4 and 7 (pages 99 and 110) data with and without pretest scores indicated no significant increase in latency as a result of treatment. Both groups increased in mean latency to first response with the experimental group's latency increasing more. This represents a failure to replicate Egeland et al. (1976). The training provided in the present study appears to have led some subjects to increase the time before responding, but this did not occur uniformly across subjects. There was a large amount of variability in the latency data which made the detection of a significant difference between groups unlikely.

A comparison of the three findings reported by Egeland (1974); Egeland et al. (1976); Egeland & Weinberg (1976)

with the findings of the present study suggests a possible trend regarding the variability of latency data. The first study, Egeland (1974), which included an immediate and delayed posttest, found both specific strategy training and delay training to significantly increase response latency. A no-treatment control group, which is essentially a test-retest condition, because the MFF was administered pre- and post- with no intervening training, showed gradually increasing latency that did not reach significance.

In the second study, Egeland et al. (1976) trained children with more general strategies (VIP Program) with no response delay component and found that the experimental group significantly increased latency and the two control groups increased their latency only slightly. In the third study (Egeland & Weinberg), which was investigating the psychometric characteristics of the MFF and used a test-retest procedure found grade two impulsive children had unstable MFF scores. On retest, one week later, using the same form of the MFF, a number of children changed category. Most of those who changed category became fast-accurates with a few becoming slow-inaccurate or reflective.

In the present study, an examination of individual children's latency scores revealed high variability in both the experimental and attentional control groups with some children slowing down and others speeding up to varying degrees. With such a high level of variability in the

response latency of impulsive children it is conceivable that, with the small sample sizes typical of reflection-impulsivity investigations, very different mean latency results would occur. This may provide at least a partial explanation for the variety of latency results in the literature.

Many investigators have found that, as a result of training, errors decrease with no significant corresponding increase in latency (Cullinan, Epstein & Silver, 1977; Isakson and Isakson, 1978; Zelniker et al., 1972). Isakson and Isakson (1978) provide a plausible explanation for this finding which has contributed to so much debate in the literature regarding the processes involved in solution of the MFF and the respective roles of latency and error rate. They state that experimental subjects seem to be able to adopt more effective processing strategies without also greatly increasing their response time. Perhaps such training can help impulsive children acquire the best of the impulsive and reflective styles, that is few errors and relatively short response latencies.

To the contrary, however, are the findings of Denny (1973), Moore and Cole (1978), Egeland et al. (1976) and Karoly and Briggs (1978). All of these investigators were able to reduce latency and not error scores. For some it may be that they focussed primarily on slowing down speed of response and did not provide an alternative strategy with

which to fill the increased time.

Other investigators have been able to modify both errors and latency (Briggs & Weinberg, 1973; Egeland, 1974). The question as to whether impulsive children simply lack strategic knowledge and how or when to use it or whether they really need to slow down at all needs examination. A behavioral interpretation may be relevant here. A common behavioral technique, when faced with a maladaptive behavior, is not to modify the negative behavior but rather to train an alternative, competing, adaptive behavior. It may be possible to slow down impulsive children by training strategic knowledge without providing training in response delay skills. The very process of using perceptual-analytic skills takes time, although not for all children.

An alternative explanation of response latency relates to the role of the dynamics within the impulsive child. Block, Block and Harrington (1974) suggest that the impulsive child is a generally anxious, vulnerable child who seeks structure. The high demand situation of the MFF places the impulsive child in a stressful situation which he or she is unable to tolerate. The impulsive's quick response reflects an intolerance for uncertainty and is an escape from the demands of the decision-making situation. This explanation is in contrast to Kagan and Kogan's (1970) assumption that the quick decision of the impulsive is due to lack of anxiety over the possibility of making an error.

To the present investigator these explanations are not mutually exclusive. That is, impulsive children upon first coming into the testing situation may be highly anxious and it is reasonable that they would want to get out of the situation as fast as possible. They probably don't inhibit their natural tendency to respond impulsively because (a) they want to leave the situation and (b) they also may not care if they are right or wrong.

The data and subjective impressions from the present investigation would seem to support such an interpretation. That is, the second time around, at the immediate posttest, the testing situation is no longer an unknown anxiety producing situation and this is reflected in the fact that even children that received no training become more careful in their deliberations and make fewer errors. They also are obviously more comfortable and take longer to respond. These results may be an example of retest effects that have slowed down both the experimental and control groups. Further research is needed to determine if these subjective impressions can be verified.

Before discussing the next dependent measure, due to the weakness of treatment effects on MFF(E) and MFF(L), some theoretical implications may be appropriate. The children in the present study had difficulty acquiring the VIP skills. This observation, together with the weak effects on MFF performance, lend more support to Borkowski et al.'s (1983)

conceptualization regarding the difficulty of remediating impulsivity. As mentioned previously, from this perspective, impulsivity is seen as a setting condition with cumulative effects over time. It is seen to exert its influence by restricting a child's experience with effective solution strategies, which leads to immature metamemorial knowledge of problem-solving strategies.

In contrast, from the Overton and Newman (1982) and Neimark (1981) perspective, any performance decrements, at least in Piagetian competencies that are associated with the influence of cognitive style, are seen as superficial. From the results of the present study, it appears that impulsivity, as operationalized by the MFF, may not be so superficial. The VIP skills required a fairly intensive daily effort for many weeks to be acquired. Even with this effort, MFF results were approached but did not obtain significance.

Number of Items Correct (CEFT)

The CEFT was included in the present study on the basis of research that has shown that MFF and the CEFT to be related (Massari, 1975; Neimark, 1975). It was used for two purposes: to add to the reliability of the MFF in identifying impulsive children, and as an additional measure for evaluating the effects of training. Egeland et al. (1976) used the CEFT to evaluate the generalization of training

effects. The two measures seem to require similar skills in visual information processing or visual analysis. Both require careful scanning of the stimulus complex, and extraction of relevant information. The child must also inhibit responding until the processes are complete.

In the fourth part of the first hypothesis, it was predicted that, as a result of VIP training, subjects would obtain more items correct on the CEFT at the immediate posttest. Because the experimental group did not obtain more items correct, this part of the first hypothesis is not supported. This part of the present study's results represents a failure to replicate Egeland et al.'s (1976) study, which found no main effect of training but found a significant improvement over time (testing session) for the experimental group. Since the children in the present study and those of Egeland et al. were both in grade two and received the same training program (VIP), it is difficult to identify what factors may have led to the lack of effects over time. Successful training effects for field-dependence have required the greater part of a school year to establish in previous studies (Dolecki, 1976). One successful, brief training method involved practice with simplified versions of the embedded figures by successive removal of the embedding details with the use of overlays (Connor, Serbin & Schakman, 1977). The results of the present study are more consistent with findings which suggest the malleability of

CEFT performance requires lengthy training or practice with simplified versions of the CEFT.

There were some differences between the present study and Egeland et al.'s (1976) study that may have contributed to the different outcomes. Initial levels (pretest scores) on the MFF and the CEFT of children were lower than those in Egeland et al. It could be that these Calgary children were at a lower level of functioning, simply because they were younger. Approximately one quarter of them were in grade one. All of Egeland et al.'s sample were in grade two and could have included 8-year-olds. They were inner city children with teacher-identified learning problems, a significant proportion of which may have been held back a grade. Additionally, in the Egeland et al. study, the delayed posttest was administered during the summer, making the mean age of the sample even higher.

Another possible contributing factor to the CEFT results is that, although both studies trained children to criterion on the VIP skills, Egeland et al. (1976) used formal measures to evaluate attainment of the skills. This procedure could have improved assessment of a child's attainment level, enabling identification of those in need of extra help. Some children received as much as 10 weeks of training. In the present study, the longest training period any child received was seven-and-one-half weeks. The assessment of criterion level attainment may also have been

less reliable because an informal assessment procedure was used.

The CEFT scores indicate steady improvement across testing sessions for both groups with no performance asymtote reached. Retest (practice effects) in repeated measurement designs have been shown to positively affect scores on visual-spatial type problems when there was no training component. Hofland, Willis and Baltes (1981) examined the effects of multiple retesting on cognitive tasks with older adults. They found a linear trend of steady improvement with no evidence for a performance asymptote. They note performance factors with older adults, many of which also apply to the young child. These include: lack of test sophistication, test anxiety, and lack of motivation. The CEFT results of the present study are consistent with the Hofland et al. findings. Retest effects may have contributed to the control group's improvement in the present research, making it difficult to detect a difference between the two groups on a global measure such as the CEFT.

Developmental Level

Recent research has shown the importance of considering the "fit" between the cognitive demands of the intervention and the cognitive capabilities of the child (Schleser & Thackwray, 1983). It may be that in the present study the skills needed for success on the CEFT are at too high a

level. The Calgary sample may not have benefited from training because they had not reached the necessary cognitive developmental level. Thus, they may have been unable to generalize the VIP skills in order to solve the embedded figure problems. Alternately, CEFT problems may require additional processes that young, impulsive children have not mastered.

Screening Application (CEFT)

One pratical implication of this part of the study is that as a screening measure for visual skills deficits, the CEFT is probably ineffective with impulsive children below the age of about 8. None of the children were able to solve CEFT problems with any proficiency. It appears that the measure requires a level of skills beyond those of most Calgarian seven-year-old impulsive children.

From the results of the data analysis it appears that Hypothesis 1 can be partially supported. Considering the four parts of Hypothesis 1, the experimental group achieved higher mean scores on the 64-I, lower error scores, and longer latencies on the MFF. The control group achieved higher mean scores on the CEFT. Significance tests indicate that experimental group children achieved: significantly higher Piagetian (64-I) scores and a nearly significant trend towards a lower error rate on the MFF(E). Significance tests indicated no difference in scores between groups on

the other dependent measures (CEFT, MFF(L)) and no interaction effects. Thus, no direct comparison of group by delayed posttest is indicated by the data. Additionally, because significance tests indicated there were no training effects on the MFF(L) and CEFT scores, these will not be discussed in the following section. It is now possible to discuss the findings relevant to the second hypothesis.

Findings at Two Months after Cessation of Training

64-I Maintenance

The first, and most important, part of the second hypothesis predicted that the experimental group would achieve higher mean scores on the 64-I, when compared to the control group two months after cessation of training. Results from Egeland et al. (1976) suggest the effects of process training (e.g., VIP Program) were demonstrable two months after cessation of training on several types of measures. Since the Training x Testing Session interaction was not significant, the training main effect suggests that effects were maintained across both posttests. An examination of means (as shown in Tables 3, 5 and 6 and Figure 4, pages 97, 106, 107) indicates that the experimental group has lost some, but not all, of their gains, while continuing to solve more Piagetian problems than the attentional control group. Even though the effect of training was maintained, there may be ways to make

training effects stronger and more durable.

In a recent cognitive training study, an alternative to a daily training session format was used that, if applied to the present training study, may have helped improve maintenance. Borkowski et al. (1983) successfully taught impulsive young children an organizational strategy in training sessions spaced throughout the year. Continued exposure, similar to distributed versus massed practice, may prevent the young child from interpreting training as an isolated event that can be forgotten.

MFF(E) Maintenance

The second part of the second hypothesis predicted that the experimental group would achieve a lower error rate (MFF(E)), when compared to the control group. An examination of the means (Tables 3, 5 and 6 on pages 97, 106, 107) shows that the experimental group continues to make fewer errors and to have maintained previously acquired gains two months after cessation of training. The attentional control group's error rate continues to improve, though not to the level maintained by the experimental group. These results appear to indicate a leveling out of training effects. This trend is consistent with the Egeland et al. (1976) study that found a durable, though non-significant, trend towards a lower error rate (MFF(E)) at a two-month posttest. As previously noted, the effects of training provided in the

present study may have been weak because the VIP Program teaches a more general level of skills. Versions of specific rule and strategy training for match-to-sample problems such as those provided in the earlier Egeland (1974) study may be necessary to achieve stronger effects on MFF(E). However, as previously mentioned (pp. 120, 121), there may be other ways to attain stronger effects.

From the results of the data analysis, it appears that the second hypothesis can be partially supported. Considering the four parts of Hypothesis 2, the experimental group achieved higher mean scores on the 64-I, lower error scores and longer latencies on the MFF. The control group achieved higher mean scores on the CEFT.

Post Hoc Analyses

After inspection of the data several additional comparisons were of interest. In an effort to examine the influence of atypical subjects, on treatment effects, an analysis of the data after the removal of four outliers was performed. Results indicated a significant difference between groups on MFF(E) error rate. As previously mentioned (see Chapter V, pp. 111-112), outliers were chosen on the basis of poor attendance at training sessions and behavioral-personality problems. The finding suggests that factors which contribute to poor school attendance, and therefore lower attendance at small group sessions, and the

presence of behavioral-personality problems are negatively related to successful training outcomes.

In the a priori analysis, a significant, overall, main effect for time (testing session) was found. A Newman-Keuls multiple-comparison of means, summing across groups, was performed to determine differences between each testing session for each dependent measure. Comparisons were significant for all dependent measures between the pretest session and immediate posttest. The CEFT showed significant change across all posttesting and is particularly vulnerable to retest (practice) effects because no asymptote was reached for either group. These findings seem to provide support for the differential significance of practice effects across cognitive tasks (Willis et al., 1981).

In order to investigate whether specific subtests of the 64-I were more sensitive to treatment effects, an exploratory discriminant analysis was performed. Results seemed to suggest that the two subtests that best discriminated between groups had formats that were similar to the MFF. This finding, although speculative, seems to suggest that the format of the Piagetian task is important for eliciting the effects of cognitive style on Piagetian competencies. The finding also lends support to the observations by Neimark (1981) and Brodzinski (1982) regarding the importance of task characteristics for eliciting the effects of cognitive style.

Summary

The results, taken in conjunction with previous findings (Brodzinksi, 1982; Schleser et al., 1981), suggest that there is a bond between the two domains of reflection-impulsivity and selected aspects of Piagetian classes and relations competencies. That is, some portion of each domain is common to both of them. Thus, it appears that training in the skills that underlie reflectivity improves the performance of impulsive children on a measure of reflection-impulsivity (MFF) and on a measure of Piagetian classes and relations concepts (64-I).

It must be noted here that only a narrow sampling of a broad range of Piagetian tasks was examined and therefore, the generalizability of these findings is limited. Additionally, these findings did not rule out the possibility that, in some cases, performance on the dependent measures (MFF, CEFT, 64-I) occurred as a function of other task demands and cognitive processes because: (1) the R-I construct accounts for 20% or less of the variance in cognitive task performance; and (2) no direct measurement was taken of the actual processes used by the children as they solved problems. Finally, these results only partially replicate Egeland et al. (1976). That is, while a durable, nonsignificant trend towards a reduced error rate on the MFF is consistent with Egeland et al. (1976), no training by testing session interaction for CEFT performance and no

significant increase in latency on the MFF resulted from the present investigation. Differences in subject characteristics, pupil/tutor ratio, measurement of criterion level attainment of the VIP skills, and length of training were suggested as possible contributory factors to the inconsistent results.

Additional training research is needed to indicate if other types of training would be faster and more helpful for facilitating Piagetian problem-solving in impulsive children. With respect to the VIP Program used in the present study the following factors seem to deserve further investigation: (1) the use of additional methods to initially assess impulsivity; (2) appropriate age for Canadian children; (3) tutor-student ratio; (4) colorful, interesting materials and the use of incentives; (5) protracted or distributed training; (6) formal evaluation of the attainment of criterion levels of the information processing skills; and (7) explicit feedback of the new behavior's effectiveness, that is, the inclusion of a metacognitive component.

CHAPTER VII

SUMMARY AND CONCLUSIONS

Perspectives on cognitive development have, for the most part, ignored individual variation in their theories and models of cognitive capabilities. Effort has been devoted largely to establishing general laws of learning, memory, problem-solving, and other areas of developmental change. Thus, little is known concerning the adequacy of a given theory or model of cognitive capabilities at a level applicable to the individual.

With increased interest in individualizing instruction, the necessity for identifying developmental and individual difference components of performance on cognitive tasks has emerged. The developmental processes that generate stage competencies and the individual difference processes that contribute to performance variability need explicit representation. Directly identifying the information processing components of a variety of cognitive tasks, together with representation of developmental and individual difference processes, could help clarify the situation at the level of the individual. Furthermore, identification of intermediary processes could help focus on a level of description which would provide direction for research on process trainability and transfer effects.

Cognitive style dimensions represent intermediary constructs that have emerged from the individual difference tradition and possess some explanatory value for the observed variability in cognitive performance. While there are many ways of construing notions about cognitive style, this study was concerned mainly with reflection-impulsivity (R-I) as defined by Kagan and Kogan (1970). The dimension is of special interest because a significant proportion of the study of individual differences among problem-solving approaches in children has been influenced by notions of reflection-impulsivity.

The literature suggested that impulsive children lack effective information-collecting behaviors. Although children appear to become more reflective with age, impulsive children do not seem to make the transition from passive exploration to systematic search easily. The course of future cognitive developmental competencies seems to be affected, handicapping their progress in school.

The review led to a number of suggestions regarding the significance of cognitive style. Effects on school achievement, important training components, construct validation and measurement problems were suggested. Of major importance to this study is the growing evidence suggesting a relationship between cognitive style dimensions and selected Piagetian competencies.

Recent investigations, primarily correlational, have demonstrated a possible relationship between certain cognitive style dimensions and the development or use of Piagetian concepts. These investigations have indicated that children and adults with certain cognitive styles fail to develop or use selected Piagetian concepts, even when appropriate to their developmental level. The research has raised many questions as to the nature of the relationship between aspects of cognitive style dimensions such as impulsivity and field-dependence and the use of operative and logical skills.

Consequently, the question was raised whether training in the skills that underlie reflectivity would enhance the acquisition or utilization of selected Piagetian skills. The development of the capacity for reflectivity, and its relationship to the expression of Piagetian competencies, was the concern of the present study.

There were two aspects to the present research. First, there was the training of impulsive children in skills shown to underlie reflectivity. Second, there was assessment of the transfer of the skills to the Piagetian task situation.

The rationale for the present study argued that there may be a related set of elementary processes that are the building blocks or prerequisite skills for both reflectivity and classes and relations competencies. Training in the skills of reflectivity might therefore enhance performance

on selected Piagetian competencies as well. If such a relationship could be demonstrated, aspects of both domains would be further defined.

The first hypothesis stated that on the immediate posttest the experimental group, as compared to the control group, would achieve improved scores on all the dependent measures, 64-Item Groupements (64-I), Children's Embedded Figures Test (CEFT), Matching Familiar Figures Test, errors (MFFE), and Matching Familiar Figures Test, latency (MFFL) as a result of treatment. The second stated that on the delayed posttest the experimental group, as compared to the control group, would achieve improved scores on all the dependent measures.

To test the above hypotheses all 207 children between the ages of 6.5 and 7.5 years from four Calgary elementary schools received forms requesting parental permission to participate in the study. Of the 180 children whose forms were returned granting permission, 64 met the criteria for the study sample, that is, the selection criteria required that study sample children score above 13 errors and below 9.3 seconds mean latency to first response on the MFF. From the entire group of 180 children, 84 were classified as impulsive. The second criterion required that the study group be approximately within the average range of intelligence. Of the 84 impulsive children who were administered the Peabody Picture Vocabulary Test-Revised, 71 were within

approximately 1.5 standard deviations (SD) from the mean. The third criterion required children to score below the mean for 7-year-olds on a second cognitive style measure, the Children's Embedded Figures Test. No children were eliminated on the basis of their scores on this measure. The final selection criterion required that children score approximately two standard deviations below the ceiling of the Piagetian measure (64-Item Groupements), at no more than 51 items correct. Of the 71 children, 64 met the last criterion. Of these 8 children left the study for a variety of reasons, including geographical relocation, leaving a final sample of 56 children.

Children were randomly assigned to experimental and control groups. The "Learning to Look and Listen: A Visual Information Processing Training Program" (VIP)(Wozniak & Egeland, 1975a) was selected to provide the training component of the study. This program provides training in part-whole hierarchical relationships, distinctive feature discrimination and systematic scanning. It has been successful at remediating impulsivity as well as increasing field-independence in school-age children (Egeland et al., 1976). The VIP Program required that children be taught for 20-30 minutes outside the classroom to criterion level on the three skills. Children in the attentional-control group left their classrooms for the same amount of time but used normal curriculum materials. Immediately after completion of

training (approximately 7 weeks) and again two months later, posttests comprised of the dependent measures (64-I, CEFT, MFF(E), MFF(L)) were administered to determine if gains were maintained.

The data analysis is presented in Chapter 5. The most important findings are summarized below.

1. The results of the first MANOVA indicated a significant effect for treatment; however, in follow-up ANOVAs on individual dependent measures, only marginal trends were evidenced. Because it was suspected that pretest scores were masking the effects of treatment, a second MANOVA was performed (see Tables 3 and 7). Results verified that pretest scores masked treatment effects (Cronbach & Furby, 1970; Nesselroade et al., 1980). The following summary will therefore reflect results of the analyses, which excluded pretest scores. The initial assessment of training effects indicated significant treatment and testing session main effects. Since the Treatment x Testing Session interaction was not significant, the treatment main effect suggested that the differential effect of training was maintained across posttest sessions. In other words, the experimental group maintained the advantage over the control group. The testing session main effect is interpreted to reflect both

normal cognitive development as well as retest (practice) effects common to both experimental and control groups.

2. Univariate 2 (Treatment: experimental, control) x 2 (Testing Session: immediate and delayed posttests) ANOVAs were conducted to examine training effects separately for each measure. Significant treatment main effects were found for the Piagetian measure (64-I) and a nonsignificant trend towards a lower error rate was noted for the MFF. This pattern of results suggests that Visual Information Process training facilitates the expression of Piagetian competencies as predicted. The transfer effect (of visual information processing skills that underlie reflectivity) tends to give credence to the notion that there are some connections between the domains of reflection-impulsivity and selected Piagetian classes and relations competencies. Thus, support for the notion of a set of elementary processes or prerequisite skills for both reflectivity and selected classes and relations competencies has accrued. The results also suggest that extra training components may be necessary, in addition to the more general skills taught in the VIP Program, if significant or more powerful training effects are to be achieved

on the traditional measure of reflection-impulsivity, the MFF.

Results of ANOVAs on CEFT and MFF(L) scores were not significant which represents a failure to replicate Egeland et al. (1976). It was suggested that the younger age of the present study sample was a contributory factor in the failure to find effects. In addition, the variability of MFF latency scores made it unlikely that training effects could be detected.

3. Post hoc analyses included a third MANOVA and set of four univariate ANOVAs for each dependent measure. These analyses were performed with four outliers removed (Ross, 1981). Outliers were selected on the basis of: (a) poor attendance at school which resulted in poor attendance at the daily sessions of the present training study; and (b) behavioral-personality problems noted by teacher-tutors. Results indicated a significant effect of training for MFF error rate. These results suggest that factors that contribute to poor school attendance and the presence of behavioral-personality problems detract from training effectiveness.
4. In order to examine the possibility that some Piagetian subtests (64-Item Groupements) were more

sensitive to treatment, a post hoc analysis, that was exploratory in nature, was performed. The data did not fit the usual requirements for the analysis because more subjects would be required for eight dependent measures (predictor variables) than were available for the present study. The discriminant analysis on the subtests of the Piagetian measure indicated two groupements: primary addition of classes and bi-univocal multiplication of classes discriminated between groups with marginal significance. This finding tentatively suggests task format is important for eliciting cognitive style effects.

The literature has suggested two broad sources of variation that contribute to cognitive style differences. One general source might be referred to as cognitive processing or information processing differences. The other appears to refer to an effort or motivational dimension. Both aspects were noted in the review.

On the one hand, the habitually low effort processing of Case (1974) and the passive exploration noted by Wright and Vlietstra (1977) appear to refer to the effort component. On the other hand, an aspect of reflection-impulsivity, noted by these investigators, was the tendency to attend to misleading cues in the problem situation which suggests an information processing component.

Another information processing type factor mentioned in Chapter 2 is Borkowski et al.'s (1983) view that a deficit in metamemory is a setting condition for impulsive children. If over a period of time impulsive children acquire less practice with successfully adapting problem-solving strategies, a cumulative deficit accrues.

The findings of the present study fall primarily, although not entirely (p. 129), under the information processing type of sources of variance. The VIP Program skills probably represent only a part of the information processing skills deficit of impulsive children. Such deficits might include both specific and general skills and strategies. This perspective would be consistent with that of Schleser and Thackwray (1983), who noted that assessment and remediation of more basic processes (prerequisite skills) in impulsive children may be necessary before remediation of higher order problem-solving skills can be accomplished. Such a perspective is also consistent with Borkowski et al.'s (1983) view.

There is a significant amount of evidence indicating that it is possible to improve performance of impulsive children by providing training to change attention deployment strategies. Training methods range from teaching visual information processing skills to self-instruction techniques with the use of effective problem-solving skills. This study has provided evidence for another type of benefit to impul-

sive children that accrues by providing such training. The skills of reflectivity appear to facilitate the expression of selected Piagetian competencies as well. It was noted previously, however, that only a narrow sampling of a broad range of Piagetian tasks was examined. Such a narrow sample limits the generalizability of the present findings. The findings in the present study that indicated a trend towards a lower error rate on the MFF and no significant increase in latency (MFFL) suggest the need for attention to additional types of training components.

The Overton and Newman (1982) competence-activation/utilization model may be of primarily theoretical rather than practical interest. If impulsive children habitually do not use certain competencies and there is evidence that developmental lag does not explain the phenomenon (Zelniker & Jeffrey, 1978), then the issue of whether children do or do not possess such capabilities needs further explanation.

The role of an effort or motivational component was briefly mentioned and derived from informal observation in the present study. Both experimental and control group children expended more effort and time solving problems at the posttesting sessions. There are several possible patterns of relationships that may exist between effort expended and the type of processing strategies used by a child. For example, the strategy chosen may determine the effort expended or vice versa. People balance speed and

accuracy against one another when they perform tasks. Where they place the balance depends on motivation, bias, and beliefs, among other things (Fitts, 1966).

There is a recurring problem in analysis of the reflection-impulsivity dimension. It is difficult to find a level of description that can encompass the range of types of variables that need specification. Cognitive developmental, effort-motivational, individual difference, treatment and criterion variables are needed to guide research and provide an analysis of training options.

Implications for Testing and Training

Impulsive children have special psychoeducational needs. Current knowledge is approaching a level of sophistication which will allow its appropriate application to the individual instructional needs of the impulsive child. It is here suggested that intervention to enhance the skills of reflectivity may facilitate the expression of some Piagetian competencies as well as other aspects of problem-solving. Such intervention may, thus, contribute to the continued development of those higher level skills which otherwise might be limited. To the extent that reflectivity and selected operational skills facilitate the development of academic competencies, for example, number concepts (Clements, 1984) and readiness for learning school tasks that have high cognitive demands (Arlin, 1981), the training

may contribute to school achievement.

Advances in the initial identification of the impulsive child include a longer version of the MFF, the MFF-20 (Cairns & Cammock, 1978) and the norms provided by Salkind and Nelson (1980). These advances suggest an improved ability to identify potential training program recipients. Even so, the reliability of an individual assessment could be enhanced with additional sources of information, perhaps from the classroom teacher or additional cognitive measures. Reliable assessment of the young impulsive child (7 years) is particularly difficult. The effectiveness of training programs, the generalization of training to school achievement, and the logistics involved in reaching the children that need such training deserve further attention.

Implications for Further Research

If the relationship between reflection-impulsivity and selected Piagetian competencies proves to be valid, many questions remain concerning the nature of the relationship. For example, it remains to be determined whether training in reflectivity facilitates the use of operative competencies better than training in operativity is able to facilitate the expression of a reflective style. A study that provides training in operational skills for impulsive children could provide additional information about the direction of the relationship.

Results from the present training study have led to a number of factors that may have improved training effects. Evaluation of the following suggestions may lead to their consideration in future training programs: (1) the use of additional methods to initially assess impulsivity; (2) slightly older Canadian children--for example, 7.0 to 8.5 years; (3) a lower tutor-student ratio, perhaps 2 to 1; (4) colorful, more interesting materials and the use of incentives; (5) protracted or distributed training; (6) better evaluation of the attainment of criterion levels of the information processing skills; and (7) explicit feedback of the new behavior's effectiveness, that is, the inclusion of a meta-cognitive component. Finally, construct validation issues that obscure the nature of the reflection-impulsivity dimension need examination.

One approach that seems to hold promise is the componential analyses or the cognitive components approach which attempts to directly identify the information processing components of performance on cognitive tasks. Other work along these lines, which examines constructs such as adapting, selecting and shaping, may also be informative (Sternberg, 1985). Such an approach is basically task analytic and addresses questions such as "What does the MFF test?" A first step in reflection-impulsivity would be to identify the core or prototypical tasks associated with the cognitive style dimension. The next steps would involve

developing a process model of individual task performances and a detailed specification of the intellectual functions required for the task which might include memory demands, processing strategies, scanning, comparison and eventually the generation of a set of individual process scores. There already exists an extensive data base of reflection-impulsivity research from which to draw. If the component processes as well as the prototypical tasks that elicit impulsive responding were more clearly specified, alternative measures could be developed and the utility of the construct would be enhanced. Unless alternative measures are developed and used in future research, it seems likely that the perspective from which fundamental questions concerning the development of a reflective style emerge will be too narrow and important aspects of the dimension will not receive attention.

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