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The Relationship of Selected Cognitive Style Dimensions and Piagetian Levels of Cognitive Development

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THE RELATIONSHIP OF SELECTED COGNITIVE STYLE DIMENSIONS
AND PIAGETIAN LEVELS OF COGNITIVE DEVELOPMENT

by

Luisa B. Gutierrez

A Thesis Submitted to the Faculty of the Graduate
School of Loyola University of Chicago in
Partial Fulfillment of the Requirements
for the Degree of Master of Arts

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	ii
LIFE	iii
LIST OF TABLES	ix
CONTENTS OF APPENDICES	xi

Chapter

I.	INTRODUCTION	1
II.	REVIEW OF THE LITERATURE	6
	The Behavioristic-Associationistic Conceptualization of Cognitive Development	6
	The Piagetian Conceptualization of Cognitive Development	12
	The Information-processing Approach to Cognitive Development	19
	Cognitive Style Dimensions	22
	The Relationship of Cognitive Style and Cognitive Development	25
	Recapitulation	29
III.	METHOD	33
	Hypotheses	33
	Subjects	33
	Procedure	34
	Instrumentation	35
	The Children's Embedded Figures Test	35
	The Class-inclusion Test	37
	The Conservation Test	38

Instrumentation (cont'd)	
The Transitivity Test	39
Psychometric Aspects of the Piagetian Tasks	41
Statistical Procedure.....	42
Path Analysis of Competing Models	42

Chapter

IV. RESULTS

Major Hypotheses.....	44
Examination of Competing Causal Models.....	46
Correlational Analysis.....	47

V. DISCUSSION..... 50

Hypothesis 1.....	50
Hypothesis 2.....	50
Hypothesis 3.....	51
Hypothesis 4.....	52
Hypothesis 5.....	53
Hypothesis 6.....	53
Hypothesis 7.....	55
Path Analysis of Competing Causal Models.....	56
Correlational Analysis.....	57
Statements Supporting External and Internal Validity.....	59
Educational Implications and Recommendations for Future Research....	61

VI. SUMMARY..... 65

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VITA

The author, Luisa B. Gutierrez, was born March 11, 1949 in Lima, Peru.

Her elementary education was obtained in the public school system of Lima, and her secondary education at Dalton High School, Lima-Peru, where she graduated in 1965. In January 1966, she entered Major National University of San Marcos in Peru and in December 1972 received the degree of Bachelor of Arts with a major in Psychology. A year period was awarded her for studies in Educational Technology with the faculty members of the Department of Education of Florida State University, Tallahassee.

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A full two year scholarship was awarded her by Ford Foundation for studies in Educational Psychology at Loyola University of Chicago, Illinois.

CHAPTER I
INTRODUCTION

Studies of cognition during the last two decades have been highly influenced by American and British cognitive experimentalists primarily concerned with describing the role of mediating processes (i.e., thinking and memory), and personality variables. On the other hand, European theorists such as Piaget have focused their attention essentially on the maturational stages of cognitive organization. However, the descriptive relation between perceptual organization and cognitive processes has not received a great deal of attention from the Genevan researchers.

Many observers have noted that the degree to which behavior is global and diffuse (i.e., differentiated or analytical) is a key dimension in individual psychological development. From the information processing point of view, there appear to exist individual modes of cognitive organization that correspond to an identified style of categorization or information processing which could be either analytical or global. Analytical subjects tend to differentiate the stimulus field, responding to parts of the stimuli, as well as to wholes, whereas more global subjects tend to respond to whole stimuli in a passive and non-reflective manner. There is a reported developmental tendency for most children to become more analytical as they become older, but individual differences in analytical attitudes remain rather constant (Kagan, 1970).

In attempting to describe cognition, the concept of cognitive styles deserves special attention. Cognitive styles refers to stable individual preferences in modes of perceptual organization and conceptual categorization of the external environment. It is important to note, however, that the term, style, refers to two different kinds of individual differences: capacity and stylistic preference. One particular style dimension involves the tendency to analyze and differentiate the stimulus environment in contrast to categorizations that are based on the stimulus as a whole. For example, the extremely field independent individual has available to him a highly analytic mode of functioning. This mode of functioning does not appear in the field dependent individual. Because the field dependent individual's capacity to function in a highly differentiated fashion is poorly developed, this individual does poorly in tasks demanding such functioning.

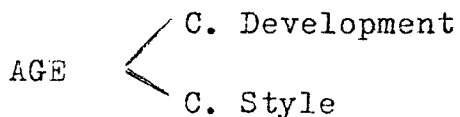
It is assumed in the present investigation that the construct of cognitive style (i.e., field dependence-independence) provides information about individual differences in analytical abilities; whereas developmental theories such as the Piagetian provide a general framework or structure by which to evaluate a given individual's level of cognitive development. However, these two theories (i.e., cognitive style and developmental theories), although different in their assumptions and conceptualizations of intellectual functioning, could have some elements in common, especially those which might be broadly classified as emphasizing analytical

abilities. Thus, bringing together the two theories, would seem to yield further information as to how analytical abilities influence cognitive functioning.

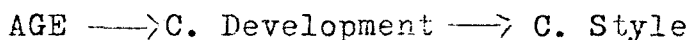
The primary objective of the present study was to compare cognitive performance, using Piagetian tasks, among pre-operational, concrete-operational, and operational subjects with relative field dependence-independence performance. In addition, the present study attempted to determine to what extent the relationship found between measures of field dependence and stages of cognitive development were based on a common factor (i.e., analytical abilities). A secondary concern was to explore a possible relationship between cognitive development and the dimensions of cognitive styles. Determination of the presence or absence of sex differences in field dependence-independence, in terms of levels of cognitive development, was also considered. This sex-differences analysis is theoretically supported by the frequent finding showing that females are significantly more field dependent than males. If the effect of sex is an important determinant of relative field independence, then it must be taken into consideration in exploring a potential developmental relationship between field independence and logical thought. The continual decline in egocentrism that accompanies cognitive development (Piaget, 1965; Elkind, 1975) could have an important role in terms of a developmental conceptualization of field independence. Thus, maturation variables were hypothesized in this study as factors which are influencing

patterns of cognitive change.

The research literature (Pascual-Leone, 1969; Kogan and Kagan, 1970; Bruner and Kalnins, 1973) concerning maturation as a direct causal variable influencing the cognitive style dimension and levels of intellectual development shows three main tendencies: The first tendency places maturation as a direct causal variable for the cognitive style dimension and for levels of intellectual development. However, this causal relationship between maturation and cognitive development does not imply a direct relationship between cognitive style and cognitive development. (Pascual-Leone, 1969).



The second tendency regards maturation as a direct cause of cognitive development. Cognitive development in turn is seen as an influential variable on the cognitive style dimension. Thus, the relationship between cognitive style and maturation seems to be mediated by cognitive development according to the Piagetian point of view (Saarni, 1973). This is illustrated as:



The third tendency regards maturation as a direct influential factor on cognitive style, which in turn influences cognitive development in the Piagetian sense. For instance, Bruner (Bruner and Kalnins, 1973) sees perceptual development as influencing the development of conservation. The diagram for

this tendency is as follows:

AGE → C. Style → C. Development

In summary, the major concerns of the present investigation were related to the analysis of the dimension of cognitive style as an influential factor in cognitive development. In addition, an analysis of sex differences at different ages was considered with respect to cognitive style and cognitive development. The research sample used here, consisted of 64 subjects, 32 males and 32 females, ranging from eight to eleven years of age, enrolled in the third through the sixth grade of a parochial elementary school located in a middle-class north-side neighborhood of Chicago. An equal number of male and female subjects was selected from each grade sample. In order to select the subject, one teacher from each grade was asked to select eight boys and eight girls who had an average level of achievement and who showed no evidence of mental or emotional problems. All subjects were given the Children's Embedded Figures Test (CEFT) developed by Karp and Konstadt (1963), and each set of the Piagetian Tasks (Class inclusion, Conservation, and Transitivity) in two independent sessions. A clinical interview methodology was utilized for the Piagetian tasks; both tests were individually administered to all subjects.

The implications of the findings of this study were directed mainly toward educational guidance and curriculum planning. Knowing the role of cognitive style as a factor

of intellectual development and determining to what extent analytical abilities are a common factor to both processes are of both theoretical and practical importance. Indeed, the relevance of this issue has been demonstrated in recent studies where the dimension cognitive style is considered a crucial factor during learning and concept attainment (Cantu, 1977). Individual variations in cognitive styles create differences in the quality of achievement as is reported by Kagan (Kagan, 1970). Field independent subjects showed better levels of achievement than field dependent subjects, especially in areas involving logical and mathematical reasoning.

CHAPTER II

REVIEW OF LITERATURE

The construct cognitive style has appeared as a variable of interest in the psychological research literature of the last two decades. This interest has been focused primarily on personality constructs or on the concept of psychological differentiation developed by Witkin (1963). More recent studies in this area show a contemporary interest in intellectual development. This increase of empirical research related to intellectual development has focused on the developmental aspects of cognitive functioning.

In cognitive developmental psychology several different types of theories or approaches to the conceptualization of psychological development have been proposed. These different points of view concerning cognitive development can be summarized under three main theoretical approaches: the Behavioristic-Associationistic approach, the Piagetian approach and the information-processing approach. In this section, a brief description of each of the above theories along with the research supporting them is presented. In addition, a section concerning a description of cognitive styles, and a section of recapitulation is included.

The Behaviorist-Associationist Conceptualization of Cognitive Development.

Behaviorism is a system of theories whose development

implies the consideration of different levels of analysis of complex behavior; includes in its early stages, Pavlov's theory of conditioned reflexes, and in its later stages, Guthrie's and Skinner works. These theoretical systems represent, however, derivations of the behavioristic system originally proposed by Watson (1943). From this perspective Hull's systematic behavior theory (1952) appears as the most serious effort to build a hypothetic-deductive system in psychology made during the first two decades of this century. Hull's position that thinking involves a chain of covert responses has led to changes in the traditional associationist point of view in which, a stimulus (S) is presented, a response (R) is emitted, and everything that occurs in between is summarized by rg-sg associations. However, the question about what comes in between or mediates between the overt behavior and the response remained unsolved until Hull's postulation of his mediational theory of behavior. This theory stated that a stimulus (S) evokes a miniature internal response called a mediational response (r_m). This response in turn creates a new internal state (s_m) which in turn may evoke yet another different r_m followed by a new s_m , and so on until an overt response (R) appears (Mayer, 1976). Hull called these mediational responses "fractional goal responses". Furthermore, these fractional anticipatory responses are used by Hull to describe the mechanism of secondary reinforcement, the gradient of reinforcement, and the habit- family hierarchy.

Hull's position suggests a mathematico-deductive theory because he utilizes a hypothetical-deductive method in a quantitative way. In other words, Hull begins with the postulation of basic problems and continues with the formulation of postulates, corollaries, theorems and problems. A theoretical derivation of Hull's mediational theory is represented by Berlyne's (1965) position concerning cognition. Berlyne presented a comprehensive mediational theory based on the principle that thinking is a chain of symbolic responses and stimuli mediating an S and R connection. According to Berlyne the Hullian habit-formation theory is the basic model in trying to offer a coherent explanation of cognitive function. Hull's habit family hierarchy consists of a set of behavioral S-R chains all associated with a common starting point and ending in the same goal situation. From this point of view, Berlyne attempted to explain how a child learns the meaning of equivalence (i.e., Piaget's conservation concept), Berlyne assumed that this equivalence can only be accounted for on the basis of derived stimulus equivalence, that is, secondary stimulus generalization. The equivalence between a series of behavioral chains resides in their common membership in a number of habit-family hierarchies. This point of view is also taken to represent the essentials of what Piaget means by "operation", that is, actions that are internalizables, reversibles, and coordinated into systems. Piaget's operation concept becomes, therefore, implicit responses organized in habit-family hierarchies.

On the other hand, transformational habit-family hierarchies are provided to explain the type of anticipatory thinking involved in some cognitive operations described by Piaget, such as physical causality, time, movement and speed. According to Berlyne the conditions for the occurrence of transformational habit-family hierarchies are: (1) that each situational stimulus must belong to the domain of the subsequent transformational responses; (2) that each situational stimulus must be associated with the subsequent transformational response and, (3) that each situational stimulus is the image of a preceding situational stimulus (Berlyne, 1965; Hilgard, 1975).

An evaluation of Berlyne's theory with respect to an explanation of cognitive functioning would imply the consideration of some aspects inherent to the originality of the theory itself, as well as its implications in terms of the postulation of new research problems in psychology. Berlyne's mediational theory could be considered only as an extension of the S-R theory; the more complex derivations that Berlyne proposed do not necessarily represent a contribution to the understanding of cognition. The consideration of the transformational habit-family hierarchies as active processes of cognitive assimilation led to ambiguities because Berlyne did not explain how transformational habit-family hierarchies account for representational processes and operational thinking in terms of Piaget's findings. The translation of the Piagetian theory of cognition into a S-R vocabulary will not lead to the formulation of new research problems in cognitive psychology because it is only a convergent point of view.

A more extended review of the research literature regarding the influence of the factors of learning, generalization, and transfer on cognitive development shows a recent tendency to take these factors into account as possible causes of concept acquisition during development. Most of this research has been conducted by North American researchers (Elkind, 1967; Gelman, 1972; Brainerd and Allan, 1973), but some Genevan research has appeared recently (Sinclair and Bovet, 1974, Smedslund, 1968). Among the concepts studied, the conservation concepts of middle childhood have been the focus of many of the experiments, although some attention has been given to other conceptual areas, such as seriation, classification, and spatial concepts.

With respect to the role of acceleration of learning, some experimental research conducted by European and American investigators was concerned with the relationship between learning and development (Wohwill, 1973). Among the European researchers, Inhelder, Sinclair, and Bovet (1974) reported that, in certain conditions, an acceleration of cognitive development would be possible, but this can only occur if the training resembles the kind of situations in which progress takes place outside an experimental set-up. In Smedslund (1968) experiments, training procedures used for the acquisition of conservation concepts were unsuccessful. In order to train the conservation of weight, for example, the classic tests of conservation were used. Children who failed the test procedures proceeded to a training phase after which the same tests were administered. The reported

results showed that very few of the subjects were able to acquire the conservation concept. Of course, alternate procedures which have not yet been attempted might produce different results.

Another experimental study using self-discovery training procedures has been conducted. Sinclair and Inhelder (1974) conducted an experiment where children who passed a test for number conservation but failed a test for length conservation were trained to adopt a numerical strategy to solve length conservation problems. The emphasis was in the children's discovering of the principle by themselves. Sinclair and Inhelder reported that such methods were effective procedures for training Piagetian concepts. Among the American researches, Brainerd and Allan (1971) conducted an experimental study concerning the acceleration of the acquisition of conservation. The results of this study showed that the conservation concept was successfully accelerated by means of training. Gelman's (1972) study inducing conservation by training in the measurement of liquid quantity were also successful, and both represent attempts to use instructional means to teach concepts or processes hypothesized to underly performance on some Piagetian tasks.

In summary, the research literature concerning the behavioristic-associationist points of view shows two main tendencies. The first one is represented by the neo-associationist approach with Berlyne's attempt to achieve an integration

between the basic structures that underlie simple behavioral chains and the more complex forms of thought. Berlyne points out that "stimulus-response connections" are part of an active process of cognitive assimilation and not only simple associations based on the similarity of stimulus. Berlyne explains conservation concepts on the basis of transformational habit-family hierarchies where the equivalence between a series of behavior chains resides in their common membership in a number of habit-family hierarchies. The second point of view is represented by the learning-oriented American and European cognitive experimentalist who investigated the conditions in which learning, generalization, and transfer influence cognition as possible causes of conceptual acquisition during development. The general findings show that the training procedures which have been attempted have accelerated the learning of some cognitive concepts such as conservation. However, this learning is dependent on development and follows the same mechanism to achieve conceptual acquisition.

Piagetian Conceptualization of Cognitive Development.

Piaget presents a theory of cognitive development that involves the consideration of three main areas. The first one is a developmental point of view, that is, intellectual growth proceeds in orderly stages, each of which defines what the individual is capable of learning. The second area refers to a substantial body of knowledge that describes the developmental course of how children acquire information about the physical world (number, quantity, space, time), the social world (morality, social conventions, values), and logical

mathematical thinking (classification, seriation, hypothetical deductive reasoning). The third area involves the description of a clinical interview methodology to approach the study of general cognitive development.

In attempting to summarize the Piagetian conception of cognitive development, it is necessary to discuss several essential to the understanding of intellectual functioning. These areas are related to the consideration of biological factors (assimilation-accomodation), factors of individual development (equilibrium), and sociocultural and environmental factors. Piaget's theory is considered a biological-experiential approach in the sense that cognitive development is regarded as a mode of adaptation to the world. Cognitive growth derives from the biological characteristics of the organism, starting with the infant's reflexes and proceeding by invariant stages to the eventual capability of abstraction and logical reasoning. The processes of assimilation and accomodation refer to the means by which knowledge is mentally constructed. In this sense, constructivism is another Piagetian concept important to explain cognitive development. In order for a child to know and construct knowledge of the world, he must act on objects, and it is this action which provides knowledge of those objects. The role of actions with objects is central to the Piagetian explanation of how the child develops intellectually. However, in the course of this interaction, the child begins to know the object on many levels and to develop different

interpretations of the object.

The concept of stage as orderly appearances of behaviors is another crucial concept in the Piagetian conception of cognitive development. For Piaget, development means movement from stage to stage and development occurs as an orderly process in a bio-social context. Four factors are important in the consideration of the sequence of cognitive development: maturation, experience with the physical environment, the actions of the social world, and equilibration or self-regulation. Maturation refers to the growth of the biological structure of the individual. The concept of experience is related to sensory and motor exercise, experiences with the physical world, and experiences in reasoning. This concept also implies action and reaction of both the individual and objects, and therefore, results in acquisition of knowledge through direct exchange between the individual and the environment. With respect to the social world, the Piagetian point of view considers it as having a significant influence upon the developing organism, especially during early childhood. Cognitive development might be accelerated or retarded as a function of the cultural and educational environments. Equilibration, another important factor, implies that there is a requirement for maturation, experience, and the social world to be in constant balance. Growth of knowledge is a consequence of the conflict between structures and events, the imbalance between previous knowledge and new events creates th

conditions for the transition from one stage to another (Flavell, 1971).

Another point of view concerning cognitive development comes from American and British theorists such as Elkind and Bruner. The work of Bruner (1968) provides a major supplement to Piaget's theory. In order to describe cognitive development, Bruner uses the conception of modes of representing the world instead of stages or periods of cognitive development. These modes according to Bruner are three: a) the enactive that means the representation of the world in terms of actions, b) the iconic, in which the representation is given as static perceptual images, and c) the symbolic, that implies the use of language and symbols as essential in the representation of the world. The explanation of the transition from the iconic or concrete representation to the symbolic representation differs from Piaget's conception. Piaget emphasizes the importance of mental operations such as reversibility as a prerequisite for conservation. Bruner places identity as the essential factor utilized to explain the shift from pre-operational to operational thinking. Bruner's position about the conservation concept assumed that inversion, compensation, and qualitative identity are all essential pre-conditions for conservation.

In North America, one of the most important representatives of Piagetian research is Elkind; his work is basically related to the study of the development of logical thought. With respect to class concepts, Elkind conducted a study in

which children from 5 to 8 years old were asked to "group" a variety of blocks of different colors, shapes and sizes Elkind found that although some sort of grouping organization had been established, there were no separations into classes in the abstract sense. In problems involving hierarchies of class inclusion the children were unable to reason about parts and wholes simultaneously (Elkind, 1976). With respect to the concept of conservation, (Elkind, 1967), employing standardized procedures and statistically evaluating his results, replicated and validated Piaget's work in conservation. Elkind found that there exists an orderly, age-related progression of stages in the child discovering of substance, weight, and volume.

The research supporting the Piagetian theory covers each of its major aspects, such as the sequential conception of cognitive development, the characteristics of the conceptual acquisition within each stage through the sequence of development, and the cross-cultural differences in the acquisition of cognitive development. With respect to the issue related to the sequence of stages of cognitive development, Brainerd (1977) criticizes Piaget's conception as having many logical problems which make the theory itself not very clear. However, Brainerd reported that, on the basis of research he conducted with infants, the acquisition of sensorimotor schemas maintains the same order as the one predicted by Piaget. Another study related to this aspect was conducted at the University of Illinois (Kramer, Hill and Cohen, 1975). The area of study was object permanence which characteristics appear in the sensorimotor period. An

object permanence test was administered to 36 infants, spaced over a sixth-month interval. The results of the study confirmed the same sequence of acquisition that Piaget found earlier in his studies about object permanence.

With respect to studies concerning the pre-operational stage, Piaget's claim that the pre-operational children are profoundly egocentric has stimulated considerable research in the past few years. Thus, Borke (1977) working on pre-operational egocentrism offers an entirely new procedure for measuring children's egocentrism. This new procedure involves the identification of emotional expressions in a series of drawings presented. In contrast to the Piagetian findings that the child between two and seven years old is primarily egocentric and unable to take another person's point of view, Borke's data suggest that children as young as three years of age are aware of the feelings of other people and that these feelings vary according to the situation in which individuals find themselves. Also, Ruben and Maioni (1975), investigating a modified version of Piaget's mountain problem, found high frequencies of correct responses in spatial perspective tasks in children as young as three years of age. These investigators also confirmed Piaget's findings that performance in perspective tasks improves between the ages of three and eight years. An examination of the concept of identity and its place in the pre-operational stage was developed by Brainerd (1977) who conducted an experiment that dealt with the problem of whether the concept of identity belongs to the pre-operational stage or the concrete-operational stage. Tests of

identity and concrete-operational identity were administered to five and six year old children. According to Piaget's hypothesis that identity develops during the pre-operational stage, it did not appear in this research that children could pass the identity test before age five or six. On the contrary, the subjects apparently understood the inversion rule before they understood identity.

Research on logico-arithmetic concepts has received a great deal of attention during the last decade. In this respect, research on the conservation concept has examined stages of acquisition (Brainerd, 1971), horizontal decalages (Uzgiris, 1964), and the role of reversibility and identity rules in conservation acquisition (Blanchard, 1975; Brainerd, 1977). Brainerd, using two different test of conservation, number, and liquid quantity, found that children pass through three stages of conservation in an invariant sequence. Uzgiris, also found the same sequence of conservation acquisition (i.e., quantity, weight, and volume) in children from the third to the sixth school grades.

With respect to research on formal operational thought, follow-up studies making use of various formal operational schemas were undertaken in some European laboratories early in the last decade (Lovell and Ogilvie, 1961). Although tests that Inhelder and Piaget used to investigate other formal operational schemas have been administered in some studies (Saarni, 1973, and Berzonsky, 1975), most of the research has been conducted with probability operations. Thus, a recent

investigation by Liebert (1973) and Case (1974) has reported experiments in which cognitive concepts have been trained successfully in six to eight year old children.

With respect to cross-cultural differences in the acquisition of conceptual development and consistent with his emphasis on spontaneous development, Piaget expects only trivial cross-cultural differences. In particular, Piaget predicts that, apart from temporal deviations, the concepts associated with his global stages of cognitive development are culturally universal. A substantial amount of research has been devoted to this problem in recent years (Piaget and Inhelder, 1976). In Hong Kong, Goodnow (1965) used Piagetian tasks of the concrete and formal operational levels of schooling; when judged from Western standards, levels ranged from very low to average. In Australia, De Lemos (1965) and gave several conservation tasks to aboriginal children with various levels of schooling. In Senegal, Greenfield and Bruner (Bruner et al., 1968) attempted to determine how unschooled children understood conservation. In general, it has been found that unschooled children succeed at the Piagetian tasks at somewhat later ages than the children studied in Geneva. However, very little is known about the reasons for differences in speed of cognitive development. Little research has been conducted to determine whether differences in stimulation by the environment in general, and schooling in particular affect only the speed or also the course of development.

In summary, the general character of development and its causes according to Piaget is related to the consideration of development through stages each one characterized by a different type of cognitive structure. Each transitional stage of development implies a kind of thinking that is more extensive in terms of equilibrium and, therefore, less decentralized and more objective. In respect to causes of development, Piaget considers factors such as maturation, experience, and the social environment. Equilibrium is placed as the fundamental cause of development. In general, Piaget's concern with an empirical approach to epistemology underlies his interest in the development of logical thinking in children. It determines the principal directions of his work as a whole. Piaget has concentrated his efforts in trying to establish the genesis of the concepts or dimensions, the structure and the conception of the world. For Piaget, the growth of knowledge presupposes a series of structures, auto-regulations, concrete operations, and formal operations. The succession of these must depend on the internal mechanism of intelligence, the principle of equilibration, language or even neurophysiological development.

The research supporting the Piagetian theory of cognitive development has confirmed and at the same time extended and clarified the findings of Piaget himself. (Smedlund, 1961, Uzgiris, 1964; Elkind, 1968; Brainerd, 1977).

Information-Processing Approach to Cognitive Development.

The study of human information-processing involves the consideration of a number of basic cognitive processes such as sensation and perception or the perception and recognition of input stimuli; learning or encoding of input information; memory or the retrieval of input information; memory or the retrieval of input information; and thinking or the manipulation of perceived, learned and remembered information (Anderson, 1977). These cognitive processes have been extensively studied under different theoretical positions and experimental approaches in the area of cognitive psychology in the last decade. An early approach to the study of cognitive processes to the extent that each involves active manipulation of information and, therefore, thinking, is the work of Bartlett (1932) who proposed the basic foundations for the study of human mental processes. The concept of schemata or cognitive structure as assimilative and cumulative processors of information was fundamental to the development of a modern theory of information-processing. Bartlett's studies on learning and memory as "schematic" processes in which learning as well as remembering were based on general schemata. These schemata are formed on the basis of general rather than specific information.

More recently the concept of assimilation to schemas has been expressed as "assimilation to cognitive structures" (Ausubel, 1968). Problem solving information may be assimilated to different types of problem solving performances. Thus,

Mayer and Greeno's (1972) study about problem solving reported that new learning involves development of cognitive structures that result from relating new ideas and accomodating existing cognitive structures.

The aim of the information-processing psychologists is to define, precisely, the process and states that a particular subject is utilizing to solve a particular problem and to be able to describe, perhaps in the form of computer programs, the exact sequence of operations used. Rather than a theory of thinking, the information-processing approach could be considered as a method of empirically describing the cognitive processes involved in problem solving tasks. As a model to describe cognitive performance, the information-processing model is clearly distinguished from behavioristic ones (Thorndike and Gagne) by its explicit attempts to describe internal cognitive processes. Information-processing models also differ from the Gestalt and Piagetian positions in its attempt to describe the flow of behavioral performance, that is, the attempt to translate cognitive structures or logical operations into temporally organized sequences of actions involved in the process (Anderson, 1977).

A methodology of information-processing applied to cognitive development has recently emerged from the work of human memory. In this respect, Quillian (1972) points out that the basic method involves the construction of semantic networks which constitute models of the representation of

specific items of knowledge. Although, most of this work is concerned with semantic memory in adults, there are indications of an increasing interest in the developmental dimension. Norman et al., (1975) describe successive states of the network structures underlying language development, and on the basis of their study of these structures, Norman derives an order of developmental acquisition of verbs. This developmental order was subsequently confirmed by experimental data. However, the adoption of a process approach to the analysis of developmental states is not only confined to areas of language development. Greeno (1975), in an attempt to demonstrate that certain principles now understood, and incorporated in cognitive theories, can now be applied to the formulation of instructional objectives, has produced empirically testable descriptions of the states underlying successful performance on a range of tasks involving quantitative concepts (class inclusion, multiplication, seriation, etc.) Greeno (1974) has also proposed a memory model for problem solving performance. In order to describe the problem solving process in terms of information-processing, Greeno considers three main components: a) a short term memory (STM) through which the external description of the problem is input, b) a long term memory (LTM) or semantic and factual memory (LTM) or semantic and factual memory which stores past experience with solving problems, such as facts, algorithms, heuristically related to problems, etc., and c) a working memory (WM) in which the

information from the STM and LTM interact and the solution route is generated and tested.

An attempt to produce an outline of a theory of cognitive development that incorporates an information-processing point of view was made by Klahr and Wallace (1976). The basic unit of analysis employed is the production of conditions which are the source of the system's developmental, self-modification capacity. On the basis of this approach, Klahr and Wallace provided an explanation of the development of logical operations such as conservation, class inclusion, and transitivity.

In summary, the information-processing approach to the study of thinking in terms of actions (internal and external) is concerned with the psychology of how humans process information. Most of the information-processing theories and models appear useful in characterizing the human mind in terms of the way information is stored, retrieved, and processed. Distinctions are made among different levels of memory and this distinction is made, basically, between a sensory register of some kind through which information from the environment enters the system, a working memory, in which the actual processing takes place, and a long term memory in which the information is stored. The research supporting the information-processing model has been generally conducted under the basic paradigm that involves the construction of computer programs which, explicitly, represent a theory or model of processes in cognitive performance.

Cognitive Style Dimensions.

The concepts and methods derived from the work on cognitive styles over the past two-and-a-half decades are being applied at an ever increasing rate to research problems in psychology and education. Among the cognitive styles identified to date, the field dependence-independence dimension has been the most extensively studied (Witkin et al., 1963/1977; Machover and Goodenough, 1954/1972).

The earliest work of Witkin et al., (1953) was concerned with the analysis of the characteristic ways in which people perceive the world and themselves. The interpretation of external vs. internal orientation was then extended to a more general dimension of perceptual analysis. Witkin used several measures to assess levels on the dimension of cognitive styles (i.e., The Rod and Frame Test, The Body Adjustment Test, The Tilting Room Test, and The Embedded Figures Test). The common denominator underlying individual differences in cognitive styles is the extent to which the person perceives part of a field as discrete from the surrounding, rather than embedded in the field. It is also the extent to which the person perceives analytically. Because at one extreme of the performance range, perception is strongly dominated by the prevailing field, that mode of perception was designated "field dependent". At the other extreme, where the person experiences items as more or less separate from the surrounding field, the designation of "field independence" was used. Because scores for any of the measures

used by Witkin to assess field dependence-independence form a continuous distribution, these labels reflect a tendency in varying degrees of strength toward one mode of perception or the other.

A later development of Witkin's research (Witkin., 1977) shows increasing attention to the area of interpersonal behavior. According to Witkin, people with field dependent or field independent cognitive styles are different in their interpersonal behavior. Social referents seem to be more relevant for field dependent individuals. They also have an interpersonal orientation, a tendency to be always, physically, close to people and get along with them easily. On the other hand, field independent individuals are less dependent on interpersonal relationships, more skillful in cognitive analysis and structuring than field dependent individuals.

The results of Witkin et al., research (Witkin, Dyk, Faterson, Goodenough and Karp, 1963/1974; Witkin and Machover, 1954/1972) reported that people are likely to be quite stable in their preferred modes of perceiving, even over many years (Witkin, 1970; Witkin, Goodenough and Karp, 1967). Furthermore, in Western societies there are small but persistent sex differences in field dependence-independence people, beginning in adolescence. Women on the average, tend to be more field dependent than men. However, the difference in means between the sexes is quite small compared to the range of the scores within each sex (Maccoby, 1966; Lewis, 1976).

Evidence from cross-cultural studies indicates that

sex differences in field dependence-independence may be uncommon in mobile, hunting societies and prevalent in sedentary, agricultural societies, in which characteristically, differences in sex-role in the economy, points up the important role of socialization in the development of sex differences in field dependence-independence (Witkin and Berry, 1975).

With respect to the relationship of the cognitive style dimension to other areas of cognitive functioning, research conducted in the area of concept learning studies (Ohnmacht, 1966; Dickstein, 1968) has shown the existence of differences between field independent and dependent subjects in the strategies used during concept attainment. Thus, field independent subjects due to their analytical abilities attain logical and mathematical concepts more easily than field dependent subjects.

In regard to the relationship between field independence and general intelligence, considerable overlap in variance between them has frequently been demonstrated. Thus, Zigler (1963) and Vernon (1972) have argued that knowledge of the separate effects of field independence and IQ is not greatly in excess of that which can be predicted from intelligence scores alone. Busse (1968) was able to extract a cognitive style factor separated from general intelligence among correlation measures between children and adults and between field independence and verbal comprehension. He found that the correlations were generally low.

Another area of research comes from the work of Kagan and Kogan (1975) in the area of styles of conceptualization. This aspect of intellectual functioning has been proved to be highly related to the cognitive styles field-dependence-independence and is considered an important variable that deserves attention in analyzing cognitive activity (Wallach, 1965; Fritsky, 1963). As Kagan, Moss and Sigel (1963) pointed out, cognitive style is a term that refers to stable individual preferences in modes of perceptual organization and conceptual categorization of the external environment. One particular style dimension involves the tendency to analyze and to differentiate the stimulus environment in contrast to categorizations that are based on the stimulus as a whole. Many observers have noted that the degree to which behavior is global and diffuse or differentiated or analytic is an important dimension in psychological development and in the determination of differences between individuals. In this respect this dimension of analyzing behavior has been playing a relatively important role in research during the last decade. Thus, Kagan has identified a style of categorization of information-processing that he calls analytical as opposed to global. He also found that there is a developmental tendency for all children to become more analytic as a function of maturation (Kagan and Moss, 1963).

Relationship of Cognitive Style and Cognitive Development.

From the review of the research literature (Witkin et al., 1967/1977), cognitive style appears to have been analyzed

in a broad sense in respect to cognitive functioning and in relationship with other variables influencing behavior (i.e., perception and personality). However, some aspects of cognitive development such as physiological acquisition of logical thought and cognitive structuring has not received a great deal of research attention. Among the relatively few studies oriented to the analysis of the role of cognitive style in the acquisition of logical thought of which findings are of relevant importance, is the one conducted by Saarni (1973). Although this study is based on a population of adolescent subjects, the correlation between other variables and cognitive style provides some valuable information related to this issue. In her study, Saarni correlated Piagetian measures with field independence and divergent thinking. Formal operational tasks and the Rod and Frame Test were administered to a population of adolescents evenly divided according to sex and school grade. Their performances in two complex multi-step problems was evaluated according to level of field independence nested with the levels of cognitive development. The results indicated that the Piagetian cognitive developmental level significantly predicted success in the problems, whereas levels of field independence did not appear to clarify individual differences in a meaningful way. Significant sex differences were found in the Rod and Frame Test, but not in the formal operational tasks.

From this perspective a group of researches (Saltz, Soller and Sigel, 1973) have strongly endorsed the view that

development entails a shift from narrowness to breadth of categorization. As Saltz *et. al*, pointed out, conceptual development is most strongly characterized by a shift away from overdiscrimination and toward integration rather than a shift away from overgeneralization and toward differentiation. In this respect the outcomes of the Saltz and Sigel investigation are significant from the developmental point of view. These investigators worked with a population of 5 to 9 year old children and adults using stimulus materials consisting of photographs of boy's faces where they had to specify the variations between series. They found a significant preponderance of overdiscrimination error in the group of children and overgeneralization error in the adult group. This is a particularly relevant finding in respect to the perspective of cognitive development given the importance of acquiring and processing information through perceptual channels and in terms of analysis and structuring of experience in intellectual situations. In this perspective, individual differences in analytic functioning in perception have been investigated in the earlier work of Witkin as a part of the study of the fielddependence-independence dimension (Witkin, 1963).

A more recent significant finding in the study of the relationship between cognitive style and cognitive development is reported by Cantu (1977). This investigator found that for many high school students abstract subjects such as chemistry and physics are difficult to learn. Cantu suggests that part of this difficulty is associated with the student's

level of intellectual development as is described by Piaget and also depends on their cognitive style level as are described by Witkin. In his study, Cantu administered to a high school population the Longeot Test of Piagetian levels (Longeot, 1972) to classify students as formal or concrete thinkers and the Group Embedded Figures Test (Witkin, 1971) to classify students as field dependents or independents. Also, instructional material consisting of lessons about science concepts was given to the students. Concepts analysis was taken into account to identify concrete and formal concepts. The major conclusion of this study indicated that formal thinkers achieved more than concrete thinkers when they studied concrete and formal concepts. However, for this last group, improvement was better if instruction was based on concept analysis. In respect to cognitive styles, field independent subjects learned concepts more rapidly with materials that involved spatial ability when compared with field dependent subjects. It was also reported that intellectual development and cognitive style appear to be important variables to take into account in concept learning.

Another study relevant to concept learning is reported by Balick (1976) concerning the effects of cognitive style on mathematical learning among boys and girls enrolled in the second through sixth grade. Using Sigel's Cognitive Style Test, Balick found that analytical field independent subjects were higher in mathematical achievement than global and field dependent subjects. He also found that cognitive style operates independently of the sex of the subjects.

With respect to the relationship of creativity and cognitive style, Wilson (1976) indicated that certain styles of information-processing are characteristic of creative individuals and are closely related to the modes of handling information. Using the Embedded Figures Test as a measure of cognitive style and the Guilford's Test of Creativity Thinking, Wilson found significant effects between levels of field independence and figural elaboration, verbal fluency, and verbal originality. Sex differences were not indicated.

In summary, most of the research done related to the analysis of the dimension cognitive style as a factor of intellectual development was focused initially on the perspective of individual differences in analytic functioning in perception. Later these studies focused on the styles of conceptualization as a broader categorization of the perceptual dimension of cognitive style. In this respect, the construct of differentiation and abstraction became helpful in providing some explanation of cognitive activity and individual differences in describing cognitive products. More recently in the last ten years, some investigators have been trying to determine to what extent the behavior which is global and diffuse (i.e., field dependent) or differentiated and analytical (i.e., field independent) is an important dimension in psychological development. In this context, they have been working mainly on the basis of Piaget's schema of intellectual development (Saarni, 1973; Balick, 1976, and Cantu, 1977). From the point of view of the research analyzed, cognitive development seems to be accompanied by more

differentiated perceptions and the acquisition of abstract concepts. Thus, differentiation and abstraction appear to proceed simultaneously, and the number of differentiated elements that belong to a category or class may be a more critical attribute of level of cognitive development than the consideration of the broad category. In effect, the child gradually comes to learn structured wholes.

Recapitulation.

Psychological theory is a set of basic principles that provides a framework for understanding human development. The field of psychology has several different theories directly relevant to the understanding of intellectual development and there is considerable disagreement as to which one provides the best explanation.

Three different theoretical approaches (i.e., the behavioristic-associationistic; the cognitive, and the information-processing) described in the present study imply three quite different conceptualizations of thought. The behavioristic-associationistic point of view approaches intellectual development in the same way it approaches the study of behavior in general, that is, developmental change is regarded as a particular instance of behavioral change. Thus, intellectual development consist of a broad integration of gradual changes that take place during a period of the individual's life, but they are not different, qualitatively, from the character of changes that occur in any other period

of individual development. In attempting to explain a child's level of intellectual development, one considers environmental circumstances and previous learning history. These circumstances might include conditions such as amount of information given to the child during his or her development. A further development of the behavioristic contention of cognitive growth is represented by Berlyne's neo-associationistic tendency to achieve an integration between the basic behaviors that underlie the learning process and the more complex structures of thought. The Hullian habit-family hierarchies of behavior was utilized by Berlyne as a theoretical model to explain this integration. Berlyne also attempted to explain the empirical findings of the Piagetian theory on the basis of this model. He explains cognition as a set of behavior chains associated to each other in a common membership and within a number of habit-family hierarchies. However, Berlyne's mediational theory could be considered only as an extension of the S-R theory; the more complex derivations that Berlyne proposed do not necessarily represent a contribution to the understanding of cognition.

On the other hand, the concept of practice or training originally confined to the behavioristic point of view has also been analyzed by American and European learning-oriented psychologists, specifically, in studies concerning the conservation concept. The results seem to confirm the Piagetian theory that intellectual development depends on internal rules and appears spontaneously.

The cognitive approaches represented by European and North American theorist (Piaget et al., Bruner and Elkind) agree that development is, in some respects, a gradual accumulative process. Development proceeds through a series of qualitative changes or stages. Each stage is characterized by a different way of thinking or type of cognitive structure. Also, each stage incorporates cognitive structures developed previously and simultaneously providing new conditions and possibilities for learning and thinking.

The information-processing approach to thinking assumes that cognitive processes are represented as a sequence of mental operations performed on information in the subject's memory. The description of how information is stored and retrieved characterize most of the information-processing models of cognition. Quillian's (1968) studies concerning the representation of knowledge in memory is, in this respect, a new information-processing approach to the study of developmental states. This approach involves the construction of semantic networks which represent specific states of knowledge.

With respect to the relationship between cognitive style and cognitive development, the research findings seem to be inconsistent. The relationship between cognitive style and cognitive development appear to be qualitatively different when different age groups are involved. Thus, in younger subjects the cognitive styles seems to have more influence than in older subject (Cantu, 1977; Sääarni, 1973). Apparently these findings seem to indicate also that

psychological structuring during earlier ages could be an important factor to be controlled in trying to correlate cognitive style and cognitive developmental variables. Moreover, this assumption could receive more support from the point of view of the development of concept formation studies (Bruner, 1968). In this respect, an increasing breadth of categorization and more stability is reached as the age of the subject increases. This fact implies that the age factor may well prove to be a relevant control variable to consider during studies concerning early childhood. However, more longitudinal research is required considering sex with cognitive style as a variable in acquisition of Piagetian levels of cognitive development. More research is also necessary to determine the type of conceptual areas in which cognitive style seems to be an important variable.

CHAPTER III

METHOD

Hypotheses

The present investigation tested the following null hypotheses:

(1) The levels of cognitive development (pre-operational, concrete-operational and operational, Piaget, 1968) will not be significantly related to levels of cognitive styles (i.e., field dependence-independence) as assessed by the Children's Embedded Figures Tests (Karp and Konstadt, 1963) when sex and school grade variables are controlled.

(2) There will not be significant sex differences in cognitive development.

(3) There will not be significant sex differences in the cognitive style dimension.

(4) There will not be a significant relationship between the assessed measures of the dimension cognitive style and school grade levels.

(5) There will not be significant differences between measures of cognitive development and school grade levels.

(6) The relationship between sex and cognitive style will not be significantly different at different school grade levels.

(7) The relationship between sex and cognitive development will not be significantly different at different school grade levels.

Subjects.

Sixty-four third through sixth grade students, males (n=32) and females (n=32) ranging in age from eight to eleven years were selected from a middle-class parochial school (N=280, third through sixth grade students) located on the northside of Chicago, Illinois. An equal number of male and female subjects were selected within each grade sample. The selection process was conducted by asking the teachers to select eight boys and eight girls who had an average level of achievement, and who displayed no mental or emotional problems. The mean sample age for each grade was: 8.4 for the third grade; 9.5 for the fourth grade; 10.6 for the fifth grade; and 11.6 for the sixth grade.

Procedure.

Assessment was conducted during a three week period in May, 1978. First, the Children's Embedded Figures Test (CEFT) was administered, individually, in a single session. In a second session, the Piagetian tasks were individually administered. The clinical method of interview was utilized in the administration of the Piagetian Tasks. This method, developed by Piaget (Piaget, 1958), involves the interaction between the investigator and the subject on the basis of questions and answers. The investigator constantly formulates new hypotheses about the subject's thinking, and then rearranges the testing situation according to these hypotheses. The method also involved the manipulation of objects in addition to questions and answers (Rohwer et al., 1974). Three

different sets of tasks (Conservation, Class inclusion, and Transitivity) were evaluated in the same session.

No time limitations were placed on the completion of both cognitive style and cognitive developmental tests. However, when the subject took an excessive period of time (more than five minutes) in responding to the CEFT items, a directive encouraging him to continue was given by the examiner.

Instrumentation.

The Children's Embedded Figures Test: This test was used in the present investigation to assess measures of cognitive styles. The children's form was developed by Karp and Konstadt (1963) on the basis of the Goodenough-Eagle children's version of the Embedded Figures Test (Witkin, 1961).

The stimulus test material consists of 38 items of complex figures presented in colorful printed drawings and two cut-out models of two different shapes (a tent and a house), which were to be found embedded in the complex figures representing drawings of familiar objects (a boat, a clock, etc.). Each one of these two forms is the basis for a single test series, that is, series of complex figures which are embedded in the same sample shape. In addition, the series represents four instances of the administration process: discrimination, demonstration, practice, and testing. The discrimination series consists of 8 items each of which shows one of the simple forms (tent or house), and three similar but, obviously, incorrect forms. The demonstration series consists of 2 items showing incomplete figures representing stages of "embeddedness"

of the simple "tent" form in a complex figure. The practice series has 3 items representing three complex figures which are designed to illustrate the procedure to the child, two for the "tent" series, and one for the "house" series. The testing series consists of complex figures, 11 of which have the simple form (tent) embedded in them, and 14 of which have the simple "house" figure embedded in them. For the scoring procedure, only this testing series of 25 items is considered.

In accordance with the CEFT testing procedure, the four series of items were presented, successively, to the subject. The subject's task was to find the sample shape (cut-out), embedded in the complex figures. This sample shape was displayed only at the beginning of each test series. No specific time limits were imposed. However, administration was terminated after five consecutive failures within the testing series.

In the scoring procedure, answers were assigned a value of 1 or 0. A score of 1 was given only when the first response was corrected, and the subjects could verify their responses by outlining the shape with their finger. If an incorrect response was spontaneously corrected before the subject saw the cut-out model, full credit was given. A score of 0 was assigned when the subject was not able to find the embedded form in the figures. Also, a correct choice made after the model was presented a second time, was scored as a failure. The total score was the number of items passed. Twenty-five was the maximum score.

The CEFT is reported to have internal consistency reliability coefficients of: .87 for 7 to 8 year old subjects; .88 for 9 to 10 year olds; and .87 for 11 to 12 year olds. Data on the CEFT reliability for 5 to 6 year olds are reported by Dreyer and Nebelkopk (1969). The test re-test correlation shows a coefficient of .87. With respect to validity data, correlations between the CEFT and the Embedded Figures Test were obtained for the 9 to 12 year old children. For 11 year old children the magnitude of this correlation ranges from .83 to .86. At age 9 these validity coefficients are lower, ranging from .70 to .73. These data together suggest that the CEFT is a reliable instrument for use with children in the age range examined in the present investigation.

The Class Inclusion Test: This test used in the present investigation is based on experiments designed by Piaget to assess children's understanding of logical classes formed on the basis of attribute similarity, for example, a set of wooden blocks, most of them brown, but some white, the class inclusion relation is understood when the child is able to recognize the attributes defining a particular subclass (brown blocks) and the quantitative superiority of the higher-order class (wooden blocks) to any subclass.

The stimulus test items consisted of three different sets of materials; plastic fruits, different colored wooden blocks, and two different colored plastic beads.

According to the Piagetian methodology, this test was administered through an individual interview where the subject was presented with the sets of materials and then posed a series of questions about the attributes of a subclass or a superordinate class (more fruits or more oranges, more wooden blocks or white blocks). The typical questions presented to the subjects were of two kinds: a) to evaluate whether the child understood that the superordinate class (wooden blocks) is larger than any subclass (white blocks), and b) to evaluate whether the subclass is larger than the superordinate class or whether the subclass is larger than the superordinate class or whether they are the same. For each set of tasks, the subject was encouraged to give an answer and an explanation.

In the scoring procedure, a correct solution of each of the three tasks required a correct answer and a correct explanation. Responses were scored as correct when the subject indicated that there were more objects in the superordinate class than in either subclass. A correct explanation noted the defining attributes of the superordinate class (e.g., "they are all wood") or the total number of objects in the superordinate class. The subject who made incorrect solutions failed to either recognize the defining attributes of the superordinate class or were unable to verbalize its quantitative superiority.

On the basis of this procedure, a score of 1 was given when the answer and the explanation were both incorrect. A

score of 2 was attained when a correct answer, but an incorrect explanation was given. A score of 3 was given when the answer and the explanation were both correct. An overall score for the three class inclusion tasks expressed as continuous measures was assigned by adding the scores obtained in each one of the three instances of each of the three tasks.

Conservation Test: This test was developed by Piaget in his studies of children's logical thought (Piaget, 1958/1964-1969). According to Piaget the conservation operation involves the psychological process called "invariance" which refers to the ability to conserve the attributes of an object as a total structure in spite of its physical transformations. This concept is assessed by using three forms of conservation: substance, weight, and volume. As Piaget points out, the pre-operational child is strongly influenced by perceptual cues, centering his attention on only one aspect or element of the total situation and ignoring the others. However, this perceptual dominance over cognition tends to be reduced in later developmental stages.

Three different sets of stimulus materials were used in the present investigation to assess each form of conservation. Two different colored balls of clay were used, both having the same quantity of material. In addition, a rudimentary balance scale and two glasses of water were used for the volume tasks.

During the testing procedure, the examiner placed the two balls in front of the child. After stating that the two

balls were equal, the examiner made successive transformations in one of the balls (sausage, cookie and broken pieces).

For each transformation presented to the subject, a question was posed about the equality of the shapes. This procedure was repeated for each one of the three conservation tasks (see Appendix B).

In the scoring procedure, a solution was scored correct, if the subject gave a correct response and could justify that response. An answer was considered correct when the invariance of the material was recognized in spite of the transformations. A correct explanation was indicated by the evidence of reversibility. Reversibility is a characteristic of all operational thought. It can be seen in the conservation problem when a clay sausage is made longer, a decrease of diameter compensates for the increase in length, so the total amount is recognized as constant.

On the basis of this procedure, a score of 1 was given when answer and explanation were both correct. An overall score for the three conservation tasks expressed as continuous measures was assigned by adding the scores obtained in each of the three instances of each of the three tasks.

Transitivity Test: This test is related to the ability to understand the relationship between a set of elements (A,B,C), where $A < C$, $B < C$ so $A < C$, that is, the child can understand the relationship between A and C without the necessity for directly comparing them. On the basis of Piaget's studies on transitivity (1964), Smedslund and Tuddenham (1968) developed

a new procedure to test this logical operation. In the present investigation this procedure was applied in situations in which the child who follows the perceptual cues can not maintain the concept of transitivity.

The stimulus material consisted of three different sets of cardboard sticks. The longest one, A, had lines subtending at each end to make it look shorter. Similarly, the shortest stick, C, had lines extending at each end to make it look longer. The third stick, B, used as a measuring stick was longer than C and shorter than A. The stick figures were glued to white sheets to facilitate the visual display for the child. All A and C sticks were black and all B sticks were light blue (see Appendix B).

During the testing procedure, the child was asked to compare the longest stick, A, in relation to the other sticks (B and C). A practice introduction was given to provide the child with a full understanding of the tasks.

In the scoring procedure, a correct solution of each task was required to have the answer and the explanation scored correct. Each answer was scored correct when the subject indicated the correct selection. An explanation was correct when the subject focused on both sides of the statements, if $A < B < C$, then $A < C$.

On the basis of this procedure, a score of 1 was given when the answer and the explanation were both incorrect. A score of 2 was given when a correct answer, but an incorrect explanation were obtained. A score of 3 was given when the

answer and the explanation were both correct. An overall score was assigned for the three transitivity tasks expressed as a continuous measure by adding the scores obtained in each one of the three instances of each of the three tasks.

In the scoring procedure, a correct solution of each tasks was required to have the answer and the explanation scored correct. Each answer was scored correct when the subject indicated the correct selection. An explanation was correct when the subject focused on both sides of the statement - if $A < B < C$, then $A < C$.

On the basis of this procedure, a score of 1 was given when the answer and the explanation were both incorrect. A score of 2 was given when a correct answer, but an incorrect explanation were obtained. A score of 3 was given when the answer and the explanation were both correct. An overall score for the three transitivity tasks expressed as continuous measure was assigned by adding the scores obtained in each of the three instances of each of the three tasks.

Psychometric Description of the Piagetian Tests: In tests using the Piagetian tasks, test validation is described as the process of examination of the accuracy of a specific prediction or inference made from the test's scores (Cronbach, 1971). This type of test validation which is closely related to validation of a specific theory is called construct validation. In this area of research, Goldschmid and Bentler (1968) reported a factor analytic study of the concept of conservation. Their findings that conservation of length

is completely uncorrelated with conservation of distance led them to the conclusion that Piaget's theory is in need of revision in this respect. Raven (1973) used a factor analysis procedure to study the factor pattern for seven major groups of logical operations (classification, seriation, logical multiplication, compensation, probability, and proportional thinking). The results reported that all these logical operations except seriation were discrete factors. Seriation was found closely related to logical multiplication since the ability to construct co-univocal logical operations depends upon the ability to coordinate two serially changing variables.

With respect to reliability data, the relative stability over short periods of children's performance of class inclusion tasks was established in early studies (Lovell, 1967; Smedslund, 1970). No significant differences in conservation performance were found when first graders were re-examined after a two week period (Almy, Chittenden, and Miller, 1966). Miller (1969) found no improvement in class inclusion performance among either kindergarten or second grade children who were re-examined after a six to eight week interval.

Statistical Procedure

A partial correlation coefficient between cognitive style and cognitive development, controlling for age and sex was calculated.

Hypothesis one was tested through this coefficient

A 4 x 2 analysis of variance with grade level and sex as the independent variable and field independence as the dependent variable was conducted. The main-effect for sex was used to test Hypothesis two. The main-effect for grade was used to test Hypothesis four. The two-way interaction effect was used to test Hypothesis six.

A 4 x 2 analysis of variance with grade levels and sex as the independent variable and cognitive development as the dependent variable was conducted. The main effect for sex was used to test Hypothesis five. The two-way interaction effect was used to test Hypothesis seven.

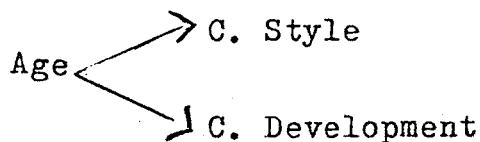
In addition, Pearson correlation coefficients were calculated between all continuous variables in order to examine the competing models and for describing purposes. These correlations were also calculated separately for each sex.

Path Analysis of Competing Models.

Path analysis is a method of investigating hypothesized causal relationships from correlational measures. In this study chronological age (as an indicator of maturation) is known to be an exogenous variable, while cognitive development and field independence are endogenous. Excluding, for simplicity's sake, mutual causality and complex relationships, there are three possible models which can be examined:

Model 1: Age is a direct causal variable affecting, independently cognitive development and cognitive style. This

model is represented as:

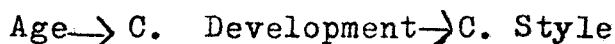


If model 1 holds, then the following equation must also hold (Duncan, 1975).

$$r_{FP} = r_{AP} \cdot r_{AF}$$

where r_{FP} is the correlation between cognitive style and cognitive development.

Model 2: Age is a direct causal variable in the acquisition of cognitive development which in turn influences the cognitive style dimension. Thus, cognitive development is a direct causal variable of cognitive style. This model is presented as:

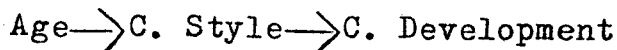


If this model holds then the following equation must also hold:

$$r_{AF} = r_{AP} \cdot r_{PF}$$

where r_{AF} is the correlation between age and cognitive style.

Model 3: Age is a direct causal variable in cognitive style which, in turn, influences cognitive development. Thus, cognitive style is a direct causal variable of cognitive development. This model is represented as:



If this model holds, then the following equation must also hold:

$$r_{AP} = r_{AF} \cdot r_{FP}$$

where r_{AP} is the correlation between age and cognitive

development. Each of these models was discussed in Chapter I (page 3).

RESULTS

The statistical analysis related to the testing of hypothesis one will be examined first followed by the statistical analysis for hypotheses two, four, and six, and then the statistical analysis for hypotheses three, five, and seven, with each null hypothesis being rejected or not rejected at the .01 level of significance. Following the statistical analysis for each hypothesis, an examination of the competing models previously discussed is presented. The correlation information pertaining to the interrelationship of the various measures is presented last. The computerized programs contained in the Statistical Package for the Social Sciences (Nie et al., 1975) were utilized for all statistical analysis.

Major Hypotheses:

Hypothesis (1) "The levels of cognitive development (pre-operational, concrete operational, and operational) will not be significantly related to levels of cognitive styles as assessed by the Children's Embedded Figures Test, when sex and school grade variables are controlled".

A partial correlation coefficient, between cognitive style, controlling for age and sex was calculated. The resulting partial correlation was statistically significant and of high positive magnitude ($r = .72$; $P .001$). Thus, null hypothesis one was rejected.

Hypothesis (2) " There will not

be significant sex differences in cognitive development."

Hypothesis (4) "There will not be a significant relationship between the assessed measure of cognitive style and school grade levels."

Hypothesis (6) "The relationship between sex and cognitive style will not be significantly different at different school-grade levels."

A 4 x 2 analysis of variance was conducted with school grade levels and sex as the independent variable and cognitive style as the dependent variable. The main effect was used to test hypothesis four. The two-way interaction effect was used to test hypothesis six. None of these effects turned out to be statistically significant (see Table 1). Thus, hypothesis two, four, and six can not be rejected.

Table 1

Analysis of Variance

Cognitive Styles by Grade and Sex

Source of Variation	Sum of Squares	df	Mean of Squares	F	Sign. of F
Grade	160.31	3	53.44	2.42	0.07
Sex	4.00	1	4.00	0.18	0.67
Grade and sex	5.38	3	1.79	0.08	0.970
Within Groups	1239.24	56	22.13		
Total	1408.93	63	22.36		

Hypothesis (3) "There will not be significant sex difference in the cognitive style dimension as assessed by the Children's Embedded Figures Test."

Hypothesis (5) "There will be no significant differences between measures of cognitive development and school-grade levels."

Hypothesis (7) "The relationship between sex and cognitive development will not be significantly different at different school grade levels."

A 4 x 2 analysis of variance with grade levels and sex as the independent variable and cognitive development as the dependent variable was conducted. The main effect for sex was used to test hypothesis three. The main effect for grade was used to test hypothesis five. The two-way interaction effect was used to test hypothesis seven. A significant effect for grade level was found ($F = 4.14$; $P < .01$). Thus, hypothesis five was rejected, neither the sex effect nor the two-way interaction effect turned out to be statistically significant (see Table 2). Therefore, hypothesis three and seven can not be rejected.

Table 2

Analysis of Variance:

Cognitive Development by Grade and Sex

Source of Variation	Sum of Squares	df	Mean of Squares	F	Sign. of F
Grade	224.55	3	74.85	4.13	0.01
Sex	2.64	1	2.64	0.15	0.70
Grade and Sex	22.80	3	7.60	0.42	0.74
Within Groups	1013.62	56	18.10		
Total	1263.60	63	20.05		

Examination of Competing Models.

In order to examine the three competing causal models, previously discussed, the correlations between age, cognitive development, and cognitive style were calculated. The correlation between cognitive style and cognitive development was statistically significant ($r_{FP} = .7570$; $P .001$) as were the correlations between age and cognitive style ($r_{AF} = .3267$; $P .01$), and between age and cognitive development ($r_{PA} = .4072$; $P .001$). For each model a different equation would be expected to hold save for errors of measurement. Table 3 presents the models and the corresponding equations, as well as the predicted and observed correlations.

Table 3
Causal Competing Models

			Correlations	
Comp. Models	Equations	Observed	Predicted	
Model 1 Age $\begin{cases} \text{C. Style} \\ \text{C. Devl.} \end{cases}$	$r_{FP} = r_{AP} \cdot r_{AF}$.7570	.1330	
Model 2 Age $\begin{cases} \text{C. Style} \\ \\ \text{C. Devl.} \end{cases}$	$r_{AF} = r_{AF} \cdot r_{PF}$.3267	.3082	
Model 3 Age $\begin{cases} \text{C. Style} \\ \\ \text{C. Devl.} \end{cases}$	$r_{PA} = r_{AF} \cdot r_{PF}$.4072	.2473	

*CS and CD indicate Cognitive Style and Cognitive Development. (Indicated here in Table 3 by C. Style and C. Devl.)

As can be seen, Model 2 shows age as causing cognitive development and this then influencing cognitive style. This Model seems to produce the best fit, while Model 1 produces the worst.

Correlational Information

The intercorrelations between the different Piagetian tasks, cognitive styles and age are presented in Table 4.

Table 4
Pearson Correlation Coefficients

	Age	F.Dep- Ind.	T. Piaget	Conserv.	Class Incl.	Trans.
Age						
F.Dep-Ind	0.33					
Totl. Piaget	0.41	0.76				
Conservation	0.43	0.80	0.88			
Class Incl.	0.32	0.64	0.92	0.69		
Transitivity	0.34	0.59	0.90	0.66	0.80	

As can be seen, the correlations between field dependence independence and all Piagetian measures are relatively high, as the correlation between conservation and field independence being the highest (.80), and transitivity and field dependence-independence the lowest (.59). Since all these correlations tend to be relatively high, there is no evidence to assume that a specific cognitive ability underlies field dependence-independence. The correlation of class inclusion with transitivity (.80) is higher than the correlations of either variable with field independence or conservation.

With respect to the correlations between age, field dependence-independence, and the Piagetian measures, the correlations are all significant, with conservation showing the highest correlation (.43) and class inclusion the lowest (.32). Therefore, field dependence-independence is more correlated to all Piagetian tasks than age.

The intercorrelation between the different Piagetian tasks, cognitive style, sex, and age are presented in Table 5.

Table 5

Intercorrelation Among Males and Females
for Cognitive Development and Field Independence

Females		Age	F.Dep-Ind	T.Piaget	Conserv.	C.Inc	Trans.
Males	Age	F.Dep-Ind	T.Piaget	Conserv.	C.Inc	Trans.	
Age		0.40	0.48	0.43	0.38	0.45	
F.Dep-Ind	0.25		0.73	0.78	0.57	0.58	
Total Piag.	0.34	0.78		0.88	0.89	0.89	
Conserv.	0.42	0.81	0.88		0.66	0.65	
Class Incl.	0.27	0.71	0.94	0.72		0.75	
Transitiv.	0.22	0.60	0.91	0.67	0.86		

With respect to the differences between sexes, Table 5 shows that for both sexes, the correlations between field dependence-independence and all Piagetian measures are high. Each of these correlations tends to be higher in the male group than in the female. However, correlations between each of the variables and age tend to be higher in the female than in the male. While the sample is not large enough for these differences to achieve significance, the consistency of the pattern is suggestive.

CHAPTER V

DISCUSSION

In this chapter, a hypothesis by hypothesis discussion of the results will be presented, followed by a more general discussion of the data, including a consideration of the study's internal and external validity. Educational implications of this study will be also discussed, as well as recommendations for future research.

Hypothesis (1)

A partial correlation analysis of the data lead to the rejection of the null hypothesis, thereby indicating that levels of cognitive development (pre-operational, concrete operational, and operational) are significantly related to levels of cognitive styles (i.e., field dependence-independence) when the sex and age variables were controlled. Thus, it does not appear that the relationship between cognitive style and cognitive development is due to the fact that both are related to chronological age or to sex differences in the same direction. The causal influences which might explain this phenomena will be discussed later in this chapter, when the causal competing model will be discussed.

Hypothesis (2)

A 4 x 2 analysis of variance of the data, along with the analysis of the main effect for sex, lead to the conclusion that the null hypothesis can not be rejected. Therefore,

there are no significant sex differences in cognitive development. These results suggest, according to the Piagetian point of view that cognitive development follows an internal pattern of change. The direction of this pattern is given by the development of groups of cognitive structures (sensori-motor, logico-mathematical, propositionals) in the individual. These cognitive structures, simultaneously, adapt themselves to the demands of the environment in a reciprocal way, that is, by altering the influences of this environment (physical and social) as well as being altered by them. In this respect, cultural patterns of child-rearing that could lead to cognitive sex differences are not seen by Piaget as having a direct influence in the child's cognition.

These results could also suggest, according to Kogan's (1976) and Maccoby's (1975) claims, that cognitive sex-differences do not really emerge until about age ten or into adolescence when social patterns demand a greater differentiation in sex-role behavior.

Hypothesis (3)

A 4 x 2 analysis of variance of the data along with the analysis of the main effect for sex lead to the conclusion that the null hypothesis can not be rejected. In other words, these results indicate that there are no significant sex differences in the cognitive style dimension. These results seem to indicate that the development of analytical abilities, in which the dimension of cognitive style is based, are not affected by sex differences. In contrast with Witkin *et al.*, (1963/1977) and Kogan's (1976) studies in which females appear

to be more field dependent than males, the present study shows no significant sex-differences in respect to field dependence-independence. A possible explanation to this finding could be based on the age-range examined in the research sample. Maccoby's (1975) point of view is also supported with this finding. Thus, no sex-differences appear to be significant before the adolescence in which socialization patterns for men and women are more differentiated.

Hypothesis (4).

A 4 x 2 analysis of variance of the data with cognitive style as the dependent variable did not yield a significant main effect for grade levels. Thus, the null hypothesis can not be rejected. In other words, no significant relationship between the cognitive style measures and school-grade levels was found.

These results could suggest that the dimension of cognitive styles does not undergo significant developmental change in the age range examined.

Another possible explanation to these results would be based on Kagan's and Sigel's (1963) findings that children after 8 years of age become more articulated and differentiated in their perceptions than younger children who are more global and overgeneralized in their perceptions. These results are also supported by Saarni's (1973) study in which age correlations with cognitive style measures were not significant. Therefore, if a wider age-range were to be compared in the present study (e.g., 3 to 11 year olds) possible

age differences in cognitive styles could have been found.

Another possible explanation of these results is focused in the analysis of the causal relationship between age, cognitive style and cognitive development which will be discussed later on in this chapter. This analysis shows that the causal direction goes from age to cognitive development, and then, as a consequence of this, to cognitive style.

A weak but significant correlation ($r_{AF} = .32; P < .01$) between age and cognitive style was found, but its magnitude was apparently not big enough to have yielded significant differences between grade levels.

Hypothesis (5).

A 4 x 2 analysis of variance of the data along with the analysis of the main effect for grade lead to the rejection of the null hypothesis, thereby indicating that there are significant differences between measures of cognitive development and school-grade levels.

These results seem to suggest, in accordance with Piaget and other cognitive psychologists' points of view (Piaget, 1958; Elkind, 1968; Brainerd, 1977) that age (seen as an index of maturation) is an important factor in the acquisition of levels of cognitive development. Piaget points out that cognitive development (especially during infancy) is related to maturational changes, that is, the cognitive progression through a series of developmental stages (i.e., pre-operational, concrete-operational, and operational) is influenced by maturation among other factors (experience,

social environment, equilibrium). Maturation can be seen, therefore, as a pre-condition for developmental change--that is, only when the organism becomes mature enough does it begin acquiring new developmental stages.

On the other hand, the correlational analysis between the different cognitive measures, which will be discussed later, also indicates differences in cognitive performance among subjects of different ages. Thus, operational levels of acquisition of conservation appear more often in the present age range examined than does the acquisition of transitivity or class inclusion.

Hypothesis (6).

The 4 x 2 analysis of variance with cognitive style as the dependent variable did not yield a significant sex X grade level interaction effect. Thus, the null hypothesis can not be rejected. In other words, the relationship between sex and cognitive style was not found to be significantly different at various school grade levels.

In contrast with the evidence of the research literature (Kogan, 1976, Maccoby, 1975, Achenbach and Weisz, 1975) supporting the existence of an interaction effect between sex and age in the cognitive style dimension, the present results show absence of that interaction. A possible explanation of these findings could be based on the fact that the age-ranges examined for most of the investigators cited above were concentrated only in infancy or early childhood (e.g., 3 to 6 years of age) or in adolescent ages rather than in middle

childhood (e.g., 7 to 11 years). Thus, Kogan (1976), Coates (1975) and Taylor (1976) found in their studies that at approximately age 5, girls are more field independent than boys. They suggest that this is due to the fact that during this age boys rather than girls are likely to show greater degrees of motoricity and impulsivity which can be seen as disturbing factors for achieving analytical abilities in which the cognitive style dimension is based. During adolescence, social factors such as a need for achievement, role-expectation, etc. lead to greater sex-differences. Males tend to be more field independent than females as a consequence of this social influence.

A possible explanation for the absence of interaction between age and sex among middle childhood subjects would be that since this age-period is spent mostly under a rather homogenous environment (school) in which goal expectations tend to be the same for both sexes, these results then are to be expected.

Hypothesis (7).

A 4 x 2 analysis of variance, with cognitive development as the dependent variable, did not show a significant sex X grade level interaction effect. Thus, the null hypothesis can not be rejected. In other words, the relationship between sex and cognitive development was not found to be significantly different at various school grade levels.

The results show that when age is analyzed in interaction with sex, the effect of age on cognitive development is not

significant. A possible explanation of this finding could be based in two aspects: First, during early childhood, girls are more analytic in cognitive functioning than boys, but in early adolescence boys are more analytic than girls (Kogan, 1975). However, during middle childhood (7 to 11 years of age) these differences tend to disappear and both sexes show a similar pattern of cognitive change. Since the research sample in the present study included middle-childhood ages, it is not surprising that no significant differences were found in the interaction between sex and grade. Second, in terms of conceptual attainment, middle childhood seems to be a less consolidated and more transitional period than adolescence. In this sense, the nonsignificant sex X age interaction found in the present study could be explained as an effect of the constant assimilation-accomodation activity toward equilibrium, which follows a similar pattern of change for both sexes. In this progress toward equilibrium the environmental conditions play a relative but not essential role in the attainment of a more progressive cognitive organization. In other words, the child deals with the environmental events (physical and social) in accordance with structures already acquired, and this process is based more in internal activity rather than on the influence of socialization processes.

Path Analysis of Causal Competing Models.

The analysis of the three causal competing models, previously discussed, lead to the conclusion that the correlation between cognitive style and cognitive development was statistically significant ($r_{FP} = .76$ $P < .001$), as were the

correlations between age and cognitive style ($r_{AF} = .33$; $P < .01$) and between age and cognitive style ($r_{PA} = .41$; $P < .001$). The analysis of the predicted and observed correlations of each model lead to the acceptance of Model 2 as the causal model describing the relationship between age, cognitive development and cognitive style. This model places age as a causal factor on cognitive development which in turn influences cognitive style.

These results would suggest that the cognitive style dimension is mediated in its causal relationship with age by cognitive developmental variables. These results seem to support the Piagetian point of view that intellectual development depends on maturation among other factors (experience, equilibrium, social environment). The eventual capabilities of logical reasoning and operational thinking is created by maturation as a dispositional factor of development, that is, possession or lack of certain cognitive structures (logical, numerical spatial, physical) in the intellectual area can interact in different ways with the structuring of the cognitive style dimension.

Another possible explanation focuses intellectual development as an influential factor in the cognitive style dimension --in the sense that intellectual development involves a broader extension of mental functions and concepts than the cognitive style dimension itself. Therefore, the cognitive style dimension, regarded, basically, as a perceptual dimension, could be subsumed as another variable of

cognitive functioning.

On the other hand, according to the presents results, Bruner's (1973) position about the importance of perceptual functioning in cognitive development seems to be rejected given the magnitude of the correlation found. Thus, the correlation between age and cognitive development ($r_{PA} = .41$ $P < .001$) was higher than the correlation between age and field independence ($r_{AF} = .33$ $P < .01$).

Correlational Analysis.

The correlation between field dependence-independence and the Piagetian measures appeared to be relatively high with conservation having the highest correlation (.80), and transitivity the lowest (.59). Since correlations between cognitive style and cognitive development measures are all relatively high, it could be assumed that no particular intellectual ability is underlying the cognitive styles. This general influence on cognitive styles could be explained on the basis of the existence of basic cognitive structures (logical, spatial) in which functional interaction underlies intellectual development. However, it is important to note the magnitude of the correlation between conservation and field independence (.80). A possible explanation could be based on Bruner's (1973) and Frank's (1961) positions on identity. Conservation, according to Bruner is based on the development of the recognition of identity across transformations in properties. If the recognition of identity is, primarily based on perception, then it is important to note the magnitude of the correlation (.80) between

conservation and field independence appears to be rather significant. However, in order to validate this explanation, more research concerning the relationship between perception and logical reasoning is required.

With respect to the correlations among the different Piagetian measures, class inclusion and transitivity show the highest correlation (.80). This result seems to support Piaget and Inhelder (1969) positions concerning the interaction between these two operations. This interaction is based on the similarity of the cognitive processes involved; quantitative and relational.

In regard to the correlations between age and cognitive style, and between age and the Piagetian measures, the correlations are all significant with conservation as having the highest correlation (.43) and class inclusion the lowest (.32). In general, these results show that all Piagetian measures are more related to age than field dependence-independence. Therefore, the Piagetian position about the importance of maturation in cognitive development is supported with this finding.

With respect to the correlations between the different Piagetian measures, cognitive style, sex and age, the results show that for both sexes the correlations between cognitive style and all Piagetian measures are high, although the male group tend to be slightly higher than the female group. This result seems to confirm the relationship between cognitive style and cognitive development. A possible explanation

to this finding could be given on the basis of the causal direction of the relationship between cognitive style, cognitive development and age. The acceptance of causal Model 2 in which the relationship between age and cognitive style is mediated by maturation is also relevant to this present finding.

As the results show, the correlations between the Piagetian measures and cognitive style are all high for both sexes, although males appear to be higher. However, since the correlations between each of the variables and age tend to be higher in the female group than in the male, and since the sample is not large enough for these differences to achieve significance, the pattern found is still suggestive.

Statements Supporting External and Internal Validity.

The present section provides support for external and internal validity by utilizing the following criteria: valid and reliable instrumentation, objective scoring, selection of subjects.

Cognitive styles and cognitive development were measured by the Children's Embedded Figures Test (CEFT) and the Piagetian tasks for Conservation, Class Inclusion and Transitivity.

With respect to the Children's Embedded Figures Test, reported research (Dreyer and Nebelkopf, 1969) suggest that this test is a reliable instrument for use with children in the age range examined in the present study. The reliability coefficients range from .87 for 8 year old subjects, .88 for 9 year olds, and .87 for 11 year olds. With respect to

validity data correlations between the Children's Embedded Figures Test and the Embedded Figures Test (Witkin, 1961) were obtained for 9 to 12 year old children. Validity coefficients for 9 year olds range from .70 to .73, and .83 to .86 for 11 year olds.

The Piagetian tasks are up to the date the most available techniques for measuring levels of cognitive development. Several attempts have been made to establish validity for these tasks. Construct validation seems to be the most suitable (Raven, 1973; Goldschmid and Bentler, 1968). Also quite a number of replication research (Brainerd, 1972, Chittenden, 1964, Blanchard, 1975, Gelman, 1972) and cross-cultural studies (De Lemos, 1965; Goodnow, 1965, Bruner, 1968; Dasen, 1975) appear sufficiently respectable in terms of reliability and validity considering the present state of cognitive development assessment.

The use of objective instruments rather than free interview provided control of subject's verbal responses. Sample selection was based on theoretical considerations presented in the literature (Witkin, 1963, 1967; Piaget, 1958, 1974) stating that the selected age-levels were critical periods for the attainment of both cognitive categories analyzed.

In considering external and internal validity or generalizability, the present study faced the problem of lack of standardization and norming for both of the instruments utilized.

In order to assess the cognitive style dimension only

one test was used, the CEFT. The reasons behind the use of only one measure was the difficulty in finding test materials to assess cognitive styles in children younger than ten years of age. The sample selection was conducted by using the teacher's judgment to select "average" achievement students. Since no objective method was used to eliminate personal bias, generalization on the basis of this population could be questioned.

The scoring procedure for both of the tests utilized was based on previous research (Almy, 1972, Karp and Konstadt, 1963) in which the validation of the procedures is supported by a series of replication studies.

Educational Implications and Recommendations for Future Research.

The analysis of intellectual development and cognitive styles, as to different perspectives to look at cognitive functioning, bring together two structural theories, Piaget's theory of cognitive development and Witkin's theory of cognitive styles. The implications of these theories in the area of education have been considerable, especially in the case of Piaget. In trying to correlate both theories, a new dimension of analyzing behavior has emerged. This new dimension implies the consideration of the factor of individual differences in information-processing, that is, to what extent individual modes of perceiving and analyzing input information are also underlying intellectual development. According to the results of this study, it was found that cognitive style and cognitive development are significantly related when sex and age variables are taken into account.

The major finding of this study was the description of the causal relationship between cognitive style and cognitive development. The analysis of the causal direction of the relationship leads to the conclusion that age, regarded as an index of maturation, is an essential factor. In this causal model, the dimension of cognitive style is also influenced by maturation, but this influence seems to be mediated by cognitive developmental variables. It is, then, possible to assume according to the results that the cognitive style dimension, regarded as a perceptual factor, is another variable in cognitive development.

From this point of view implications for education are quite significant. The evidence reviewed in this study suggests that the capabilities of structuring the environmental information depend also on individual styles of perceiving. Thus, there are probably many classroom situations in which the structuring of learning activities depends on individual modes of processing information. Frequently, the materials to be learned lack clear inherent structure, creating the requirement that the learner himself provides organization as an aid to learning. Field dependent persons are likely to have greater difficulty in learning such material compared to field independent subjects who are more likely to themselves provide the mediating processes (analyzing and structuring) that are needed to facilitate learning. In this sense, the consideration of these individual variables and attention to cognitive style differences in learning under

more structured and less structured conditions and analysis of cognitive processes underlying learning tasks is required to be investigated.

A way to analyze how cognitive style may influence the student learning behavior is found in the effects of the different kinds of reinforcement used for learning. On the basis of this, it is expected that field dependent students would be more likely to require externally defined goals and reinforcement than field independent students who tend to be more self-oriented in this respect. Therefore, field dependence-independence cognitive styles may provide a useful basis to predict the success of reinforcement techniques as an aid to learning.

Differences in concept attainment could be also explained on the basis of differences in cognitive styles. Field independent rather than field dependent subjects are more likely to use mediational processes such as internal analyzing and structuring information in terms of conceptual acquisition. The analysis of these processes regarded as learning mediators could be of relevant importance for educators because of the interest in having students learn concepts rather than only facts. On the other hand, if the cognitive style dimension is regarded as an information-processing variable, in the sense that this involves cognitive structuring of input information, then, the question that arises is to what extent this dimension influences the processes of assimilation and accommodation and, therefore, intellectual development. More

research has to be done in this particular area in order to clarify to what extent individual differences in perceiving, thinking, solving problems, and learning are related to cognitive growth. A longitudinal research approach could be required. For instance, correlate intellectual developmental variables with measures of cognitive style by using children or adolescent population whose levels of cognitive styles have been previously measured, in order to analyze how individual differences in structuring information affects conceptual acquisition.

Most of the studies conducted in order to analyze the effect of sex-differences in field dependence-independence have found differences in performance among sexes. In general, the pattern of these differences showed a tendency for females, rather than males, to be more analytic or field independent during early childhood and just the opposite situation during adolescence and later periods. In this sense, the findings of this study with respect to sex-differences in cognitive styles are significant because they were absent. The implications of this finding are quite interesting given the age range examined. The question faced in terms of educational implications is, therefore, concerned with the extent to which middle childhood is a period of greater homogeneity in terms of cognitive functioning. However, more basic research concerning the interplay of cognitive functioning and sex and age interaction is required. Longitudinal rather than cross sectional approaches will provide information about the developmental patterns of sex-differences.

CHAPTER VI

SUMMARY

The investigation was concerned with the study of the relationship between cognitive development and cognitive style (i.e., field dependence-independence).

Cognitive style is defined by Witkin et. al., (1953/1977) as stable individual preferences in modes of perceptual organization and conceptual categorization of the external environment.

Middle childhood ages (8-11 years old) were selected for investigation. Sixty-four third to sixth grade students from a northside Chicago parochial school were selected. Each grade group was balanced for sex-differences. Piagetian tasks (Conservation, Class-inclusion, and Transitivity) were utilized to assess levels of cognitive development. Cognitive styles (i.e., field dependence-independence) were measured by using the Children's Embedded Figures Test by Karp and Konstadt.

The results indicated that intellectual development and cognitive styles were significantly related when sex and grade variables were controlled. Age was found significantly related to levels of cognitive development. No sex-differences were found significant in cognitive development and cognitive style. The interaction between sex X grade in cognitive styles and cognitive development was not significant. The finding was discussed in terms of socialization patterns and the intellectual characteristics of the childhood period.

An analysis of causal competing Models to describe the direction of the causal relationship between age, cognitive style, and cognitive development was conducted. The results indicated that age is a direct cause influencing cognitive development, which in turn affects cognitive style. This finding seems to support the Piagetian position about maturation as an essential factor in intellectual development. Bruner's position about perception as a direct causal variable of intellectual development seems to be rejected.

Correlational analysis indicated significant relationships between all Piagetian measures and cognitive style. However, since all these correlations tend to be high, it is possible to assume that no particular intellectual ability is underlying the dimension of cognitive style. Correlations among Piagetian measures indicated significant relationships between class inclusion and transitivity, and conservation and class inclusion. These findings were discussed on the basis of Piaget's and Inhelder's (1958) positions about development of logical thought.

Educational implications were directed mainly toward educational guidance and curriculum planning.

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APPENDIX A

Table 1
 Description of Subpopulations
 Total Piaget by Grade and Sex

Variable	Code	Mean	Std. Dev.	N
For entire population		21.42	4.48	64
Grade	3	18.44	4.98	16
Sex	M	19.50	5.98	8
Sex	F	17.37	3.85	8
Grade	4	21.31	4.84	16
Sex	M	20.75	4.65	8
Sex	F	21.87	5.28	8
Grade	5	22.56	3.90	16
Sex	M	22.50	4.31	8
Sex	F	22.62	3.74	8
Grade	6	23.37	2.42	8
Sex	M	23.77	2.19	8
Sex	F	23.00	2.72	8

Total Cases 64

Table 2
 Descriptions of Subpopulations
 Transitivity by Grade and Sex

Variable	Code	Mean	Std.Dev.	N
For entire population		7.11	1.54	64
Grade	3	6.19	1.56	16
Sex	M	6.75	1.58	8
Sex	F	5.62	1.41	8
Grade	4	7.25	1.81	16
Sex	M	7.00	1.77	8
Sex	F	7.50	1.93	8
Grade	5	7.31	1.45	16
Sex	M	7.37	1.68	8
Sex	F	7.25	1.28	8
Grade	6	7.69	0.95	16
Sex	M	7.62	1.06	8
Sex	F	7.75	0.89	8

Total Cases 64

Table 3
 Description of Subpopulation
 Class Inclusion by Sex and Grade

Variable	Code	Mean	Std. Dev.	N
For entire population		7.26	1.61	64
Grade	3	6.44	2.06	16
Sex	M	6.62	2.38	8
Sex	F	6.25	1.83	8
Grade	4	7.19	1.64	16
Sex	M	7.00	1.69	8
Sex	F	7.37	1.68	8
Grade	5	7.62	1.31	16
Sex	M	7.62	1.60	8
Sex	F	7.62	1.06	8
Grade	6	7.81	0.98	16
Sex	M	7.87	0.99	8
Sex	F	7.75	1.03	8

Total Cases 64

Table 4
Description of Subpopulation
Conservation by Grade and Sex

Variable	Code	Mean	Std.Dev.	N
For entire population		7.05	1.83	64
Grade	3	5.81	1.94	16
Sex	M	6.12	2.17	8
Sex	F	5.50	1.77	8
Grade	4	6.87	1.71	16
Sex	M	6.75	1.67	8
Sex	F	7.00	1.85	8
Grade	5	7.62	1.67	16
Sex	M	7.50	1.69	8
Sex	F	7.75	1.75	8
Grade	6	7.87	1.36	16
Sex	M	8.25	0.89	8
Sex	F	7.50	1.69	8

Total Cases 64

Table 5
Description of Subpopulation
Age by Grade and Sex

Variable	Code	Mean	Std.Dev.	N
For entire population		120.47	14.06	64
Grade	3	101.94	2.54	16
Sex	M	102.12	2.47	8
Sex	F	101.75	2.76	8
Grade	4	114.44	2.58	16
Sex	M	115.00	2.27	8
Sex	F	113.87	2.90	8
Grade	5	126.56	2.13	16
Sex	M	126.87	1.36	8
Sex	F	126.25	2.76	8
Grade	6	138.94	2.01	16
Sex	M	138.75	1.28	8
Sex	F	139.12	2.64	8

Total Cases 64

APPENDIX B

CLASS INCLUSION

I. FRUIT -- Use 4 bananas and 6 grapes.

A. HOW ARE ALL OF THESE OBJECTS ALIKE.....WHAT DO YOU CALL THEM?

Fruit Other_____

B. CAN YOU FIND SOME WAY TO PUT THESE OBJECTS INTO TWO GROUPS WHICH BELONG TOGETHER?

Correct Incorrect _____

C. PUT ALL OF THE FRUIT INTO ONE GROUP.

Testing

1. SUPPOSE I WANTED ALL THE GRAPES, AND YOU WANTED ALL THE FRUIT.....WHO WOULD HAVE MORE PIECES OF FRUIT?

Experimenter More Child More_____

2. HOW CAN YOU TELL? _____

II. WOODEN BLOCKS - Use 6 blue and 3 orange blocks.

A. CAN YOU FIND SOME WAY TO PUT THESE OBJECTS INTO TWO GROUPS WHICH BELONG TOGETHER?

Correct Incorrect_____

B. PUT ALL OF THE WOODEN BLOCKS INTO ONE GROUP.

Testing

1. WOULD A TOWER MADE OF ALL THE WOODEN BLOCKS BE TALLER OR SHORTER THAN A TOWER MADE OUT OF ALL THE BLUE BLOCKS?

Taller Shorter_____

2. HOW CAN YOU TELL? _____

III. PLASTIC BEADS - (8 blue plastic beads and 4 red plastic beads)

A. HOW ARE ALL OF THESE ALIKE.....WHAT DO YOU CALL THEM?

Beads Other_____

B. CAN YOU FIND SOME WAY TO PUT THESE OBJECTS INTO TWO GROUPS WHICH BELONG TOGETHER?

Correct

Incorrect _____

C. WHY DO THESE THINGS BELONG TOGETHER? WHAT ARE THE NAMES OF THE GROUPS? _____

D. PUT ALL OF THE PLASTIC BEADS INTO ONE GROUP.

E. ARE THERE MORE RED PLASTIC BEADS? MORE BLUE PLASTIC BEADS OR ARE THEY THE SAME?

More red

More blue

Same _____

F. HOW CAN YOU TELL? _____

Testing

1. ARE THERE MORE BLUE BEADS, MORE PLASTIC BEADS, OR ARE THEY THE SAME?

More blue

More plastic beads

Same _____

2. HOW CAN YOU TELL? _____

(Add 4 red beads)

1. ARE THERE MORE RED BEADS, MORE PLASTIC BEADS, OR ARE THEY THE SAME?

More red

More plastic beads

Same _____

2. HOW CAN YOU TELL? _____

TRANSITIVITY

PRACTICE I

(Interviewer indicates two sticks on Practice I cloth and asks:)

WHICH ONE OF THESE TWO STICKS IS LONGER? DON'T COUNT THE ARROWS. JUST LOOK AT THE STICKS.

Correct

Incorrect

Promoting: (If S doesn't choose the correct stick, interviewer may prompt by measuring the shorter stick with his fingers and transferring them to the longer stick saying:) SEE, THIS STICK IS SO LONG AND IT ONLY COMES UP TO HERE ON THIS STICK. NOW WHICH STICK IS LONGER?

Correct

Incorrect

PRACTICE II

(Interviewer indicates two sticks on Practice II cloth and asks:)

NOW, WHICH ONE OF THESE TWO STICKS IS LONGER? REMEMBER NOT TO COUNT THE ARROWS BUT JUST THE STICKS.

Correct

Incorrect

Promoting: (If S doesn't choose the correct stick, interviewer may prompt by measuring the shorter stick with his fingers and transferring them to the longer stick saying:) SEE, THIS STICK IS SO LONG AND IT ONLY COMES UP TO HERE ON THIS STICK. NOW WHICH ONE IS LONGER?

Correct

Incorrect

Test

A. (Interviewer displays Cloth A saying:) NOW, LET'S TRY ONE THAT IS HARDER. BEFORE YOU TELL ME WHICH IS LONGER, I WILL PLACE THE BLUE STICK LIKE THIS. (Places Blue Stick B next to lefthand stick with the ends toward himself coinciding.) THE ENDS ARE EQUAL (E's end) AND YOU CAN SEE THE DIFFERENCE HERE (S's end).

1. WHICH IS LONGER: THE BLUE OR THE BLACK?
Blue Black

(Interviewer moves the Blue Stick next to the right-hand stick with the ends toward himself coinciding.)

2. WHICH OF THESE TWO IS LONGER: THE BLUE OR THE BLACK?

Blue

Black

TRANSITIVITY, Continued

(After S responds, quickly remove Blue Stick B saying,)

3. WHICH OF THE BLACK STICKS IS LONGER?

Correct

Incorrect

4. HOW CAN YOU TELL? _____

B. (Interviewer turns cloth around to the Cloth B side.)

LET'S TRY IT ONCE MORE. (Moves Blue Stick B next to the righthand test stick with the ends toward himself corresponding and asks:)

1. WHICH IS LONGER? THE BLUE OR THE BLACK?

Blue

Black

(Interviewer moves the blue Stick B next to the left-hand stick with the ends toward himself coinciding.)

2. WHICH OF THESE TWO IS LONGER: THE BLUE OR THE BLACK?

Blue

Black

(Quickly remove Blue Stick B and ask:)

3. WHICH OF THE BLACK STICKS IS LONGER?

Correct

Incorrect

4. HOW CAN YOU TELL? _____

C. (Interviewer displays Cloth C saying:) LET'S TRY IT WITH THESE STICKS. (Place Blue Stick Y next to left-hand stick saying:)

1. WHICH STICK IS LONGER?

Blue

Black

(Move Blue Stick Y to the right-hand test stick and ask:)

2. AND WHICH OF THESE STICKS IS LONGER?

Blue

Black

(Quickly removing Blue Stick Y)

3. NOW, WHICH OF THE BLACK STICKS IS LONGER?

Correct

Incorrect

4. HOW CAN YOU TELL? _____

TRANSITIVITY, Test Continued

D. (Interviewer turns cloth around to the Cloth D side.)
LET'S TRY IT AGAIN. (Moves Blue Stick Y next to the
right-hand test stick and asks:)

1. WHICH IS LONGER: THE BLUE OR THE BLACK?

Blue

Black

(Move Blue Stick Y next to left-hand test stick and
ask:)

2. AND WHICH OF THESE STICKS IS LONGER?

Blue

Black

(Quickly remove Blue Stick Y and ask:)

3. WHICH OF THE BLACK STICKS IS LONGER?

Correct

Incorrect

4. HOW CAN YOU TELL? _____

I. Introduction.

First, I want to show you these two balls. You can see, they are made from clay; one is red and the other is blue. Let's pretend that they are two pieces of candy. The red will be for you and the blue for me; and we have exactly the same to eat.

II. Testing.

1. (Red ball is transformed into a sausage). Now, look what I did with your ball (candy). What do you think now. Do we still have the same to eat or you have more than me. Or I have more than you. Or do we have the same to eat?

More red ball _____ More blue ball _____ Same _____

2. (Red ball and blue ball are displayed as in the introduction without any transformations.) Now, we have our balls again. Oh, look what I am going to make this ball (red ball is transformed into the shape of a cookie) into.

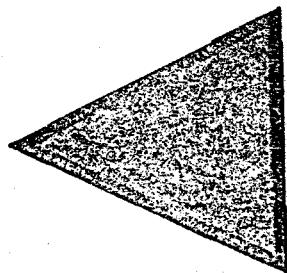
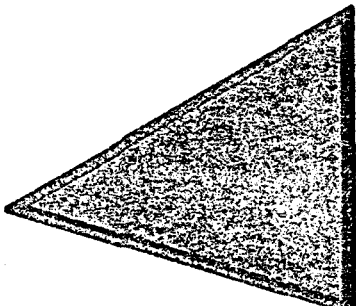
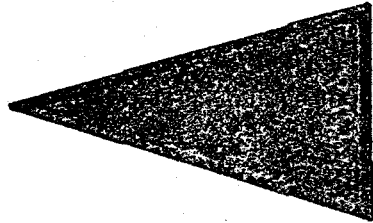
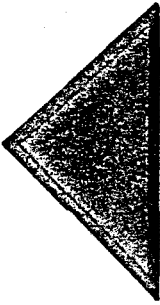
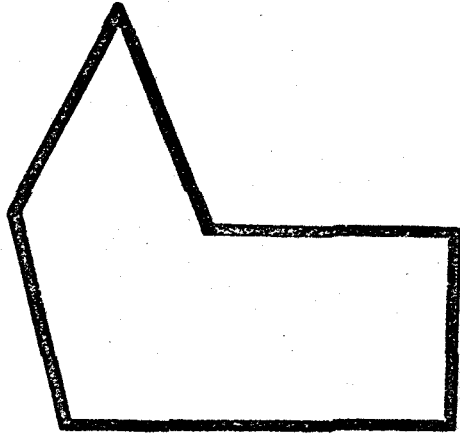
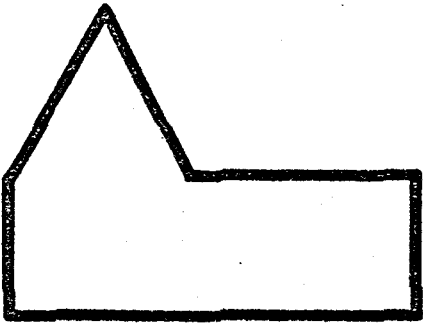
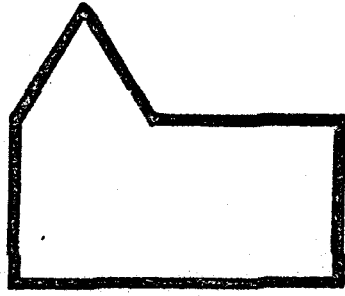
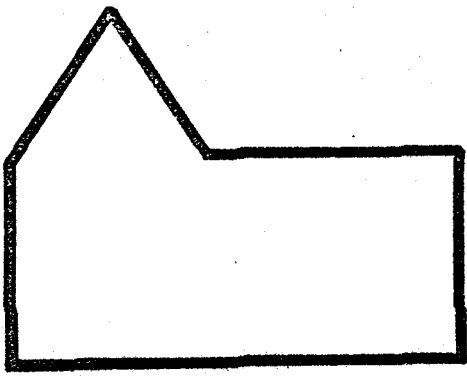
More red _____ More blue _____ Same _____

3. (Red ball and blue ball are displayed as in the introduction without any transformations)

Now, we have our balls like before. Now, look what I am going to do with this ball (red ball is transformed into pieces: 8 or 10).

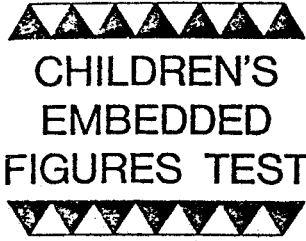
What do you think now? Do we have still the same amount to eat or do I have more than you? Or do you have more than I? Or do we have the same?

Note: This procedure is repeated for conservation of Weight and Volume. A balance scale for the weight task and two glasses of water for the volume tasks are used.





SCORE SHEET FOR



NAME _____

CLASS _____

BIRTH DATE _____ SEX: M ___ F ___

DATE _____ EXAMINER _____

TENT	DESCRIPTION	SCORE
P ₁		
P ₂		
T ₁		
T ₂		
T ₃		
T ₄		
T ₅		
T ₆		
T ₇		
T ₈		
T ₉		
T ₁₀		
T ₁₁		
Total Score TENT		

HOUSE	DESCRIPTION	SCORE
P ₃		
H ₁		
H ₂		
H ₃		
H ₄		
H ₅		
H ₆		
H ₇		
H ₈		
H ₉		
H ₁₀		
H ₁₁		
H ₁₂		
H ₁₃		
H ₁₄		
Total Score HOUSE		
TOTAL TEST SCORE		



APPROVAL SHEET

The thesis submitted by Luisa B. Gutierrez has been read and approved by the following committee:

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The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the thesis is now given final approval by the Committee with reference to content and form.

The thesis is therefore accepted in partial fulfillment of the requirements for the degree of Master of Arts.

2/13/79
Date

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