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A STUDY OF THE CORRELATIONS BETWEEN COGNITIVE DEVELOPMENT AND FORMAL OPERATIONAL THOUGHT ACROSS EDUCATIONAL EXPERIENCE LEVELS

The Ohio State University

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A STUDY OF THE CORRELATIONS BETWEEN COGNITIVE DEVELOPMENT
AND FORMAL OPERATIONAL THOUGHT ACROSS EDUCATIONAL EXPERIENCE LEVELS

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree of Doctor of Philosophy in the Graduate
School of The Ohio State University

By

William David Porterfield, B.A., M.A.

****

The Ohio State University
1984

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To my mother and my father
ACKNOWLEDGMENTS

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Finally, my father and mother, Melvin and Christine Porterfield, to whom this volume is dedicated as an expression of my long overdue gratitude for their years of patience with a son who had different dreams.
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As managers, educational administrators are concerned not only with providing education to the clients of a particular institution, but with managing the human organization which delivers this service(s) as well. Consequently, the field of educational administration has not only established a rich body of literature directly relevant to the tasks of the educational administrator, but has drawn on the literature of any number of other disciplines to train prospective educational administrators. Educational administrators, unlike administrators in the business sector, are in charge of human organizations whose primary missions involve the development of human potentials. Thus, the necessity for the educational administrator to understand human development and change is not only imperative for managing the educational organization, but for designing the programs of education that the organization delivers. This imperative exists in primary, secondary, and higher education settings alike.

The field of human developmental psychology has much to offer educational administrators in their need to understand human change, and thereby design better educational programs, and run more efficient and effective educational organizations. The current study is a research effort aimed at a better understanding of two constructs of human
development which can potentially aid educational administrators in the design of educational programs and the management of educational organizations.

BACKGROUND OF THE PROBLEM

Human Developmental Psychology Defined

Human developmental psychology is the field of study concerned with studying patterns of growth and change in individuals throughout the life span. The field is relatively new, in that the majority of the work has followed the research of child psychologist Jean Piaget (1954, 1963) who studied changing patterns of thought in children. Piaget set forth the notion of "stage" development, which has characterized much of the theory and research in human development in the past twenty years. Piaget suggested that understanding the human organism involves recording observational data on one level, and understanding the internal schemata which organize behavior on another level. Essentially, Piaget suggested that development of different aspects of the individual could be considered through the concept of "stages", which are comprised of qualitatively different sets of assumptions or beliefs about the world. Piaget further suggested that stages occur in a hierarchical and sequential manner during the course of development. In other words, each successive stage of development incorporates the aspects of the previous stage, and the stages occur in a fixed sequence. Human developmental change occurs as the organism interacts with the environment, and seeks to resolve conflict between the outside world and the assumptions of the stage or "filter" they are using to
perceive the world. Thus, the organism is in a constant state of equilibration, or reconciliation between experiences and a set of cognitive assumptions. This process of equilibration produces a natural advancement from one stage of development to the other. Many researchers since Piaget have adopted these assumptions in the study of different aspects of human development. Kohlberg (1981) has applied the notion of stage to moral development. Perry (1970) has applied the stage concept to the study of cognitive development in college students. King (1978) applied similar notions of stage to her theory of reflective judgment. Thus, Piaget's contribution of the stage notion to human development has significantly impacted modern study of human developmental change. The advancement of human developmental theory has also given new insight and interest in the potential goals of education and roles of educational practitioners as intentional developmental change agents.

**Developmental Theory and Education**

A number of educators and scholars during the twentieth century have argued that the aim of American education in general, and American higher education in particular, ought to be the intentional development of the whole person. The notion of human development as an aim of education involves not only the intellectual cultivation of the individual, but the social, emotional, moral, ethical, and cognitive cultivation of the human organism as well. Some of the most prolific writers, in terms of this concept, have been scholars such as Dewey (1960); Piaget (1954, 1963); Kohlberg and Mayer (1972); Sanford (1962,
1964, 1981); and Chickering (1969, 1981). While each of these writers has been concerned with a particular aspect of human development in education, each has articulated the development of the whole person as an aim for American education. Writers in the field of student personnel work have echoed this concern for enhancing human developmental change as a primary aim of American higher education (see Chickering, 1981; Cooper, 1971; Havighurst, 1953; Heath, 1978; Parker, 1978; Hurst, 1978; Perry, 1970, 1981). Thus, the idea of a more wholistic approach to education through the application of human developmental psychology has gained much attention in the past four decades as a philosophical direction for American education.

Concurrently, this idea has received particular attention from educational administrators in the field of student services on college campuses.

Student services administrators of the 1980's face a growing challenge within their profession to be concerned about the intentional development of college students, in settings other than the university classrooms, through the application of theories of human development in educational practice. In The Modern American College, Chickering (1981) argues that the overarching purposes of American colleges and universities "should be to encourage and enable intentional developmental change in students throughout the life cycle " (p.2).

This goal is not a new concern for educators and educational administrators. However, research in the past twenty years on the changing patterns of student attitudes, beliefs, values, and behaviors during the course of the college experience has provided a broader and
more descriptive theoretical base for educators seeking to inform their educational practices through the use of student development theory, thereby increasing the "tools" available for the realization of the broader educational goal of 'intentional developmental change' in students. Consequently, there appears to be a renewed interest in educators becoming intentional developmental change agents.

**Developmental Theory and Student Personnel Administration**

During the past forty years, the field of student services administration has moved rapidly toward adopting a "student development perspective" as a professional direction. Clyde Parker (1978) outlines the history of the field of student personnel in an attempt to demonstrate the emergence of this perspective. Essentially, Parker notes that the concern for the development of the student outside the classroom emerged as an educational concept around the turn of the century. After World War II, student services administration evolved as a specific field of educational administration with the appointment of the first deans of men and women on the college campus. Initially, these administrators were in charge of managing housing programs, and dealing with student discipline concerns. Williamson (1940), however, argued that the role of these administrators involved not only management and student discipline, but the development of students socially, emotionally, and morally as well. The next cohesive set of statements of this nature came in 1971 and 1972 when the Council of Student Personnel Administrators (COSPA) issued two documents in which emerging professionals in the field of student personnel were challenged
to become familiar with developmental theory as the vehicle for implementing the philosophical directions set out by Williamson in 1940. Currently, a joint committee of professional organizations including the National Association of Student Personnel Administrators, the Association of College Personnel Administrators and the American Counseling and Guidance Association is working on a set of standards for the preparation of masters level student personnel administrators. These standards (1981) note three emphases in academic preparation; student and organizational development, administrative and organizational behavior, and counseling with student development as an adjunct. Thus, a "student development perspective" in the administration of student services has become firmly established as a philosophical direction for the field. The firm establishment of philosophical direction, however, is only part of the necessary path from theory to practice.

The field of student services administration has been impacted by at least two major trends which have furthered the interest in human developmental psychology's application to student affairs administration on the post secondary level. The two major trends are 1) an accelerated emphasis on student development research, and 2) an accelerated emphasis on the application of student development theory in educational and administrative practice. Although several student development theories have been explicated which attempt to describe and predict different "threads" of development within the individual, all the theorists have been concerned with the development and verification of frameworks for understanding the changes that occur in students' beliefs, attitudes,
values, and behaviors during the course of the college experience. Along with the growth in the number of theories available, there has been a subsequent trend emphasizing the use of these student development theories in educational and administrative practice. (Parker, 1978; Newton and Ender, 1980; Decoster and Mable, 1974). Rodgers and Widick (1980) succinctly state the implications and problems that these trends present for student personnel administrators:

Student personnel workers historically have moved from control to service to developmental foci in implementing their professional work. Yet, the developmental perspective has proven to be problematic. The use of developmental theory has been an espoused goal, but rarely a reality (Kuh, 1977). As a field (we) need conceptual models and guidelines for relating theory to day-to-day practice. (p.5)

Thus, out of the broad goal of development of the total person as an aim of higher education, there have evolved a number of significant trends that form the context for current research and practice in the area of student services administration. First, the emergence of student services administrators on college campuses during the twentieth century has been an implicit statement that American higher education professionals should be concerned with development of students outside the classroom setting. Second, the historical development of student services administration as a field has brought the definition of 'development outside the classroom' into a sharper theoretical focus. Third, more recent research on student attitudes, values, beliefs, and behaviors has provided a data base for practitioners to use in the administration of student services, and the consequent "intentional development" of the college student.
A number of human development theories which have been advanced in the past twenty years attempt to describe various aspects of human growth and change during the life cycle. Student services practitioners interested in applying theory to educational practice have "borrowed" some theories from the field of developmental psychology (see Kohlberg, 1981; Sheehy, 1981; Erikson, 1968; Gould, 1977; Levinson, 1978; Loevinger 1976), while other theories have actually been formulated through recent research on college students (see Perry, 1970; King, 1978; Chickering, 1969). This abundance of theory in the area of human development has provided further incentive for research in the area of developmental change, as attempts are made to understand the relationships between and among the various threads of human development that comprise the organism.

The State of the Art in Developmental Research

Although there are several theories available for use by student development educators, there are a number of research issues in the area of human developmental theory which become crucial to further use of student development theory as a tool for producing intentional change in individuals. Nevitt Sanford (1981) argues that educators must understand the various threads of human development as a way to gain greater insight into individuals. However, Sanford also notes that the next advance in the area of human development research should be geared towards understanding how each of these threads of development relate to one another. In other words, it is not enough to know that the individual is developing socially, morally, and ethically. Educators
must also understand how the different strands of development affect one another. For example, what affect, if any, do developmental changes in cognition have on other aspects of development such as moral or ethical development? If educators are to use developmental theory in educational practice, then there must be greater knowledge generated about the correlations between various strands of human development. This knowledge would provide a greater understanding of how the total organism grows and develops. Such research and knowledge is essential if student personnel administrators and other educators are to have adequate understandings for enhancing and deliberately developing the whole person.

DEFINITION OF TERMS

The following descriptions serve to clarify the terms and variables under consideration in this study.

Developmental theory. This term refers to any theory of human change which assumes the existence of internalized structures of assumptions, or stages of development, as defined by Piaget (1963). These structures or stages are hierarchical, and occur in an invariant sequential manner.

Cognitive development. This term refers to the mental structure or stage which the individual uses to process experiences. Nine such stages are defined by William Perry (1970). The stages range from a dualistic view of issues, where authority figures are seen as having answers to all questions, to a relativistic view of issues, where the individual reaches reasoned conclusions about issues within a given context. The
stages are hierarchical and sequential in a Piagetian sense, with each successive stage representing a qualitatively different way of processing experiences and information.

Logical thinking This term refers to the degree to which an individual is able to solve increasingly complex problems involving various mental processes. Three such stages of logical thought development are described by Piaget (1963). The stages include pre-operational thought, concrete operational thought, and formal operational thought. These stages represent a progression from an ability to solve only simple problems, to formal operational thought where the individual develops the ability to transfer solutions across complex contexts.

Educational experience This term refers to the formal educational attainment of subjects involved in this study. For this study, educational experiences can be categorized into freshmen in college, seniors in college and graduate students (including masters and doctoral students).

STATEMENT OF THE PROBLEM

To what extent are the constructs of logical thought and cognitive development related to one another; and how does this relationship change over the course of educational experience?

PURPOSE OF THE STUDY

The purpose of this study is grounded in Sanford's notion that educational practitioners must begin to understand the correlations between and among the various strands of human development in order to
better understand the change process in education. Specifically, this study is designed to explore the relationships between cognitive developmental levels as described by William Perry (1970), and the development of formal operational thought, as defined by Jean Piaget (1963). Such a correlational exploration is a necessary beginning toward the larger research goal of understanding the empirical relationships between and among theories of cognitive, moral, ethical, and logical thought. Thus, it is important to view the current work as exploratory, in search of correlations between constructs of human development which may add further to the understanding of the human organism as a whole.

Much of the interest in studying the human organism as it changes can be attributed to the field of psychology during the past forty years. Thus, many of the theories of ethical, moral, social, and cognitive development are still in various stages of development. Much of the current research in the area of human development might be called narrow, inasmuch as it focuses on further development of the constructs and measurement of particular strands of development, as opposed to focusing on the relationship(s) between and among the strands. Consequently, Nevitt Sanford is not only suggesting a need for greater information with respect to human developmental change, but a new area of research in human development as well.

Limitations of the Current Study

With the field of human development theory being so new, one cannot hope to find all the correlations between strands of development in one
research design. Indeed, it is more prudent to select particular strands of development that are of interest and pursue correlational studies. The process suggested by Sanford will undoubtedly take years of research. Therefore, it is important to begin this process through selective inquiry about particular strands of human development of interest to educators in a specific field. This research study begins the process of inquiry by identifying the theories of Perry (1970) and Piaget (1928, 1963) as points of departure.

It is important to understand the larger research context in which correlational studies, such as the current one, are grounded. Essentially, correlational research in human developmental psychology is embedded in the following steps of logical inquiry. First, the researcher must identify a particular construct of human development as an interest area. Second, the researcher must develop methods for measuring the proposed construct. Third, the researcher does initial correlational research between chosen constructs of human development. The current study is a part of this third step. Results of the correlational research lead to further lines of inquiry. If the correlation between the two or more constructs of development is high, then the researcher must design studies which help to determine whether the high correlation is a result of the constructs being the same or similar, whether the high correlation is an indication of another mediating variable, or whether the two constructs are interactive (development in one construct seems to promote development in another construct). If the correlations between the two or more constructs of human development is low, then the researcher may either pursue other
replication studies with improved designs, or conclude that the constructs under study are most likely unrelated to one another. Each of these lines of inquiry can be associated with a particular research design, and each line of inquiry can take years to explore fully. The current study is framed in this larger research context of human developmental psychology.

In any study, it is important to note the research designs which might most likely follow in order to demonstrate the relevance of the particular study to the larger research context. For example, in this study, the researcher attempts to ascertain the relationship of cognitive development and logical thinking ability over the course of the college experience. Future designs, which would build on the current research, might involve specific interventions which would help to ascertain not only the correlations between these two constructs of development, but the intervening variables in the university setting which might promote or inhibit growth along either dimension.

SIGNIFICANCE OF THE STUDY

The importance of studying relationships between various strands of human development has been briefly introduced above. For this particular study, the author has chosen to explore correlations between William Perry's constructs of cognitive development and Piaget's constructs of formal operational thought. Indeed, with so many "stage" theories of human development available for further study, one must
decide, using some criteria, where to begin with correlational research. The criteria used for selection of these two particular aspects of human development are given below.

**Significance in the Research Context**

As a logical starting point in the study of correlations between various threads of human development, one should keep the following criteria in mind. First, the theories under study ought to be well developed in terms of the validation of constructs. Well developed constructs give the researcher the benefit of being able to study validated constructs, as opposed to theoretically proposed constructs of development. Second, the constructs under study should have some relevance to a particular field of application. In this case, William Perry's work has been applied in several settings in higher education including career counseling (Knefelkamp and Slepitza, 1976), classroom instruction (Knefelkamp, Widick, Parker 1978), and residence hall milieu management (Rodgers, 1983). Piaget's levels of logical thought have been similarly applied to classroom teaching. Third, efficient, reliable, and valid instrumentation techniques must have been developed in order for research to be expedient and affordable. Instrumentation techniques have been established for both of these theories. Fourth, and perhaps most importantly, there must be some theoretical rationale for inquiring about relationships between constructs of development. In this case, the rationale for the study is two fold. Primarily, research of this nature could add to the knowledge base of the interaction between constructs of human development, thereby providing additional
data on the total development of the human organism. Secondarily, since both Piaget and Perry adopt a stage notion in the description of their constructs, one might theoretically assume that the relationship between constructs based on the same notions would be linear. Indeed, if the family of developmental stage theories are to continue to be used as tools for educational practice (particularly in student personnel), then research needs to be conducted on correlations between and among constructs that comprise the entire family of theories.

Significance for Educational Administrators

The further development of the body of theory relative to human developmental processes has implications and value for educational administrators on at least two levels. First, educational administrators are usually charged with delivering some type of service of an educational nature, including the design and implementation of educational goals. This function is inescapable for the educational administrator, whether the context is elementary education, secondary education, or higher education. The effectiveness with which educational programs are designed and implemented can be attributed to the administrator's success in understanding the needs of the client group, and subsequent delivery of educational services based on this assessment. In this respect, developmental theory becomes one of the assessment techniques for the design and implementation of educational programs. In essence, developmental theory can be viewed as a part of the 'technical core' of educational organizations inasmuch as the administrators and managers are charged with delivering educational
services, and the theory base about the students serves as one of the tools which these administrators use in the design of the programs and services they deliver (Mintzberg, 1978). Thus, developmental theory has particular relevance for educational administrators in the area of program design.

It has been noted previously that student personnel administrators in higher education are increasingly depending on developmental theory to guide the design of educational programs in the university setting. While the enthusiasm for the use of theory in the design of programs has grown rapidly, the empirical and theoretical clarity of human developmental constructs is in need of further research (Hanson et al., 1982). Further research in this area will be beneficial not only to student personnel administrators, but to other educational administrators wishing to use developmental theory in the design of educational programs and services.

A second area of application of developmental theory for the educational administrator is in the management of people. The acknowledged coordination of the activities and interests of people as a management responsibility serves as the basis for much of the theoretical writing in educational administration and in the management literature. As our notions of management have developed from the 'rational systems' perspective to the 'open systems' perspective, the role of managers as change agents of people has been accentuated (Scott, 1981). For example, management is no longer viewed as the simple coordination and design of tasks and work flow, but is now inclusive of the design and coordination of employee perceptions as well. Mills
(1967) discusses the concept of the "executive's dilemma", which highlights the need for executives to not only possess the skills necessary for efficient and effective administration, but the knowledge of the human dynamics which will affect administration as well. This concept, logically, infers a manager's responsibility to be knowledgeable of the field traditionally called psychology. Blanke (1983) writes about the concept of "coalition building" as a major responsibility for administrators in organizations. Essentially, coalition building involves the direction of people around a set of organizational goals and objectives, and similar to Scott and Mills, again reiterates the idea that administrators must possess knowledge of human development processes as one way of better understanding how to be attentive to the 'human' aspect of management.

More specifically, on this second point, developmental theory offers the educational administrator or manager a framework for understanding the 'cognitive maps' of others in the organization (Johnson, 1977). An understanding of cognitive maps can serve as the basis for directing others in terms of supervision and evaluation. The present author and others (Piper, Ricci, 1983) have begun to explore the use of developmental theory in the design of jobs, recruitment of employees, supervision of employees, and the evaluation of employee performance. In brief, developmental theory can help the administrator better understand the cognitive processes of employees, thereby offering information for more effective management of the employees.
In summary, the body of theories which comprise the area known as human developmental psychology has much potential for educators who perceive their role as intentional developmental change agents of the whole student, for educational administrators interested in a better understanding of the human dimension of organizations, and for administrators interested in new ways of structuring job descriptions, personnel evaluation systems, and performance appraisal. The field of student services administration has placed particular emphasis on intentional development as a professional aim. Much research is currently underway to continue to validate the various stages of development described in the theories. The next important step in research will be in the area of correlational research between and among the various stage constructs across several theories. This type of research will aid in integrating and separating constructs of development, thereby providing a better picture of the development of individuals during college and across the life span. In this respect, this piece of research provides a starting point from which other research can be conducted to empirically describe the complex relationships between strands of development within the human psyche.

HYPOTHESES FOR THE STUDY

For the purposes of this particular study, several hypotheses will be tested. Stated simply, the major research question is, what is the empirical nature of the relationship between cognitive development and logical thought development, and how does this relationship change over the course of educational experience?
Theoretically, one might assume that both schemes of development are positively correlated to educational experiences (Copes, 1982) inasmuch as educational experience can be said to provide the stimulus to promote growth on either dimension. Additionally, it is important to test for sex differences, particularly in early correlational research such as the current study. The null hypotheses are stated below. A more detailed explanation of the hypotheses is contained in the methodology section.

H1: There will be significant differences in cognitive development scores across educational experience levels.

H2: There will be significant differences in logical thinking scores across educational experience levels.

H3: There will be no significant differences in cognitive development scores between males and females.

H4: There will be no significant differences in logical thinking scores between males and females.

H5: There will be a moderate to high positive correlation between cognitive development scores and logical thinking scores ($r = .60 - 1.00$).

H6: There will be no significant differences in the correlations of cognitive development scores and logical thinking scores across educational experience levels.

H7: There will be no significant differences in the correlations of cognitive development scores and logical thinking scores between males and females.
Earlier, the idea was set forth that educational administrators in general, and student personnel administrators in particular, must consider the application of developmental theory in designing programs in educational institutions, and in managing human organizations. Indeed, it is suggested that developmental theory and assessment are not only rational and reasonable variables for program design considerations, but serve as tools for understanding and managing the human dimensions in natural and open systems of organizations as well. Further research in developmental theory must include continued efforts to clarify conceptually the various theories; efforts toward refined, valid, and reliable instrumentation procedures; and efforts in correlational research within the body of theory assuming a developmental perspective (Hanson et al, 1982). Simultaneously, creative individuals will continue in efforts to apply current theoretical and empirical work in developmental theory to particular settings (e.g., counseling, supervision, personnel evaluation, residence hall management, etc.). Thus, the current study must be viewed in this context, as it represents an effort to clarify empirically correlations between at least two constructs. This study is set in a larger goal of
contributing to the knowledge necessary for effective use of developmental theory in educational administration.

Following this set of ideas, the literature review is organized under the following headings: theory development from the Piagetian perspective; research issues in developmental theory; current and potential applications of developmental theory in educational administration; literature directly related to the theories in the current study; and a conclusion.

Theory Development From the Piagetian Perspective

The work of Jean Piaget (1928, 1963) has served as the basis for most of the developmental theories that have followed. Piaget spent much of his professional life studying the cognitive and epistemological development of children and developing a theory of human learning and change through his years of observation. It is important to understand the basic assumptions of developmental theory, as outlined by Piaget. This understanding of the basic assumptions of the theories helps clarify the present study, and differentiates developmental theory from other theories of human change.

According to Piaget, the human organism is in a constant state of equilibration. This equilibration process serves to assist the organism in making meaning of experiences. In essence, Piaget is defining human learning as a process of equilibration. Additionally, the equilibration process involves two distinct sub-processes; assimilation and accommodation. When the organism experiences an event, the meaning of the event can be assimilated, or made to fit into the current cognitive
structures. On the other hand, the event may not "fit" the organism's current cognitive structures, and therefore is accommodated. In the process of accommodation, the organism is forced to change the cognitive structure to make meaning of the event. While these processes have been outlined in a very simplistic manner here, they are the underpinnings of almost all developmental theories.

The cognitive structures represent stages of development, and the equilibration process serves as the natural motivator which moves the organism through stages of development across the life span. Development is stimulated by experience, and mediated by the equilibration process. Out of a Piagetian definition, stages of development represent, "1) new thought operations; 2) internalized schemata of action; 3) logically or philosophically formalizable systems in equilibrium; and 4) culturally universal patterns" (Gibbs, 1981). These criteria for identifying "stages" of development, and the explication of the assumptions of equilibration serve to define human change out of a Piagetian definition, and differentiate developmental theory from other theories such as anthropological theory (Mead, 1973), psychodynamic theory (Freud, 1966), behaviorist theory (Skinner, 1972), and others.

The assumptions of developmental stage theory and the equilibration process have been applied to a number of other areas of cognitive growth during the past three decades. The overarching value of these theories lies in the proposition that theory offers an informed point of departure for working with and understanding individuals. In the field of education, where individual development often represents the object
of the organization, such theories have particular relevance. Lawrence Kohlberg (1969) used the assumptions of developmental theory to study moral reasoning. Kohlberg has spent much of the past two and one-half decades in efforts to continually define the six stages of moral development, and to work on assessment techniques for his theory of moral reasoning development. Jane Loevinger (1966, 1976) has used developmental assumptions in the study of ego; identifying several stages of ego development, and working diligently on assessment techniques. In 1970, William Perry published his study of the intellectual and ethical development of college students. Perry spent several years defining the stages of development through interviews with college students. Patricia King (1977) has used developmental assumptions in studying reflective judgment. James Fowler (1976) adopts stage assumptions in the study of faith development. Each of these researchers has added to the knowledge base about human development, as well as the knowledge base about the methods for studying development from a Piagetian perspective. Background information on how these theories are derived and validated is contained in the section below.

**Research Issues in Developmental Theory**

There are a number of research issues which emerge when considering the study of human change from a developmental perspective. First, one must ask how developmental theories are derived. Second, one must ask how the theories are validated. Third, one must have valid and reliable instrumentation procedures for measuring the theory(s). Instrumentation is important if the theory is to be used in interventions. Studies by
developmental theorists during the past two decades have helped to answer these questions.

Gibbs (1982) explains the process by which developmental theories are created and refined. Essentially, one selects a particular area of study for developmental change such as moral development, ego development, or cognitive development, and then interviews subjects through some set of open ended questions. From this rich interview data, one scans the content for evidence of reasoning structures or stages. Based upon this data, and a description of the stages, one continues to interview subjects with the intention of better defining the stages that have been initially described. A second level of progress involves the development of instrumentation which will identify, in reliable and valid ways, the constructs which have been ascertained in interview data. Yet a third level of progress, which Kohlberg notes few have attained yet, is the use of instrumentation data to further refine or revise the theory. Of course, a fourth level is the explication of the relationships between and among the various strands of development. This fourth level is the context of the current study.

A number of methodological issues are inherent in the study of developmental theory. First, the theories are in a constant state of revision. Second, the process for the development of valid and reliable instruments is time consuming and costly. Third, without the development of valid and reliable instrumentation, the theories are difficult to utilize in individual, group, organizational, or social interventions. These methodological issues not only impact the current
study, but also serve as a stimulus for the study. The theories under study in the current research have undergone the first three levels of progress in terms of development, and thus lend themselves more aptly to the questions raised at the fourth level of progress.

Current and Potential Application of Developmental Theories

Despite the inherent methodological issues involved in the study of developmental theory, several researchers and practitioners have already begun to use this theory in the design of educational interventions, and the management of people in educational organizations. Generally, developmental theory has been used in the design of interventions in the following areas: classroom teaching, career counseling, residence hall environmental management, and personnel supervision and evaluation. The first three categories can be viewed as parts of the technical core of education (Mintzberg, 1978), while the latter category is more directly related to the day-to-day management functions. In either case, developmental theory appears to be a viable tool in helping administrators design programs and manage organizations. The overriding rationale is that by understanding individuals' thought patterns and stages of development, managers and educational practitioners can better design activities and interventions which promote growth of the individual and add to the effectiveness of such processes as personnel supervision and evaluation.

Perhaps the most enthusiastic use of developmental theory has been in the classroom setting. Essentially, researchers and practitioners have used the theories to assess individuals, and subsequently design
classes and activities which promote development along the particular scheme. Knefelkamp, Widick, Parker (1978) reported use of the Perry scheme in designing instruction at the college level. These authors reported significantly higher levels of development among participants in classes structured using the Perry scheme, than in comparable classes using traditional methods of teaching. Additional studies have reported similar results in using developmental theory in the design and implementation of learning activities (see Stephenson and Hunt, 1977; Knefelkamp and Cornfield, 1977; Widick and Simpson, 1978). Knefelkamp and Slepitza (1976) designed career counseling courses using the Perry scheme as a basis. Knefelkamp, Widick and Stroad (1976) have also reported use of the Perry scheme in counseling situations. Tobin and Capie (1981) report that similar applications of Piaget's scheme of logical thinking can be achieved through the use of the Test of Logical Thinking (TOLT), stating that, "given the large numbers of students who are not operating formally and the potential for grouping, diagnostic pre-assessment seems a fruitful possibility." These classroom applications of developmental theory as diagnostic tool have the potential to add greater clarity to the teaching experiences in terms of activities and measured outcomes of the learning process.

A more recent application of developmental theory to the day-to-day management activities is conceptualized by Piper (1983) and Ricci (1983) at the Ohio State University. Essentially, these writers propose that developmental theory can be applied to the personnel supervision and evaluation process. More specifically, training sessions, evaluation forms, supervision interviews, and evaluation sessions are designed with
the developmental level of the individual in mind. It is projected that sensitivity to structuring these activities according to the individual's stage of development can promote developmental growth in the process of supervision and evaluation, and add to the overall efficiency and effectiveness of the organization by enhancing the communication process between supervisors and supervisees. While empirical evidence of the effectiveness of such an intervention is yet to be designed, these practitioners hope to undertake such studies in the near future.

In conclusion, developmental theories (particularly Perry and Piaget) seem to have been applied most frequently in classroom situations and other instructive activities. There is evidence of growing interest to apply the theories to other contexts (counseling, residence hall social systems management, personnel supervision, personnel evaluation). Application in these other contexts can only serve to clarify the utility of these concepts in educational practice, and in educational administration.

**Literature Directly Related to Theories in the Current Study**

This study selects two developmental constructs for further empirical study; logical thought development, and cognitive development. Each of these theories is described below in terms of constructs and current instrumentation techniques.
William Perry's Scheme of Intellectual and Ethical Development

In 1970, William Perry published his work, entitled *Forms of Intellectual and Ethical Development in the College Years: A Scheme*. Perry's description of the nine positions or stages of development was derived from interview data collected from college students spanning several age groups from freshmen to senior. The interview data was reviewed, and a scheme of development was described, based on the interview data. The scheme description was later tested for validity, as trained raters listened to transcripts of the interviews and assigned the data a rating based on Perry's description of the scheme. Sufficient interrater reliability was obtained to validate the observation of the developmental scheme in the data. This highly inductive process is typical of the methods used to surmise developmental schemes (see Kohlberg, 1981; King, 1977; Loevinger, 1976; Fowler, 1976).

Perry describes nine positions of development, which assume a Piagetian notion of structure. These positions of development are grouped in subsets (Dualism, Relativism, and Commitment) of three positions each, comprising structured filters for processing information. Taylor (1983) provides the following parsimonious description of the scheme described in Perry's original work.

**Dualism.** The first three positions are characterized by a dichotomous structure from which the world is viewed in absolute either-or terms. Truth is assumed to be known and information is processed to fall neatly into one of the two categories: right or wrong, good or bad, et cetera. The student perceiving the world from one of these structures views authority figures as the holders of truth from whom he must learn. Thus reliance on authority rather than one's own ideas is the order of the day in learning and decision-making.
Position One. Perry (1970) describes this position as a pure, closed structure. The world as seen from this structure is free of conflict since uncertainty is not perceived. Everything is absolute to the point of inability to imagine the existence of more than one answer to a question. Truth is accepted without question from the authorities, since they are always right.

Position Two. Diversity and alternate possibilities are recognized in this structure in a limited fashion. The truth still exists and is known to authorities. Two new twists appear, however. Authorities introduce uncertainty as a way of helping students learn to find the truth on their own. Perry (1970) notes that this uncertainty is seen as "temporary, good for the mind, resolvable and therefore ultimately unreal" (p. 78). Learning to find one's own answers is dealt with through a focus on quantity and hard work. Complexity as such also represents the freedom to explore in the process of acquiring the truth. A second change is that some authorities do not seem to know the answers, and in accord with the dualistic structure are categorized as wrong.

Position Three. The major discovery in this position is that some truth is not known at present, even to authorities. Uncertainty is more uncomfortable since it cannot be immediately resolved by appeal to authority. Confusion over evaluation of work arises since authorities cannot be expected to know the answers in all areas. In the attempt to relieve anxiety the student focuses on quantity of work and holds tightly to the notion that the authority will lead the way to finding the truth in the future.

Relativism. Position Four, Five and Six represent a view of knowledge as relative. The dualistic structure is discarded in favor of recognition of numerous possibilities. Uncertainty replaces absolutism as the order of the day. This change releases authority from its previous all-knowing position and elevates the student's ideas to an equal status. The search for absolute right answers is abandoned as the structure calls for a variety of answers dependent on the context.

Position Four. Position Four represents the beginning of the shift from uncertainty as the way reality is perceived. Some truth remains in limited areas. For the most part, there are no answers and no criteria with which to distinguish one opinion from another. Learning focuses on thinking about thinking, or practicing the way the authorities want us to think with their guidance.

Position Five. All knowledge is now viewed as relative and contextual. Opinions can be judged better or worse depending on the existence of supportive evidence. Authorities are redefined as those who have experience and competence in groping for the truth in a given context. Introspection and detachment are possible for the first time. The ability to evaluate and subsequently choose creates the fear of narrowing one's options.

Position Six. The acceptance of a truly relativistic world in which infinite contexts exist is accompanied by the realization that choosing is essential to avoid disorientation. One must affirm one's identity through establishing a context in which to
invest oneself. The Position Six individual recognizes this need for commitment but has not yet acted on it.

**Commitment in Relativism.** Positions Seven, Eight and Nine do not represent restructuring as do the previous positions. They are characterized by the development of commitments. The individual takes responsibility for making choices and affirming his or her identity in numerous contexts or areas of life. Perry notes that this process addresses both the content and style of identity.

**Position Seven.** Position Seven marks the point of initial commitment in some aspect of life such as career, relationships, or values. The commitment is an examined act, presupposing a genuine exploration of alternatives. Commitment is initially viewed as a settling act, restoring some order to one's life.

**Position Eight.** Position Eight is accompanied by the emergence of additional choices regarding how to carry out initial commitments. The major focus is on the style with which to implement the commitments as well as the issue of responsibility. The recognition of the infinite nature of choosing comes with the acceptance of relativism in its fullest sense.

**Position Nine.** This constitutes an integration of commitments and one's lifestyle as determined by implementation of commitments. Commitment is recognized as an ongoing activity, never to be settled in a final sense. (p. 15-18).

**Instrumentation for the Perry Scheme**

It was noted earlier that use of any theory in research and intervention must be accompanied by efficient, reliable, and valid instrumentation methods. The original assessment instrument for the Perry scheme was developed by Knefelkamp and Widick (1976), and consisted of a number of sentence stems, and two essay questions. Respondents were asked to write answers to the questions, and trained raters then rated the materials based on the description of the Perry scheme. Other instruments of similar format and rating system were developed by Knefelkamp and Slepitz (1976); Mentkowski, Moeser and Strait (1981); and Zachary (1982). A difficulty with each of these instrumentation procedures has been the lack of a manual for raters which clearly explicates the criteria upon which one rates protocols, and assigns a position of development.
In 1981, the current author and Taylor (1983), set out to develop an instrument which would improve rating on the Perry scheme. Essentially, the instrument, called the Measure of Epistemological Reflection (MER), consists of six sets of questions. Each set of questions focuses the respondent on a particular domain or aspect of development (role of peers in learning process, role of instructor in learning process, role of evaluation in the learning process, nature of truth, decision making, and ideal learning situations). Respondents answer a series of questions under each of these domains, designed to ascertain the reasoning structure as defined by Perry (1970). Raters then use a rating manual to compare responses with responses which are indicative of each of the first five positions. Protocols (six sets of questions per respondent) are assigned a score (1 to 5) which is indicative of the primary position or mode of reasoning.

The MER has been administered to four samples totalling 621 subjects across various educational experience levels. Reliability for the instrument was determined through an examination of interrater agreement. Two independent raters scored the data using a rating manual (Taylor and Porterfield, 1982, 1983). Interrater agreement on total protocol ratings ranged from 59.5% on the original sample to 74.4% on the four samples used for reliability and validity studies. Correlation coefficients for interrater agreement on the total sample was .79 ($p < .0001$) (Taylor and Porterfield, 1984). Internal consistency for the instrument was examined through the use of Cronbach's alpha, which assessed the degree to which ratings in one domain were consistent with total protocol ratings across subjects. The coefficient ranged from .60
to .76 for individual samples, and was .74 for all samples. Validity of the instrument was tested through an analysis of variance by level of education. Statistics on the validity test indicated significant differences by educational level ($p < .0001$). Thus, reliability, internal consistency and validity statistics indicate that the Measure of Epistemological Reflection provides a reasonable and accurate assessment for the Perry scheme of cognitive development.

Jean Piaget and the Development of Logical Thought

Jean Piaget spent most of his life studying the mental development of the human organism. As noted earlier, Piaget's theorizing in the area of intellectual development set the stage for much of the work currently known as "developmental psychology". Piaget's primary interest was the development of intelligence, and he set about studying and theorizing about intelligence in countless experiments, subsequently publishing numerous books on both his theory of cognitive development and his experiments (1926, 1928, 1930, 1932, 1954, 1970, etc.). It was Piaget who asserted that cognitive and intellectual changes occur in a developmental sequence, where internalized schemata for processing experiences are broadened to incorporate increasingly complex thought processes. The notions of equilibration, assimilation, and accommodation are a major theoretical contribution from Piaget's work.

In 1963, in *The Psychology of Intelligence*, Piaget outlined four stages of cognitive development, or logical thought development. In the initial stage of development, sensori-motor intelligence, the individual's behavior is primarily motor. The child (0-2 years old)
does not think conceptually (Wadsworth, 1968). Pre-operational thought (2-7 years) is a period in which language develops, and the child begins to think conceptually. Concrete operational thought marks the first time in which the child (7-11 years) begins to apply logical thought to concrete problems. A final period, or stage of development, is that of formal operational thought (11-15 years). It is at this stage that the individual begins to apply logic to various contexts of problems. Even though age ranges are given for each of the levels of development, subsequent studies have noted that much of the adult population falls within concrete or formal operational reasoning structures. King (1984) notes, in a review of literature and studies on formal operational thought in adults, that "it is apparent...that a rather large proportion of adults do not evidence formal thinking, even among those who have been enrolled in college." (p. 10-11).

Instrumentation for Piaget's Stages of Development

To derive, and later test, this theory of cognitive development, Piaget devised a number of actual tests (Piaget, 1963; Inhelder and Piaget, 1958). These tests were both time consuming, and difficult to administer, in that they required equipment, a trained technician, and an interview with each subject. Respondents were taken through a series of logical tests, to clarify their respective level of cognitive abilities. Inhelder and Piaget (1958) described fifteen tasks which could be used to assess formal operational thinking abilities. King (1984) reports that different studies have traditionally used different combinations of these tasks to assess formal reasoning abilities.
The work of Tobin and Caple (1981) represents an attempt to establish a reliable and valid pencil and paper measure of operational thought that can be group administered. Tobin and Caple (1981) note that, "Two important trends that have emerged from research are that many adolescents and adults are limited in their ability to use formal modes of reasoning and that formal reasoning ability is an important mediator of cognitive achievement (e.g., Cantu and Herron, 1978; Goodstein and Howe, 1978)." Based on this research need, these two individuals set out to establish a measure of formal reasoning which would be both reliable, and valid for group administration. The Test of Logical Thinking (TOLT) requires respondents to solve a number of problems, similar to those used by Inhelder and Piaget (1958), and to produce a justification for the solution to each problem. A scoring procedure then allows raters to determine the relative degree to which the individual is using formal reasoning. Validity and reliability data reported in Tobin and Caple (1981) indicate that the instrument does provide a good measure of formal reasoning ability, and therefore, the TOLT was employed in the current study as the measure of formal thought.

Copes and the Necessity to Consider Perry and Piaget

Since the work of Piaget stands as the basis for much of the subsequent studies of development, it is important to use Piaget's work as a standard of measure for other developmental theories. In other words, how do other aspects of development correlate with the formal reasoning abilities of the individual? This work is essential to our further understanding the correlations between aspects of development,
but is impeded by the lack of sufficient reliable and valid instrumentation for many of the theories. The development of reliable and valid measures for Perry's scheme, and for Piaget's formal thought levels now makes such a study possible.

Copes (1982) notes that "in rereading the literature that deals with both Piaget and Perry, I am struck by the fact that all but one writer assumes that the development Perry describes takes place within and beyond the formal operational period." Perry claims that his own work is an extension of Piaget's formal operational thought. Clearly this question can be addressed through an empirical study such as the present one, where the researcher attempts to ascertain more clearly whether certain of Perry positions are preceded by, followed by, or simultaneous with the acquisition of formal operational thought structures. In other words, are the correlations between these two constructs similar across all educational levels?

Copes also notes that Allen (1982) conducted a study at West Virginia University in an attempt to answer this question. It is the only other study where this research question has been addressed explicitly. Allen found no significant correlations between cognitive development and Piagetian reasoning. However, the study is yet unpublished. The Allen (1983) study involved a very limited number of subjects, and thus is questionable on methodological grounds.
The research question in this particular study is; what is the relationship between cognitive development and logical thought, and how does this relationship change over the course of educational experience? Two measures were used to collect appropriate data for this inquiry. The Measure of Epistemological Reflection (MER) (Taylor and Porterfield, 1982) was used to ascertain individual levels of cognitive development as defined by William Perry (1970, 1981). The Test of Logical Thinking (Tobin and Capie, 1981) was used to ascertain individual levels of logical thought as defined by Piaget (1963).

There were no independent and dependent variables. The purpose of correlational research is to determine statistical relationships which can be inferred from theoretical foundations. The particular variables involved in the study are neither independent nor dependent inasmuch as the research question involves an investigation of the relationship between several variables. The variables under consideration are educational experience level, cognitive development level, logical thinking level and gender.
The Sample

The subjects for this study were solicited from the student population at the Ohio State University. Subjects were randomly selected from the following educational experience levels: freshmen, seniors, graduate (masters and doctoral) rankings. Rankings were determined from the paid fee listing published by the Office of Registration Services at the Ohio State University. Fifty subjects were solicited from each educational experience level. Such a sampling accomplished two important foundations for this study. First, participants randomly selected assure that the sample drawn is representative of the population at Ohio State University. Second, by drawing the sample from three different educational levels, the major research question will be addressed more systematically. A description of the total sample is given in Table 1.

Instrumentation

Subjects who were randomly selected by the process outlined above were telephoned to solicit their participation. The study was briefly explained including purpose, time commitment, mailing procedures, and any questions the prospective subject had about the study were answered. Those persons indicating a willingness to participate in the study were mailed a cover letter (appendix C), consent forms (appendix D), the Measure of Epistemological Reflection (appendix A), the Test of Logical Thinking and answer sheet (appendix B), and a return envelope stamped with the investigator's campus mailing address.
Subjects were asked to return completed instruments in the return envelope to the investigator within ten days of their receipt. Follow up calls were done to subjects who had not returned the packets within fifteen days of the initial phone contact. The current researcher targeted at least thirty subjects in each educational experience level. This target ensured that meaningful statistical comparisons could be made between groups without violations to the mathematical constructs underlying the analysis of variance procedures (Kennedy, 1977). The sample for this study, then, represents complete randomization, except for the freshman sample. In order to complete the freshman sample, approximately half of the subjects were solicited from students enrolled in an introductory psychology course at The Ohio State University. Students completed the instruments for the study as a part of a course requirement to participate in research. While these subjects were not selected in the same manner as other subjects, it was felt that these students were representative of the freshman class since the introductory psychology courses consist of subgroups of the total freshman population at Ohio State University.

All instruments were assigned a code number and names were removed to assure anonymity of subjects. All data are reported as group data, to insure that no individual could be identified through the results section of the study.

The Instruments and Scoring

The MER was developed by the current author and Taylor (1982). The instrument consists of six sets of questions which probe six cognitive
domains of the subject (Taylor and Porterfield, 1984). Each set of questions probes a particular cognitive domain. Scores were computed through a rating system which uses a manual of comparison data (Taylor and Porterfield, 1984). Each set of six questions was rated independently by two raters, who then met to discuss any disagreements over ratings. After this compromise rating session, each protocol or instrument was assigned a Total Protocol Rating. This rating can range from one (1) to five (5), indicating overall cognitive developmental level of the subject (see earlier description of the Perry scheme). Reliability and validity data for the MER was discussed earlier. For more details on the MER see Taylor and Porterfield (1984).

The TOLT was developed by Tobin and Capie (1980). The instrument consists of ten problems which the subject is asked to solve. Each problem is followed by a list of answers. The subject selects the answer he or she believes correct, and then selects the best reason for the answer from a list of reasons provided. Scores on the TOLT range from zero (0) to ten (10). The higher the individual score, the higher the development of logical thinking ability or formal operations (Piaget, 1963; Tobin and Capie, 1980). The investigator scored the TOLT using a scoring key provided by the authors of the instrument. Validity and reliability data for the TOLT were discussed earlier. Additional information can be found in Tobin and Capie (1980).

Hypotheses and Analysis of Data

Seven hypotheses were generated under the overarching research question stated earlier. Below, each hypothesis is stated in the null
format (Kennedy, 1977). Following each hypothesis is a statement of the projected results based on the theoretical foundations, and the statistical analysis which was performed on the data. The analysis of variance and the Pearson-product-moment correlation statistic were the two primary statistical methods employed. The analysis of variance is designed to determine, through statistical measurement, whether differences between groups can be attributed to chance, or whether differences might be attributable to a particular variable(s) under study. An indication of significant differences in the analysis of variance was followed by additional statistical tests (Student Newman-Keuls and Scheffe) to determine where differences actually existed, and which variable(s) seemed to be more closely related to the variance in group scores. Appropriate follow up tests were determined after all data were collected, since follow up tests vary according to actual data cell size. The Statistical Analysis System was used to analyze the data, using an analysis of variance package.

Null hypothesis number one: There will be no significant differences in cognitive development scores across educational levels.

Theoretically, this null hypothesis was expected to be rejected based upon the data collected. Perry (1970) and Taylor (1983) note changes in students' cognitive development across various educational experience levels. A two-way analysis of variance was used to determine empirical differences across the three educational experience levels. It was expected that freshmen would have the lowest cognitive
developmental level as a group, followed by seniors and graduate students, respectively.

The analysis of variance was used to determine group means for scores on the MER, and to determine whether variances in scores were statistically greater than those variances which might otherwise accrue to chance. The analysis of variance was used as a superior method to multiple t-test comparisons (Kennedy, 1977).

Differences in scores across groups would indicate, and confirm, that cognitive development does occur in the sequential manner across educational experience level as originally described by Perry (1970).

Null hypothesis number two: There will be no significant differences in logical thinking ability across educational experience levels.

Theoretically, this null hypothesis was expected to be rejected based upon the data. Piaget (1963) and Tobin and Caple (1980) note progressive increases in logical thinking ability across educational experience levels. As with the MER, differences in group means can be plotted graphically to more clearly indicate the development of logical thinking ability across levels of education. Again, it was expected that freshmen would have the lowest logical thinking ability, although differences would not be as sharp as those found in cognitive development.

A two-way analysis of variance was performed on the data to determine the amount of variance due to chance, and that due to actual differences in groups.
Null hypothesis number three: There will be no significant differences in cognitive development scores between males and females.

Theoretically, this null hypothesis was expected to be accepted based on the data. Since cognitive development theory assumes "universal" structures, sex differences would not be expected in the data. Nevertheless, it was important to test such an hypothesis given that this study was grounded in the context of exploratory research, and given that improved measurement with the Perry scheme could reveal sex differences heretofore undetected.

A two-way analysis of variance was performed on the total sample to ascertain whether sex differences were statistically significant.

Null hypothesis number four: There will be no significant differences in logical thinking ability between males and females.

Theoretically, this null hypothesis was expected to be accepted based on the data. Logical thinking is defined as a developmental construct (Piaget, 1963), and therefore it was expected that logical thinking development would not be affected by the sex variable.

A two-way analysis of variance was performed to ascertain whether there were differences between groups in logical thinking ability by sex.

Null hypothesis number five: There will be no correlation between cognitive development scores and logical thinking scores.

Theoretically, this null hypothesis was expected to be rejected based upon the data. Both Piaget (1963) and Perry (1970) use
developmental assumptions to define particular aspects of human development. In this study, the investigator was attempting to ascertain the relationship between these two constructs. More specifically, does correlation analysis of the data indicate that logical thinking is positively correlated to one stage of cognitive development more than others.

In any case of conjecture (logical thought more positively related to one stage of cognitive development than another), it was projected that the overall correlation between the scores would be moderate to high in a positive direction ($r = .60 - 1.00$).

Null hypothesis number six: There will be no significant differences in the correlations of cognitive development and logical thinking across educational experience levels.

Theoretically, this hypothesis was expected to be accepted. Since both theories under study are developmental, it was expected that the correlations between scores by educational level would not vary significantly. A Pearson-product-moment correlation was performed by educational experience level. These group correlation statistics were compared for variance.

The purpose of the study was to more clearly indicate the relationship of the two constructs across educational experience levels. Although one might expect no significant differences in correlations across educational experience levels given the nature of the two theories under study, lack of previous empirical evidence surrounding served to highlight interest in this particular
hypothesis. Other research designs will assist in answering questions about any causative effects between logical thinking and cognitive development.

Null hypothesis number seven: There will be no significant differences in the correlations of cognitive development scores and logical thinking scores between males and females.

Theoretically, this null hypothesis was expected to be accepted based upon the data. As stated previously, sex differences are not a part of the theoretical assumptions of either cognitive development or logical thinking. It was important, however, to test for such differences in early correlational research. This need was highlighted by the relatively recent emergence of both theories.

Pearson-product-moment correlations were performed by sex to determine acceptance or rejection of this hypothesis.

SUMMARY

The major research question was the relationship between logical thinking and cognitive development over the course of educational experience. Seven research hypotheses were explicated to assist in answering the major research question. Data from this study were analyzed and graphed to provide better information on the relationship between these two developmental constructs.

The results of this study may be used to better inform at least three groups. First, the results may better inform developmental theorists in their understanding of whether logical thinking presupposes
cognitive development, vice versa, or whether the two constructs develop parallel to one another within the organism. Second, the results may be useful to college instructors as they attempt to design classroom experiences which more closely account for differences in cognitive development and logical thinking ability among groups of students. Third, the results may be useful to educational administrators, particularly student personnel administrators, as they design programs and interventions based on developmental theory, and as they manage organizations comprised of students of several educational experience levels.
CHAPTER FOUR

RESULTS

The research question in this study was the nature of the relationship between logical thinking and cognitive development across educational experience levels. To that end, seven null research hypotheses were stated in Chapter Three. The presentation of results in this chapter is organized around the seven research hypotheses.

Preliminary Notes on the Measure of Epistemological Reflection

It was noted earlier that the MER represents a recent attempt to establish valid and reliable instrumentation for the Perry (1970) scheme of intellectual and ethical development. Results of validation studies for the MER involving 621 subjects were presented in Chapter Three. Given the instrument is a relatively new development in the field of cognitive assessment, statistical operations were performed on the current data to determine the stability of the instrument compared to previous studies.

Interrater reliability is of primary concern in the assessment of cognitive structures. Essentially, interrater reliability tests the degree to which two or more independent raters are assigning data to the same theoretical categories. In the case of the MER, two raters rated all data independently and then compared ratings to determine levels of
TABLE 1

Description of the Sample

<table>
<thead>
<tr>
<th></th>
<th>Number solicited</th>
<th>Number received</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MALES</td>
<td>FEMALES</td>
<td>MALES</td>
</tr>
<tr>
<td>Freshmen</td>
<td>17</td>
<td>17</td>
<td>4,16*</td>
</tr>
<tr>
<td>Seniors</td>
<td>23</td>
<td>28</td>
<td>16</td>
</tr>
<tr>
<td>Graduate students</td>
<td>21</td>
<td>14</td>
<td>20</td>
</tr>
<tr>
<td>TOTALS</td>
<td>61</td>
<td>59</td>
<td>56</td>
</tr>
</tbody>
</table>

* 16 males volunteered to participate in this study as a part of an introductory psychology course requirement.
### TABLE 2

Percentage Agreement Between Raters for Domain and Total Protocol Ratings

<table>
<thead>
<tr>
<th>Domains</th>
<th>N</th>
<th>Exact Agreement</th>
<th>Within One Position</th>
<th>Cumulative Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td>95</td>
<td>46.31</td>
<td>34.73</td>
<td>81.05</td>
</tr>
<tr>
<td>Two</td>
<td>95</td>
<td>69.47</td>
<td>16.84</td>
<td>86.31</td>
</tr>
<tr>
<td>Three</td>
<td>95</td>
<td>64.21</td>
<td>33.68</td>
<td>97.89</td>
</tr>
<tr>
<td>Four</td>
<td>95</td>
<td>62.10</td>
<td>29.47</td>
<td>91.57</td>
</tr>
<tr>
<td>Five</td>
<td>95</td>
<td>56.84</td>
<td>30.52</td>
<td>87.36</td>
</tr>
<tr>
<td>Six</td>
<td>95</td>
<td>54.73</td>
<td>29.47</td>
<td>84.21</td>
</tr>
<tr>
<td>Total Protocol*</td>
<td>95</td>
<td>60.00</td>
<td>38.94</td>
<td>98.94</td>
</tr>
</tbody>
</table>

*Pearson r between Rater 1 and Rater 2 on compromise total protocol ratings = .7263 (p < .0001).
### TABLE 3

Cronbach's Alpha Coefficients of MER Scores by Educational Level and Sex

<table>
<thead>
<tr>
<th>Level of Education/Sex</th>
<th>N</th>
<th>Alpha Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshmen</td>
<td>35</td>
<td>.1286</td>
</tr>
<tr>
<td>Seniors</td>
<td>28</td>
<td>.5986</td>
</tr>
<tr>
<td>Graduate students</td>
<td>32</td>
<td>.6798</td>
</tr>
<tr>
<td>Males</td>
<td>56</td>
<td>.5550</td>
</tr>
<tr>
<td>Females</td>
<td>39</td>
<td>.7131</td>
</tr>
</tbody>
</table>

| Total Sample           | 95  | .6390             |
Interrater reliability. Discrepant ratings were discussed, and a compromise domain and total protocol rating was determined for each protocol.

The most rigorous measure for interrater agreement on the MER is a comparison of the domain ratings assigned within a protocol. Each protocol receives six domain ratings, from which a total protocol rating is calculated. Domain ratings were compared through percentage of exact agreement and within one position agreement. Exact agreement between the two raters for this sample ranged from 46.31% on domain one to 69.47% agreement on domain two. Within one position agreement ranged from 16.84% on domain two to 34.73% on domain one. Cumulative agreements (exact agreement and within one stage agreement) ranged from 81.05% on domain one to 97.89% on domain three. This percentage of agreement was comparable, and in some cases, higher than agreement achieved in previous studies. A complete listing of percentages is contained in Table 2.

Aside from interrater agreement on domain ratings, total protocol ratings were also compared for these data. Exact agreement on total protocol ratings between the two raters was 60%, within one position agreement was 38.94% and the cumulative agreement was 98.94%. Correlation coefficients between the two raters for this set of data was .7263 ($p < .0001$). Comparing these data with data from the previous studies using the MER, it was felt that the instrument and the manual yielded reasonable interrater reliability for the current study.

In addition to interrater reliability, Cronbach's alpha was used to determine the internal consistency of the instrument for the data in
this study. The compromise total protocol ratings were used to
determine Cronbach's alpha. Cronbach's alpha measures internal
consistency through an examination of the variance on domain scores in
comparison to the variance of the overall scores (Taylor, 1983). For
this set of data, Cronbach's alpha was .6390. While Cronbach's alpha
for previous studies ranged in the sixties and seventies, it was felt
that .6390 was within acceptable range compared to other studies. The
alpha was also computed for subgroups within the entire data set.
Results of these computations are contained in Table 3.

Overall, the H E R  demonstrated reasonable interrater reliability and
internal consistency for this particular study in comparison to other
studies using the instrument.

Null hypothesis one: There will be no significant differences in
cognitive development scores across educational levels.

To test this hypothesis, a two-way analysis of variance was
performed on the data. Table 4 contains the results of this analysis.
The analysis of variance indicated significant differences (p < .0001)
associated with educational levels. Scheffe multiple comparison tests
(Kennedy, 1977) were then performed to determine where significant
differences actually existed. The Scheffe method of multiple
comparisons is more rigorous than other procedures (Ferguson, 1976).
The Scheffe test indicated that means of H E R  scores were in the
predicted direction, freshmen had the lowest mean, followed by seniors
and graduate students. Additionally, graduate student scores were found
to be significantly different from freshmen or seniors.
### TABLE 4
Two-Way Analysis of Variance of MER Scores
Educational Level, Sex and Interaction Effects

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>df</th>
<th>SS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educational level</td>
<td>2</td>
<td>10.3702</td>
<td>14.37</td>
<td>.0001</td>
</tr>
<tr>
<td>Sex</td>
<td>1</td>
<td>0.9809</td>
<td>2.72</td>
<td>.1027</td>
</tr>
<tr>
<td>Level*Sex</td>
<td>2</td>
<td>0.6278</td>
<td>0.87</td>
<td>.4224</td>
</tr>
</tbody>
</table>

N=95

### TABLE 5
Scheffe Comparisons of MER Scores By Educational Level

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshmen</td>
<td>35</td>
<td>2.4052</td>
</tr>
<tr>
<td>Seniors</td>
<td>28</td>
<td>2.7667</td>
</tr>
<tr>
<td>Graduate students</td>
<td>32</td>
<td>3.1927*</td>
</tr>
</tbody>
</table>

* Graduate student scores determined to be significantly different from freshmen and seniors when alpha = .05.
### TABLE 6
Student Newman-Keuls Comparisons of MER Scores By Educational Level

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshmen</td>
<td>35</td>
<td>2.4052*</td>
</tr>
<tr>
<td>Seniors</td>
<td>28</td>
<td>2.7667*</td>
</tr>
<tr>
<td>Graduate students</td>
<td>32</td>
<td>3.1927*</td>
</tr>
</tbody>
</table>

* All groups are found to be significantly different when alpha = .05.

### TABLE 7
Scheffe Comparisons of MER Scores By Sex

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>56</td>
<td>2.7051</td>
</tr>
<tr>
<td>Females</td>
<td>39</td>
<td>2.8803</td>
</tr>
</tbody>
</table>

* No significant differences were found when alpha = .05.
A Student Newman-Keuls multiple comparison was also performed on the data. The Student Newman-Keuls comparisons is based on equal numbers in each data cell. In this case, data cells were slightly unequal. Again, means were in the expected order for rejection of the null hypothesis. Additionally, all groups were found to be significantly different when the alpha level was set at .05. Therefore, statistical analysis of the data lead to rejection of null hypothesis one. The complete analysis of variance information is contained in Table 4. The Scheffe and Student Newman-Keuls comparisons are contained in Tables 5 and 6 respectively.

**Null hypothesis two:** There will be no significant differences in logical thinking ability across educational experience levels.

To test this hypothesis, a two-way analysis of variance was performed on the data. Table 8 contains complete information on the statistical tests. For the TOLT scores, significant differences were found to be associated with educational experience levels ($p < .0007$). The Scheffe test for multiple comparisons was performed to determine where the differences actually existed. As with the MER scores, TOLT means for each group were in the expected ascending order of freshmen, seniors and graduate students. The Scheffe test ($\alpha = .05$) indicated that the freshman sample was significantly different from the senior and graduate student samples. The Student Newman-Keuls was also performed, and indicated similar differences. Again, caution is given that data cell sizes were not equal, a condition for use of the Student Newman-Keuls.
Based on statistical analysis, null hypothesis two was rejected. However, a note on the scoring algorithm for this instrument is necessary. Although means were in the expected sequence, and significant differences existed between groups, the scores from the instrument indicated that formal operational thought is already accomplished for most of the entire sample (N=95). Gibbs (1983) notes that a score of 0-1 indicates no formal reasoning ability, 2-3 indicates transitional reasoning, and a score of 4 or more indicates the acquisition of formal reasoning ability. This particular point is discussed in more depth in Chapter Five.

**Null hypothesis three:** There will be no significant differences in cognitive development scores between males and females.

To test this hypothesis, a two-way analysis of variance was performed on the data. The analysis of variance indicated no significant differences between males and females. The Scheffe multiple comparison test confirmed that scores did not vary significantly across the sex variable. Thus, null hypothesis three was accepted. More detailed information is contained in Tables 4 and 7.

**Null hypothesis four:** There will be no significant differences in logical thinking ability between males and females.

The two-way analysis of variance test performed on the TOLT scores indicated no significant variance in scores between males and females ($p < .2483$). The Scheffe multiple comparison test confirmed that there
### TABLE 8

Two-Way Analysis of Variance of TOLT Scores
Educational Level, Sex and Interaction Effects

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>df</th>
<th>SS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educational Level</td>
<td>2</td>
<td>57.9350</td>
<td>7.94</td>
<td>.0007</td>
</tr>
<tr>
<td>Sex</td>
<td>1</td>
<td>4.9235</td>
<td>1.35</td>
<td>.2483</td>
</tr>
<tr>
<td>Level*Sex</td>
<td>2</td>
<td>8.3975</td>
<td>1.15</td>
<td>.3208</td>
</tr>
</tbody>
</table>

N=95

### TABLE 9

Scheffe Comparisons of TOLT Scores By Educational Level

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshmen</td>
<td>35</td>
<td>6.7714*</td>
</tr>
<tr>
<td>Seniors</td>
<td>28</td>
<td>8.2857</td>
</tr>
<tr>
<td>Graduate students</td>
<td>32</td>
<td>8.4688</td>
</tr>
</tbody>
</table>

* Freshmen student scores are significantly different from seniors or graduate students when alpha = .05
were not significant differences between males and females on the TOLT. Thus, null hypothesis four was accepted. More detailed information is contained in Tables 8 and 10.

Null hypothesis five: There will be no correlation between cognitive development scores and logical thinking scores.

A Pearson product moment correlation was performed between compromise total protocol ratings on the MER and raw scores on the TOLT. In Chapter Three, theoretical projections had indicated that this hypothesis might be rejected, and that correlations would be in a positive direction \( r = .60-1.00 \). However, the overall correlation \( (N=95) \) indicated a relatively low coefficient, \( r = .1620 \). This correlation must be examined in light of the earlier point that scores on the TOLT indicated that only a minority of subjects had not achieved formal operational thought structures. Thus, on the basis of former projections, this null hypothesis was accepted. A more detailed discussion of the interpretation of these data is found in Chapter Five.

Null hypothesis six: There will be no significant differences in correlations of cognitive development and logical thinking across educational levels.

Correlation coefficients between the MER and the TOLT were determined for each educational grouping in the sample. Beginning with the freshman sample correlations were .0760, -.0864 and -.0265 respectively for seniors and graduate students. These correlations were not significant inasmuch as \( p < .6643, .6619 \) and .8855 respectively.
### TABLE 10

Scheffe Comparisons of TOLT Scores By Sex

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>56</td>
<td>8.0000</td>
</tr>
<tr>
<td>Females</td>
<td>39</td>
<td>7.4872</td>
</tr>
</tbody>
</table>

* No significant differences in scores when alpha = .05

### TABLE 11

Student Newman-Keuls Comparisons of TOLT Scores by Educational Levels

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshmen</td>
<td>35</td>
<td>6.7714*</td>
</tr>
<tr>
<td>Seniors</td>
<td>28</td>
<td>8.2857</td>
</tr>
<tr>
<td>Graduate students</td>
<td>32</td>
<td>8.4688</td>
</tr>
</tbody>
</table>

* Freshmen student scores are found to be significantly different from seniors or graduate students when alpha = .05.
TABLE 12

Correlation Coefficients of TOLT and MER Scores
By Educational Level, By Sex

<table>
<thead>
<tr>
<th>Educational Level/Sex</th>
<th>N</th>
<th>r</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshmen</td>
<td>35</td>
<td>.0760</td>
<td>.6643</td>
</tr>
<tr>
<td>Seniors</td>
<td>28</td>
<td>-.0864</td>
<td>.6617</td>
</tr>
<tr>
<td>Graduate students</td>
<td>32</td>
<td>-.0265</td>
<td>.8855</td>
</tr>
<tr>
<td>Males</td>
<td>56</td>
<td>.1369</td>
<td>.3142</td>
</tr>
<tr>
<td>Females</td>
<td>39</td>
<td>.2269</td>
<td>.1648</td>
</tr>
<tr>
<td>Overall</td>
<td>95</td>
<td>.1620</td>
<td>.1166</td>
</tr>
</tbody>
</table>
Table 12 contains a full listing of correlation coefficients across sex and educational levels. Based on these data, null hypothesis six was accepted.

**Null hypothesis seven:** There will be no significant differences in the correlations of cognitive development scores and logical thinking scores between males and females.

Correlation coefficients between the MER and the TOLT were also compared across sexes. As with educational level, correlations were not in the expected range. For males, the correlation coefficient was .1369 ($p < .3142$) and for females the coefficient was .2269 ($p < .1648$). Null hypothesis seven, therefore, was accepted.

**Limitations and Cautions**

There are a number of limitations and cautions which must be considered when interpreting these data. First, the freshman sample was selected differently from the remaining two samples. The freshman sample contained 16 males who were volunteered to participate in the study as a part of an introductory psychology course at the Ohio State University. Other subjects were randomly selected from the Ohio State University student population. Although it was not felt that this sampling deviation was significant enough to violate sampling norms, it is nevertheless a consideration for further study in this area. Additionally, optimal data cell sizes would have been larger than those in this study. While these limitations and cautions do not seem to be particularly grave with respect to interpreting results, they stand,
nevertheless, as reasonable considerations for replication studies which might occur in the future.

Additionally, the experimenter did not have full control of the conditions under which participants completed the instruments. While there is no theoretical basis for believing that this lack of control could have affected scores significantly, it is, nevertheless an important consideration for future research. While both the instruments used in the study have been validated previously, the results are also limited with respect to the instruments themselves.

In summary, the most obvious limitations of the current study are in data cell size, experimental control and instrumentation methods. Future researchers in this area might observe these cautions as attempts are made to build upon the current design and methodology.

SUMMARY

It is important to point out that this research was exploratory. Therefore, although seven hypotheses were designed for testing, the results must be taken collectively to answer the research question. Apparently, this sample of students did vary significantly across educational experience levels with respect to both cognitive development scores and logical thinking scores. Means of scores were in a progressive order for both tests with freshmen having the lowest overall mean and graduate students having the highest mean. Differences according to sex were not found in these data. Although samples scored progressively higher on the TOLT across educational experience levels, raw scores indicated that all but a very small minority of subjects had
acquired formal operational thought structures regardless of scores on the MER. Correlation coefficients across sexes and educational levels appear to be in line with this explanation. Therefore, based on the collective data, it appears that cognitive development, as defined by Perry (1970), follows the development of formal operational thought. This relationship is plotted graphically in Figure 1 with the respective mean scores of each test across educational levels.

The null hypotheses are listed below in summary of the research findings:

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Accepted or rejected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypothesis One: No significant differences in cognitive development scores by education.</td>
<td>rejected</td>
</tr>
<tr>
<td>Hypothesis Two: No significant differences in logical thinking scores by education.</td>
<td>rejected</td>
</tr>
<tr>
<td>Hypothesis Three: No significant differences in cognitive development between males and females.</td>
<td>accepted</td>
</tr>
<tr>
<td>Hypothesis Four: No significant differences in logical thinking ability between males and females.</td>
<td>accepted</td>
</tr>
<tr>
<td>Hypothesis Five: No correlation between cognitive development and logical thinking.</td>
<td>accepted</td>
</tr>
</tbody>
</table>
Hypothesis Six: No significant differences in accepted correlations across educational levels.

Hypothesis Seven: No significant differences in accepted correlations between males and females.
### TABLE 13

Means, Standard Deviations and Variance of MER Scores
By Sex and Educational Level

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>56</td>
<td>2.71</td>
<td>.61</td>
<td>.37</td>
</tr>
<tr>
<td>Females</td>
<td>39</td>
<td>2.88</td>
<td>.78</td>
<td>.61</td>
</tr>
<tr>
<td>Freshmen</td>
<td>35</td>
<td>2.41</td>
<td>.42</td>
<td>.17</td>
</tr>
<tr>
<td>Seniors</td>
<td>28</td>
<td>2.77</td>
<td>.57</td>
<td>.32</td>
</tr>
<tr>
<td>Graduate students</td>
<td>32</td>
<td>3.19</td>
<td>.78</td>
<td>.62</td>
</tr>
<tr>
<td>Total sample</td>
<td>95</td>
<td>2.78</td>
<td>.68</td>
<td>.47</td>
</tr>
</tbody>
</table>

### TABLE 14

Means, Standard Deviations and Variance of TOLT Scores
By Sex and Educational Level

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>56</td>
<td>8.00</td>
<td>1.97</td>
<td>3.89</td>
</tr>
<tr>
<td>Females</td>
<td>39</td>
<td>7.49</td>
<td>2.15</td>
<td>4.62</td>
</tr>
<tr>
<td>Freshmen</td>
<td>35</td>
<td>6.77</td>
<td>2.35</td>
<td>5.53</td>
</tr>
<tr>
<td>Seniors</td>
<td>28</td>
<td>8.29</td>
<td>1.76</td>
<td>3.10</td>
</tr>
<tr>
<td>Graduate students</td>
<td>32</td>
<td>8.47</td>
<td>1.46</td>
<td>2.13</td>
</tr>
<tr>
<td>Total sample</td>
<td>95</td>
<td>7.79</td>
<td>2.05</td>
<td>4.21</td>
</tr>
</tbody>
</table>
Figure One

MEAN SCORES OF THE TOLT AND MER ACROSS EDUCATIONAL EXPERIENCE LEVEL
The purpose of this study has been to determine the nature of the relationship between cognitive development and formal operational thought across the college educational experience. In light of this question, seven research hypotheses were generated and tested. It was noted in Chapter Three that the results of this study could be potentially useful to researchers in human development theory, university instructors and educational administrators. In this chapter, each of these areas will be discussed relative to the results of the research noted in Chapter Four. The format will be as follows: review of the results, results relative to logical thinking in college students, results relative to cognitive development in college students, correlations between cognitive development and logical thinking, measurement issues and a conclusion. Relevance of the findings for the three groups will be discussed as necessary under each of these categories.

Review of the Results

Essentially, an examination of the data would suggest that formal operational thought had already been acquired by most participants in
the study. Using Gibbs' (1984) interpretation of the TOLT scores (a score of 4 or more indicates the acquisition of formal operational thought structures), only three (3) of the participants scored less than four on the TOLT indicating an absence of formal operational reasoning ability. Even though mean scores across the groups were in ascending order from freshmen to graduate students, over 95% of the sample scored over three on the TOLT.

Students develop greater cognitive abilities across the course of educational experience according to the MER data. Means were, again, in ascending order from freshmen to graduate students. The analysis of variance indicated significant differences at the .0001 level between educational experience levels. The Scheffe multiple comparison test demonstrated significant differences between the graduate student sample and the freshmen and senior sample taken collectively. The Student Newman-Keuls multiple comparison test indicated significant differences between all educational experience levels. Thus, cognitive reasoning is closely associated with educational experience level according to the data in the current study.

Correlations between the MER and TOLT were relatively low for all groups under consideration. This low correlation was not expected, given that both theories are developmental in nature. However, the low correlation could have potentially been affected by the variance of the TOLT scores inasmuch as the great majority of the participants scored above four, the level required for evidence of formal operational reasoning ability.
Sex differences did not appear in either the TOLT data or the MER data. Thus, the universality notion upon which these theories were founded was not disconfirmed in the current study. Indeed, males and females were not significantly different with respect to logical thinking ability and cognitive development.

Taken collectively, the results indicate that formal reasoning ability is indeed a precondition of all measured levels of the Perry scheme (1970). These conclusions, and the potential utility of the conclusions, are discussed in more depth below.

**Results of the Test of Logical Thinking (TOLT)**

King (1984) notes that the incidence of formal operational thought has varied widely in studies of adult populations. In this particular study of college students, the incidence of formal operational thought was unusually high compared to other studies reviewed by King (1984). This finding might be attributed to any number of issues regarding formal operational thought. King (1984) notes that variance in the incidence of formal operational thinking could be attributable to instrumentation issues, theoretical issues or sampling issues. In this particular study, a reliable and valid measure of logical thinking was utilized with the samples under consideration. Additionally, sampling was, for the most part, random. This brings the researcher logically to issues related to the theory of formal operational thought as a most likely explanation of the current results.

Caple and Tobin (1981) note that the development of formal operational thinking should be fostered in secondary education
settings. The theoretical rationale for this focus is in the thinking that formal reasoning ability is a mediator of cognitive achievement (Capie and Tobin, 1981). The current study, however, would seem to suggest that formal reasoning ability is already accomplished by a surprisingly high number of college students. Therefore, researchers are left with the question as to whether formal reasoning ability is an inevitable outcome of the educational or aging process. The current study included students randomly selected from three class levels.

Given the results of the current study, it appears that formal reasoning ability has been accomplished by most college students entering the freshmen class. Further, scores on the TOLT continued to increase with educational experience. Questions might be raised about the results of the TOLT in terms of the experimenter's lack of control over the testing situation. However, the results are nevertheless supportive of the idea that formal reasoning ability is accomplished during the secondary education phase of one's educational career.

One of the limitations of the current study is the age group that was tested. All participants in the current study were enrolled in college study at the graduate or undergraduate level. Given the results of the study, it would be useful to determine the time when students make the transition to formal reasoning. This knowledge can only be gained through additional testing of middle school and high school students. This testing can give human development researchers a better idea of the development of formal reasoning ability before the college experience.
Results of the Measure of Epistemological Reflection (MER)

Perry (1970) defined a nine stage scheme of cognitive development for college students. Since that time, various studies have attempted to verify the existence of these stages in other college populations and to utilize the scheme as a basis for classroom, counseling and supervision interventions aimed at student development. The current study employed the MER as a measure of cognitive development across educational experience levels. The results of this study confirm that college students do change over the course of their experience with respect to views about authority, decision making, classroom learning and evaluation. The results of this study, then, can be useful to university instructors and student personnel administrators.

Models of practice which are grounded in human developmental theory can be useful in at least three ways. First, the model(s) can serve to assist the instructor or administrator in understanding the cognitive filters most likely employed by various groups of college age students. Second, the model(s) can serve as a guide for instructional or administrative practice. The model, in this sense, serves as a rationale for certain practices aimed at promoting the growth and development of the student. Third, the model(s) and the theory can be used to design deliberate interventions which attempt to measure specific outcomes of particular teaching or administrative practices.

In terms of models for instructors, the results of this study highlight at least two relevant points. First, according to these results, participants varied significantly in their perceptions of the college learning experience. Second, the variance in scores point to
qualitatively different ways of viewing learning experiences in college. Teachers, therefore, can use these data to more effectively plan classroom learning experiences. Knefelkamp (1974) varied teaching styles based on classroom developmental data to ascertain whether or not teaching styles could be used to produce cognitive change in students. The results of this study indicated that teaching style did make a difference in cognitive outcomes.

More specifically, Rodgers (1982) notes that different teaching strategies can be used for dualists (positions one and two in earlier description), multiplists (positions three and four in earlier description) and multiplists (position five and above in earlier description). Each of these groups of students have necessarily different ideas of the learning process and the pursuit of knowledge. Dualists tend to need a high degree of structure in the learning environment. Assignments need to be specific and the teacher is seen as the ultimate authority in terms of the topic. Multiplists, on the other hand, have begun to accept a reality that answers do not exist to all problems. Further, instructors may no longer be seen as having all the answers. Nevertheless, the student is dependent on the instructor to provide a way to find the answers. At position four, students are frustrated by the uncertainty involved in learning, and may reject all opinions in an effort to establish their own criteria for learning. Relativists, in comparison, need less structure in the learning environment. Learning through group discussions may be more acceptable inasmuch as peers have a legitimate role in the learning process. These broad theoretical categories were confirmed in the current study.
Therefore, teachers might design instructional methods which provide appropriate mechanisms of challenge and support for students depending on individual and group developmental data.

The concepts noted above can also be applied to the supervision process for student employees in residence life. Mean ages of participants in this study were 20.80 years for freshmen, 22.61 years for seniors and 28.00 years for the graduate student sample. The overall mean was 23.97 years (see Table 15). This age group represents both the normative age groups to whom student personnel administrators deliver services, and with whom student personnel practitioners work. Piper (1983) and Ricci (1983) note that resident advisors vary in cognitive developmental level, thereby necessitating varying supervision strategies for each individual. Management information systems on staff members' developmental levels can be useful to the student affairs professional involved in the supervision of undergraduate staff. Such management information systems are one method for these managers to fulfill their roles as administrators and educators. Assessment of the resident advisor population at the Ohio State University during the fall quarter of 1983 indicated that most student employees were in positions two and three on the Perry scheme (Taylor and Porterfield, 1984). This management information system was then used to more effectively design training and supervision which would more accurately fit the developmental needs of participants. While studies must be
<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshmen</td>
<td>35</td>
<td>20.80</td>
</tr>
<tr>
<td>Seniors</td>
<td>28</td>
<td>22.61</td>
</tr>
<tr>
<td>Graduate students</td>
<td>32</td>
<td>28.00</td>
</tr>
<tr>
<td>Total sample</td>
<td>95</td>
<td>23.76</td>
</tr>
</tbody>
</table>
conducted in the future to compare developmental interventions in supervision with control groups using traditional management techniques, face validity for using developmental strategies in supervision is supported with the results of the current study.

Developmental profiles constitute data bases for the use of practitioners in designing educational interventions. Further study with cognitive development needs to be done with non-college populations. Research questions might be: does the college experience make a difference with respect to cognitive development? Is cognitive development accelerated or decelerated by the college experience? Additionally, measurement needs to be conducted with pre-college age samples to determine cognitive profiles of these students. Teaching in secondary education could potentially follow similar developmental constructs as developmental data are produced on pre-college populations.

The results of the MER in this particular study confirm previous studies of cognitive change in college students. Given this confirmation of trends in cognitive development, continued attempts to develop practical models from the theoretical framework can be of high utility to educational administrators in all types of learning situations including teaching, training, supervision and understanding student attitudes toward authority figures in university settings. While a great deal of work remains in terms of creating additional models for practice out of the theoretical framework, the results of this study, taken with other studies, suggest promise for teachers and administrators in higher education.
Correlational Results Between Cognitive Development and Logical Thinking

One of the major hypotheses was that cognitive development and logical thinking would be positively correlated ($r = 0.60-1.00$). This hypothesis was not confirmed. This is, perhaps, the major finding of the study. Given the literature on the variance of formal reasoning ability in adults (King, 1984), and the theoretical similarities in the constructs of the two theories, it was proposed that the relationship would be much stronger than the data indicated. Instead, correlations were low and formal operational reasoning ability, in this study, seems to be a precursor to cognitive development as defined by Perry (1970). Perry (1970) makes the conjecture that his scheme extends beyond formal operational thinking. This conjecture was confirmed by the current data.

The fact that the TOLT and MER indicated low correlations suggests that, for this particular population, cognitive development and logical thinking are somewhat independent as developmental constructs. This statement is made with caution, as other researchers might also explore an age range when cognitive development and logical thinking might be more closely related. For example, data are needed on middle and high school students for both measures. These data would assist researchers in determining whether or not the constructs demonstrate a stronger relationship in different age ranges. There is not sufficient data in this study to suggest that logical thinking and cognitive development are interacting variables. Instead, it appears that formal operational reasoning is a precursor to development on the Perry scheme.
Sanford's (1981) notion that further study must be conducted to ascertain relationships between developmental constructs continues to be a concern in the current study. It is plausible that while cognitive development is not highly correlated with formal operational reasoning, it may be correlated with other constructs such as moral development (Kohlberg, 1981) or reflective judgment (King, 1978). The results of this study suggest that such correlational studies in the future need to focus on other constructs in a continuing attempt to piece together a total developmental profile of the college student population.

Measurement Issues in Developmental Theory

It was noted earlier that valid and reliable instrumentation is a precondition to meaningful research in developmental theory, whether that research involves intervention designs, profile construction or correlational research. The results of this study point to several issues regarding measurement. First, the TOLT appears to be a valid and reliable measure of formal operational thinking, and stands as a potentially useful instrument in further mapping the development of formal reasoning ability across any number of populations. Second, the MER performed well in the current study as a measure for the Perry scheme of development. Data from the MER relative to validity and reliability were comparable to other studies using the instrument (Taylor and Porterfield, 1984). Inasmuch as the Perry scheme has great utility in higher educational administration, the need to continue efforts in reliability and validity studies is imperative for continued research and application.
Conclusions and Summary

The results of this study can be viewed in several different ways. First, there is substantial data to support the argument that formal operational reasoning has been accomplished by the time students enter college. Therefore, the theory has little utility for designing interventions at the college level to promote formal operational reasoning ability. These interventions may be better directed at the middle and high school levels. Second, the data support the argument that cognitive development does vary over the course of the college experience. A sensitivity to this variance and the nature of the variance can serve as a theoretical basis for the design of college learning environments and student employee supervision strategies. Additional models for practice may be generated in the future based on Perry's description of college student development. Third, the Measure of Epistemological Reflection (MER) holds continued promise as a valid and reliable assessment tool for the Perry scheme. Fourth, results support the notion that while logical thinking and cognitive development are not positively correlated at the college level, there may be interaction between the two variables at the secondary education level. Clearly, this question can only be answered through studies involving subjects at this educational level. Fifth, this research must be placed, again, in the larger rationale for correlational studies in human development. More specifically, given the results of this study, researchers must continue in efforts to test theoretical hypotheses about interaction between and among strands of human development. It is only through confirmation and disconfirmation of such hypotheses that
researchers will be able to create a more wholistic picture of college student development from a developmental perspective.
LIST OF REFERENCES


MEASURE OF EPistemOLOGICAL REFLECTION

INSTRUCTIONS: The questionnaire that follows has to do with your perspective on a number of concerns related to college students. Each of the questions on the following pages asks for your opinion or choice on a given subject, and the REASONS why you have that particular perspective or opinion. We are interested in understanding your perspective as fully as possible. Please give us as much detail as you can to describe how you feel about each question. Feel free to use the backs of pages if you need more space. Thank you.

NAME ________________________________
AGE _______ CLASS RANK _______
SEX (circle) MALE  FEMALE
COLLEGE MAJOR ____________________
FATHER'S JOB ______________________
MOTHER'S JOB _____________________
DATE ______________________________

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(for office use only)
THINK ABOUT THE LAST TIME YOU HAD TO MAKE A MAJOR AND DIFFICULT DECISION IN WHICH YOU HAD A NUMBER OF ALTERNATIVES (E.G., WHICH COLLEGE TO ATTEND, COLLEGE MAJOR, CAREER CHOICE, ETC.). WHAT WAS THE NATURE OF THE DECISION?

__________________________________________________________

WHAT ALTERNATIVES WERE AVAILABLE TO YOU?

__________________________________________________________

__________________________________________________________

__________________________________________________________

__________________________________________________________

HOW DID YOU FEEL ABOUT THESE ALTERNATIVES?

__________________________________________________________

__________________________________________________________

__________________________________________________________

__________________________________________________________

HOW DID YOU GO ABOUT CHOOSING FROM THE ALTERNATIVES?

__________________________________________________________

__________________________________________________________

__________________________________________________________

__________________________________________________________

WHAT THINGS WERE THE MOST IMPORTANT CONSIDERATIONS IN YOUR CHOICE? PLEASE GIVE DETAILS.

__________________________________________________________

__________________________________________________________

__________________________________________________________

__________________________________________________________

__________________________________________________________
DO YOU LEARN BEST IN CLASSES WHICH FOCUS ON FACTUAL INFORMATION OR CLASSES WHICH FOCUS ON IDEAS AND CONCEPTS?

WHY DO YOU LEARN BEST IN THE TYPE OF CLASS YOU CHOSE ABOVE?

WHAT DO YOU SEE AS THE ADVANTAGES OF THE CHOICE YOU MADE ABOVE?

WHAT DO YOU SEE AS THE DISADVANTAGES OF THE CHOICE YOU MADE ABOVE?

IF YOU COULD GIVE ADVICE TO ANYONE ON HOW BEST TO SUCCEED IN COLLEGE COURSEWORK, WHAT KIND OF ADVICE WOULD YOU GIVE THEM? TALK ABOUT WHAT YOU BELIEVE IS THE KEY TO DOING WELL IN COLLEGE COURSES.
DURING THE COURSE OF YOUR STUDIES, YOU HAVE PROBABLY HAD INSTRUCTORS WITH DIFFERENT TEACHING METHODS. AS YOU THINK BACK TO INSTRUCTORS YOU HAVE HAD, DESCRIBE THE METHOD OF INSTRUCTION WHICH HAD THE MOST BENEFICIAL EFFECT ON STUDENTS.

WHAT MADE THAT TEACHING METHOD BENEFICIAL? PLEASE BE SPECIFIC AND USE EXAMPLES.

WERE THERE ASPECTS OF THAT TEACHING METHOD WHICH WERE NOT BENEFICIAL? IF SO, PLEASE TALK ABOUT SOME OF THE ASPECTS AND WHY THEY WERE NOT BENEFICIAL.

WHAT ARE THE MOST IMPORTANT THINGS YOU LEARNED FROM THE INSTRUCTOR'S METHOD OF TEACHING?

PLEASE DESCRIBE THE TYPE OF RELATIONSHIP WITH AN INSTRUCTOR THAT WOULD HELP YOU TO LEARN BEST AND WHY.
DO YOU PREFER CLASSES IN WHICH THE STUDENTS DO A LOT OF TALKING, OR WHERE STUDENTS DON'T TALK VERY MUCH?

WHY DO YOU PREFER THE DEGREE OF STUDENT INVOLVEMENT/PARTICIPATION THAT YOU CHOSE ABOVE?

WHAT DO YOU SEE AS THE ADVANTAGES OF YOUR PREFERENCE ABOVE?

WHAT DO YOU SEE AS THE DISADVANTAGES OF YOUR PREFERENCE?

WHAT TYPE OF INTERACTIONS WOULD YOU LIKE TO SEE AMONG MEMBERS OF CLASS IN ORDER TO ENHANCE YOUR OWN LEARNING?
SOME PEOPLE THINK THAT HARD WORK AND EFFORT WILL RESULT IN HIGH GRADES IN SCHOOL. OTHERS THINK THAT HARD WORK AND EFFORT ARE NOT A BASIS FOR HIGH GRADES. WHICH OF THESE STATEMENTS IS MOST LIKE YOUR OWN OPINION?

IDEALLY, WHAT DO YOU THINK SHOULD BE USED AS A BASIS FOR EVALUATING YOUR WORK IN COLLEGE COURSES, AND WHO SHOULD BE INVOLVED IN THE EVALUATION?

PLEASE EXPLAIN WHY YOU THINK THE RESPONSE YOU SUGGESTED ABOVE IS THE BEST WAY FOR EVALUATING STUDENTS' WORK IN COLLEGE COURSES.
Sometimes different instructors give different explanations for historical events or scientific phenomena. When two instructors explain the same thing differently, can one be more correct than the other?

When two explanations are given for the same situation, how would you go about deciding which explanation to believe? Please give details and examples.

Can one ever be sure of which explanation to believe? If so, how?

If one can’t be sure of which explanation to believe, why not?
APPENDIX A CON'T.--EXCERPT MER MANUAL

In Position Three the notion that some of the truth is unknown at present even to authorities complicates finding the right answers. Abstract learning contexts like philosophy are likely to be viewed as areas where the truth is yet to be discovered. The learners role remains one of receiving the answers in concrete contexts, and shifts to one of learning along with the authority how to find the answer in uncertain contexts. Advice about the latter is in the form of going through the right steps to insure that the truth will be discovered in the future. The student generally draws a distinction between learning facts and concepts. Facts are learned by memorizing whereas concepts require understanding.

Reasoning Structures

2.3.1 Preferred type of learning is a process in which memorization of facts is no longer sufficient. Facts need to be linked to ideas in order to gain a "real" understanding which one will remember.

Example: I can think about the material and relate it with other ideas so that I can remember it better. It is often more interesting than straight facts. If it is factual information I am just being told. If it's conceptual information I am being asked to think. I can design my own thoughts and theories from discussed material. Also if it is factual it can be proven correct or incorrect. If it is conceptual this is not necessarily the case. The disadvantage is that I don't learn concrete facts well and they need to be learned.

Example: Ideas and concepts are easier for me because I don't get so bored with ideas as I do with straight facts. It is easier to learn. No memorization. You don't forget it as easily. At times it can be hard to understand, but once you understand it you don't forget it.

2.3.2 Preferred type of learning is one that results in practical information that is more useful at present and in the future.

Example: Ideas and concepts can be utilized and practiced. Facts cannot be used and thus I forget them shortly after committing them to memory for an exam. Ideas are more practical and interesting too. They can be disputed, make for good conversation.

2.3.3 Preferred type of learning is one that provides a basis for exploring unknown areas in the attempt to discover the truth.

Example: Because of the level of education I have attained, I am aware of factual information in my field and like opportunities to apply concepts and ideas to past learning. The fact that learning concepts and ideas involves students in the learning process is an advantage. Learning can be active discovery, not just memorization. However sometimes the major point is missed or faulty assumptions can be made due to lack of factual information. Improper conclusions may be made.

2.3.4 Preferred type of learning is one that provides information and/or a process to be used in solving other problems or answering other questions.

Example: Ideas and concepts. You learn procedures for analysis and problem solving. You can apply the solution procedures for any general problem. A disadvantage is that it can often be just memorization and not understanding what you're doing or why.
<table>
<thead>
<tr>
<th>QUESTION</th>
<th>DECISION MAKING</th>
<th>LEARNING</th>
<th>INSTRUCTORS</th>
<th>PEERS</th>
<th>EVALUATION</th>
<th>TRUTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>POSITION 1</td>
<td></td>
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<td>POSITION 2</td>
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<td>POSITION 3</td>
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<tr>
<td>POSITION 4A</td>
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<tr>
<td>POSITION 4B</td>
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<tr>
<td>POSITION 5</td>
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</tr>
</tbody>
</table>

UNSCORED DATA
(Note reason as per manual)

NEW CATEGORY
(Please explain)
APPENDIX B

INSTRUCTIONS

On the following pages are several problems which you are asked to solve. Following each problem situation are a number of solutions. Please choose the solution, and select the best reason for your response from the reasons listed. You may record all answers on the answer sheet provided. Please be sure to return both the instrument and the answer sheet in the envelope provided. Thank you.
A painter uses four cans of paint to paint six rooms. How many rooms can be painted with six cans of paint?

a. 7 rooms  
b. 0 rooms  
c. 9 rooms  
d. 10 rooms  
e. other

Reason

1. The number of rooms compared to the number of cans will always be in the ratio of 3 to 2.

2. With more cans of paint, the difference will be less.

3. The difference in the numbers will always be two.

4. With four cans of paint the difference was 2. With six cans of paint the difference would be two more.

5. There is no way of predicting how much paint is needed.
Item 2

How many cans of paint are needed to paint eleven rooms?

a. 5 1/2 cans
b. 7 cans
c. 7 1/3 cans
d. 9 cans
e. other

Reason

1. The number of cans of paint compared to the number of rooms will always be in the ratio 2 to 3.

2. If there are five more rooms, then 3 more cans are needed.

3. The difference in the numbers will always be 2.

4. The number of cans will be half the number of rooms.

5. There is no way of predicting the amount of paint.
Item 3

Rolling Cylinders #3

Suppose you wanted to do an experiment to find out if changing the height of a ramp changed the distance a ball rolled off the end. Which sets of apparatus would you use?

I. 2 ft. II. 4 ft.
III. 3 ft. IV. 2 ft. V. 1 ft.

a. I and IV  
b. II and IV  
c. I and III  
d. II and V  
e. all of them

Reasons

1. The highest ramp should be tested against the shortest.
2. All sets need to be tested against each other.
3. As the height is increased the weight must be decreased.
4. The heights should be the same but the weights should differ.
5. The heights should differ but the weights should be the same.
Suppose you wanted to do an experiment to find out if changing the weight of the ball changed the distance it rolled off the end of a ramp. Which sets of apparatus would you use?

- I. 2 ft.
- II. 4 ft.
- III. 3 ft.
- IV. 2 ft.
- V. 1 ft.

a. I and IV  
b. II and IV  
c. I and III  
d. II and V  
e. all of them

Reasons

1. The heaviest ball should be compared to the lightest.
2. All sets need to be tested against each other.
3. As the weight is increased, the height should be decreased.
4. The weights should be different but the heights should be the same.
5. The weights should be the same but the heights should be different.
An American tourist is sharing a compartment on a Swiss train with six people. Three speak only English and three speak only French. What are the chances of speaking to someone who speaks English on the first try?

a. 1 out of 2
b. 1 out of 3
c. 1 out of 4
d. 1 out of 6
e. 1 out of 6

Reasons:

1. Four selections are needed because the three French speakers could be chosen in a row.

2. There are six people from which one English speaking person must be chosen.

3. One English speaking person needs to be selected from a total of three.

4. One half of the people speak English.

5. In addition to an English speaking person, three French speaking people could be selected from a total of six.
Item 5  The Coins and Rings

Three gold coins, four silver coins, and five copper coins are placed in a sack. Four gold rings, two silver rings and three copper rings are placed in the same sack.

What are the chances of pulling out a gold object on the first try?

a. 1 out of 2  
b. 1 out of 3  
c. 1 out of 7  
d. 1 out of 21  
e. none of the above

Reason

1. One gold object has to be selected from objects made from gold, silver, and copper.

2. 1/4 of the coins and 4/9 of the rings are made from gold.

3. It does not matter whether a coin or a ring is picked. One gold object needs to be selected from a total of 7 gold objects.

4. One gold object must be selected from a total of twenty-one objects.

5. 7 of the 21 objects in the sack are made from gold.
Item 7  

The Gumball Machine

A boy has a penny to use in one of two gumball machines. The first machine has 30 red and 50 yellow gumballs; the second has 20 red and 30 yellow. He likes only red gumballs.

His chance of getting a red in gum ball in the second machine?

a. Yes
b. No

Reasons:

1. There are 30 red in the first machine and only 20 in the second.
2. There are 20 more yellows in the first machine and only 10 more yellows in the second.
3. There are 50 yellows in the first machine and only 30 in the second.
4. There is a greater proportion of reds in the second machine.
5. There are more gumballs in the first machine.
Item 8: The Spotted Dogs

Seven large dogs and 21 small dogs are shown in the picture. Some dogs are spotted and others are not spotted.

Are large dogs more likely to have spots than small dogs?

a. Yes
b. No

Reason

1. Some small dogs have spots and some large dogs have spots.
2. Nine small dogs have spots and only three large dogs have spots.
3. 12 of the 28 dogs are spotted and 16 of the 28 dogs are not spotted.
4. 3/7 of the large dogs are spotted and 9/21 of the small dogs are spotted.
5. 12 of the small dogs have no spots and only 4 of the large dogs have no spots.
The Sandwiches

A restaurant allows a choice of three types of bread, three types of meat and three types of spread.

<table>
<thead>
<tr>
<th>Bread</th>
<th>Meat</th>
<th>Spread</th>
</tr>
</thead>
<tbody>
<tr>
<td>wheat (W)</td>
<td>ham (H)</td>
<td>ketchup (K)</td>
</tr>
<tr>
<td>rye (R)</td>
<td>chicken (C)</td>
<td>mayonnaise (M)</td>
</tr>
<tr>
<td>pumpernickle (P)</td>
<td>turkey (T)</td>
<td>butter (B)</td>
</tr>
</tbody>
</table>

Each sandwich must contain bread, meat and spread. How many types of sandwich can be prepared using only one type of bread, one type of meat and one type of spread?

List all of the possible types of sandwiches in the spaces provided on the Answer Sheet. More spaces are provided than you will need. Two examples of different sandwiches are provided for you. (WHK, RCM)
In an automobile race there is a Dodge (D), a Chevy (C), a Ford (F) and a Mercury (M). An observer predicts that the order of finish will be DCFM. In the spaces provided on the Answer Sheet list all other possible orders in which the cars might finish.

More spaces are provided than you will need.
**Directions**

A series of eight problems is presented. Each problem will lead to a question. Record the answer you have chosen and reason for selecting that answer.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Best Answer</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
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<tr>
<td>2.</td>
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<td>3.</td>
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<td>6.</td>
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<td>7.</td>
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<td>8.</td>
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</tbody>
</table>

Put your answers to questions 9 and 10 below:

9. ___ ___ ___ ___ ___

10. ___ ___ ___ ___ ___
### Test of Logical Thinking

<table>
<thead>
<tr>
<th>Answers: Form A</th>
<th>Answers: Form B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. c</td>
<td>1. c</td>
</tr>
<tr>
<td>2. b</td>
<td>1. c</td>
</tr>
<tr>
<td>3. c</td>
<td>5.</td>
</tr>
<tr>
<td>4. a</td>
<td>4. a</td>
</tr>
<tr>
<td>5. a</td>
<td>4. a</td>
</tr>
<tr>
<td>6. b</td>
<td>5.</td>
</tr>
<tr>
<td>7. a</td>
<td>4.</td>
</tr>
<tr>
<td>8. b</td>
<td>4.</td>
</tr>
</tbody>
</table>

- **9. Twenty-seven combinations.**
- **10. Twenty-four combinations.**

For questions 9 and 10 the subject should have the correct combinations and the correct number of combinations. If a combination is repeated the item would usually be scored incorrect. An exception to this procedure occurs if the repeated combination is the one given on the answer form. In this instance a subject could have 25 combinations for item 10, and 28 or 29 combinations for item 9.

In items 1-8 a subject needs to have both the answer and the reason correct to be awarded 1 mark. No part marks should be awarded. Since 1 mark can be obtained for each item, a total test score of 10 is possible.

Raw scores are recommended for use for research and evaluation.

Research is currently underway to provide equating procedures for Form A and Form B. The "transformed" scores will be available early in August 1983 and can be obtained from the authors.
February 5, 1984

Dear participant:

Thank you for your willingness to participate in my research! Enclosed you will find the consent form, the two questionnaires, an answer sheet for the second questionnaire, and an envelope in which to return the materials. Please sign both copies of the consent form, and keep one copy for your records.

The first questionnaire (HER) asks your perspective on a variety of topics. It is important that you express your own views and the reasons that make up your perspective. The second questionnaire poses a number of problem situations. You are asked to select an answer to each problem, and also select a reason for your response. Please record all your responses to the second questionnaire on the answer sheet provided. If possible, please try to complete both questionnaires in one sitting.

You will notice that the return envelope shows my campus address. Please drop the completed materials in any campus mail slot. I would appreciate having the questionnaires back within 10 days of the time that you receive them. If this is problematic, please give me a call. As numbers of participants are always important in a study of this nature, it is imperative that I receive your materials as soon as possible.

Should you have questions about the study or the questionnaires, please contact me at 263-0446 (home) or 422-3930 (work).

Thanks again for your assistance!

Sincerely,

William D. Porterfield
College of Education
February 12, 1984

Dear participant:

Thank you for your willingness to participate in my research! Enclosed you will find the consent form, the two questionnaires, an answer sheet for the second questionnaire, and an envelope in which to return the materials. Please sign both copies of the consent form, and keep one copy for your records.

The first questionnaire (MER) asks your perspective on a variety of topics. It is important that you express your own views and the reasons that make up your perspective. The second questionnaire poses a number of problem situations. You are asked to select an answer to each problem, and also select a reason for your response. Please record all your responses to the second questionnaire on the answer sheet provided. If possible, please try to complete both questionnaires in one sitting.

You will notice that the return envelope shows my campus address. Please drop the completed materials in any campus mail slot. I would appreciate having the questionnaires back within 10 days of the time that you receive them. If this is problematic, please give me a call. As numbers of participants are always important in a study of this nature, it is imperative that I receive your materials as soon as possible.

Should you have questions about the study or the questionnaires, please contact me at 263-0446 (home) or 422-3930 (work).

Thanks again for your assistance!

Sincerely,

William D. Porterfield
College of Education
Dear Participant:

Thank you for your willingness to participate in my research! Enclosed you will find the consent form, the two questionnaires, an answer sheet for the second questionnaire, and an envelope in which to return the materials. Please sign both copies of the consent form, and keep one copy for your records.

The first questionnaire (KER) asks your perspective on a variety of topics. It is important that you express your own views and the reasons that make up your perspective. The second questionnaire poses a number of problem situations. You are asked to select an answer to each problem, and also select a reason for your response. Please record all your responses to the second questionnaire on the answer sheet provided. If possible, please try to complete both questionnaires in one sitting.

You will notice that a return envelope is included with my campus address. Please drop the completed materials in any campus mail slot. It is imperative that you finish your questionnaires within 3 days of the time that you receive them. If, for some reason, you will not be able to make the five day deadline, give me a call. As numbers and expense of mailing packets is always a concern, I hope you will be able to return the packets within our agreed deadline.

Should you have questions about the study or the questionnaires, please contact me at 263-0446 (home) or 422-3930 (office).

Thanks again for your assistance!

Sincerely,

William D. Porterfield
College of Education
CONSENT FOR PARTICIPATION IN
SOCIAL AND BEHAVIORAL RESEARCH

I consent to participating in (or my child's participation in) research entitled:
A Study of the Correlations Between Cognitive Development and Logical Thinking.

Dr. Virgil Blanke or his/her authorized representative has
(Principal Investigator)
explained the purpose of the study, the procedures to be followed, and the expected duration of my (my child's) participation. Possible benefits of the study have been described as have alternative procedures, if such procedures are applicable and available.

I acknowledge that I have had the opportunity to obtain additional information regarding the study and that any questions I have raised have been answered to my full satisfaction. Further, I understand that I am (my child is) free to withdraw consent at any time and to discontinue participation in the study without prejudice to me (my child). The information obtained from me (my child) will remain confidential unless I specifically agree otherwise by placing my initials here.

Finally, I acknowledge that I have read and fully understand the consent form. I sign it freely and voluntarily. A copy has been given to me.

Date: ____________________ Signed: ____________________
(Participant)

Signed: ____________________
(Principal Investigator or his/her Authorized Representative)

Signed: ____________________
(Person Authorized to Consent for Participant - If Required)

Witness: ____________________

RS-027 (Rev. 12-67) - To be used only in connection with social and behavioral research.