THE RELATIONSHIP BETWEEN PSYCHOLOGICAL DIFFERENTIATION AND PERFORMANCE ON CONDITIONAL REASONING TASKS

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CURRICULUM STUDIORUM

Martin Efuetngu Amin was born on March 1st, 1946 in Fontem, United Republic of Cameroon, West Africa. He obtained his B. Sc. (Ed.) from the University of Cape Coast, Ghana in 1969 and his M. A. (Mathematics) from the University of Ottawa in 1974. The title of his Interim Report was "The Validation of a Conditional Reasoning Test."

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The Relationship Between Psychological Differentiation and Performance on Conditional Reasoning Tasks

The theoretical rationale was provided by the concept of psychological differentiation as postulated by Witkin and his associates. The purpose of the study was to investigate the relationship between psychological differentiation and performance on conditional reasoning tasks when these tasks are varied over different contents and patterns. In addition, the relationship between psychological differentiation and types of errors made on these tasks was investigated.

The Conditional Reasoning Test developed has three types of contents, concrete-familiar, suggestive and symbolic. There are two types of patterns, those in which unique conclusions could be drawn from the premises (V-patterns) and patterns in which no unique conclusions could be drawn from the premises (I-patterns). It was hypothesized that:

1.- On the V-patterns of conditional reasoning, where many subjects are expected to have the necessary abilities, field independent subjects perform better than field dependent subjects.

2.- On the V-patterns of conditional reasoning, there is interaction between content and psychological differentiation, field independent subjects performing more consistently across the various contents than field dependent

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subjects.

3.- On the V-patterns, field dependent subjects have a higher proportion of errors which express uncertainty of judgment than field independent subjects.

4.- On the I-patterns where the subjects do not have the necessary abilities, field dependent subjects perform better than field independent subjects (on these patterns, the correct conclusion is one which expresses uncertainty of judgment).

The research subjects included 302 Grade 8 students (160 girls and 142 boys). The subjects were administered the Dominion Group Test of Learning Capacity (Intelligence Test), a Conditional Reasoning Test, the Group Embedded Figures Test and the Articulation of Body Concept Scale as measures of psychological differentiation. Those who scored in the top 50% of the distributions of both measures of psychological differentiation were classified as field independent while those who scored in the bottom 50% of the distributions of both measures were classified as field dependent.

Hypotheses 1 and 2 were tested by use of a repeated measures multivariate analysis of covariance, with repeated measures on the type of content and intelligence test scores as the covariate. The other independent variable was the extent of psychological differentiation with field dependent

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and field independent subjects forming the criterion groups.

The V-patterns content subtest scores of the Conditional Reasoning Test served as the dependent variables.

Hypotheses 3 and 4 were each tested by use of the Mann-Whitney U Test for independent samples. For Hypothesis 3, the ranks on P, the proportion of errors on the V-patterns of the 'uncertain' type was the dependent variable. For Hypothesis 4, the ranks obtained on the I-patterns total scores served as the dependent variable.

In each case, psychological differentiation was the independent variable, with field dependent and field independent subjects forming the criterion groups.

The results indicated that all the four research hypotheses were supported at the 0.05 level of significance.

To conclude, it was recommended that the study be replicated with different types of tasks, at different age levels and with a test in which the students provide their own responses instead of being required to select a conclusion from the given set of conclusions.

INTRODUCTION

Witkin and his associates, over two decades ago, described and empirically supported a perceptual-personality dimension which they referred to as field independence. The all-embracing term 'psychological differentiation' was later proposed by Witkin and his co-workers in place of the more circumscribed term, field independence. In this work, the central process was described as being the ability to overcome an embedding context.

The important aspects of this construct are the field-dependent (less psychologically differentiated) and field-independent (more psychologically differentiated) cognitive styles. These styles, conceived as emanating from differences in the extent of self-nonself segregation, are tendencies to rely on external or internal referents in information processing. These contrasting tendencies are reflected in the ability of field independent persons to cope with tasks involving analytic and restructuring abilities, and their limitation on social sensitivity and social skills. Field dependent persons on the other hand, have greater social sensitivity and social skills but are not as competent in analytic and restructuring abilities. These characteristics suggest that an individual's extent of psychological differentiation may account at least in part, for variations on performance on tasks such as logic

which involves analytic and restructuring abilities.

During the past twenty years a number of studies concerned with children's logical abilities have been conducted. The aim in most of these studies has been to determine some of the factors that affect logical reasoning ability. A consistent finding in these studies is that children (ages 6 to 11) and adolescents (ages 12 to 18), have difficulty in reasoning with patterns of logic in which no unique conclusions can be drawn from the premises. Adolescents, and in some cases children, are, on the other hand, able to respond correctly to items measuring patterns in which a unique conclusion can be drawn from the premises. The type of content (e.g., concrete-familiar, suggestive and symbolic) in which an argument is presented has also been identified as a factor affecting logical reasoning ability. Socioeconomic status, intelligence and age have also been found to influence the ability to reason logically. As noted earlier, psychological differentiation may be an important factor in logical reasoning ability. One purpose of the study therefore, was to investigate the relationship between children's conditional logic abilities and individual differences in psychological differentiation. Another purpose was to determine if the type of error made on a conditional reasoning task is related to the individual's extent of psychological differentiation.

INTRODUCTION

The study is organized into three chapters. The first chapter consists of a review of the literature which leads to the statement of research problem and hypotheses. In the second chapter, the methods of data collection and data analysis are indicated. The results of the data analysis are presented and discussed in Chapter III. In addition, educational implications of this study, together with suggestions for further inquiry, are indicated. The report ends with a summary and the statement of conclusions, an annotated bibliography and appendices.

CHAPTER I

REVIEW OF THE LITERATURE

In this chapter, the theoretical rationale for the present investigation is provided. The chapter begins with a description of Witkin's concept of psychological differentiation. Following this, is a discussion of conditional reasoning as it relates to other types of logic. In addition, some factors that have been found to affect logical reasoning ability are described. In the third section, the relationship between conditional reasoning ability and psychological differentiation is examined. In addition, the empirical research which can be related to these variables is reviewed. In the last section, the research questions and hypotheses to be tested, which were derived from Witkin's theory of psychological differentiation, are stated.

1. Concept of Psychological Differentiation

In this section, the concept of psychological differentiation as conceived by Witkin and his associates is discussed. In addition, some criticisms that have been made of Witkin's theory are reviewed. The section ends with a summary of characteristics attributed to more psychologically differentiated persons and less psychologically differentiated persons.

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The early works of Witkin and Asch,[1,2,3,4] concerned with the establishment of spatial orientation, provided the basis from which Witkin's differentiation hypothesis was formulated. The purpose of the experiments was to determine whether an individual perceived the upright in space primarily through postural factors or by environmental cues in the surrounding perceptual field.

The findings indicated that there were stable and consistent individual differences in a subject's ability to orient himself in space. Spatial orientation was also related to social and personal traits such as articulated perceptual and intellectual functioning, sense of separate identity, articulated body concept and the use of structured and specialized defenses and controls in the discharge of

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[1] S. E. Asch and H. A. Witkin, "Studies in Space Orientation: I. Perception of the Upright with Displaced Visual Fields," in Journal of Experimental Psychology, Vol. 38, No. 3, 1948, p. 324-337.

[2] -------- and H. A. Witkin, "Studies in Space Orientation: II. Perception of the Upright with Displaced Visual Fields and with Body Tilted," in Journal of Experimental Psychology, Vol. 38, No. 4, 1948, p. 455-477.

[3] H. A. Witkin and S. E. Asch, "Studies in Space Orientation: III. Perception of the Upright in the Absence of Visual Field," in Journal of Experimental Psychology, Vol. 38, No. 5, 1948, p. 603-614.

[4] -------- and S. E. Asch, "Studies in Space Orientation: IV. Further Experiments with Displaced Visual Fields," in Journal of Experimental Psychology, Vol. 38, No. 6, 1948, p. 762-782.

impulses. It became apparent to Witkin and his colleagues that an individual's mode of spatial orientation is an expression of a more generally preferred mode of perceiving.

Witkin and his co-workers devised and modified a number of perceptual tasks to measure an individual's spatial orientation. This resulted in the Rod and Frame Test (RFT)[5] The Room Adjustment Test (RAT),[6] and the Body Adjustment Test (BAT).[7]

The RFT consists of a luminous square frame which can be tilted to the left or right. A luminous rod moving independently of the frame is pivoted at the centre of the frame. In the test, which is conducted in a completely darkened room, the subject is required to adjust the rod to an upright position. He must ignore the tilted frame which surrounds the rod to determine the upright.

The apparatus for the RAT and BAT consists of a box-like room suspended on ball-bearing pivots so that it can be tilted to the left or right. The subject is seated in an adjustible chair which can also be tilted to the left or right.

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[5]H. A. Witkin, R. B. Dyk, H. F. Faterson, D. R. Goodenough and S. A. Karp, Psychological Differentiation, New York, Wiley, 1962. p. 36-37.

[6]Ibid., p. 37-39.

[7]Ibid.

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The subject's task is to bring the tilted room to a position he perceives as upright (RAT) or to bring his tilted body to a position he perceives as upright (BAT).

In their later work, Witkin and his colleagues developed the Embedded Figures Test (EFT)[8] together with a group version (GEFT)[9] and a children's individually administered version (CEFT).[10] The Articulation of Body Concept Scale (ABCS)[11] was also developed.

In the EFT or its adaptations, the subject is required to find a simple figure embedded within a larger complex figure. With the ABCS, the subject is required to draw a man and a woman. The drawings are rated according to the ABCS, based on form, identity, sex differentiation and level of detailing.

In each of the tests the subject is required to perceptually differentiate an item from the influence of the prevailing field. Individual differences are found in all the tasks. Moreover, individuals tend to perform in a self-

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[8] Ibid., p. 39-40.

[9] H. A. Witkin, P. K. Oltman, E. Ruskin and Stephen A. Karp. Manual for Children's Embedded Figures Test and Group Embedded Figures Test, Consulting Psychologists Press Inc., Palo Alto, California, 1971.

[10] Ibid.

[11] H. F. Faterson and H. A. Witkin, "Longitudinal Study of the Development of Body Concept," in Development Psychology, Vol. 2, No. 3, 1970, p. 429-438.

consistent fashion on these tasks. The person who cannot separate the simple figure from the complex geometric design is not likely to produce drawings reflecting an articulated body concept or to adjust his body to the upright in a surrounding tilted room. Such a person is also unlikely to bring a rod to the upright when the rod is surrounded by a tilted frame. These individuals who are strongly influenced by the prevailing field so that parts of the field are experienced as "fused", are described as field dependent. Other individuals perceive parts of the field as discrete from organized backgrounds, and are identified as being field independent.

Witkin therefore argues that field dependence-independence is a reflection of an individual's mode of field approach. He contends further, that this field approach may be related to a number of personality characteristics. To test this hypothesis, Witkin and his colleagues have carried out several studies to identify some correlates of field-dependence-independence.

Some of the characteristics so far identified with field dependent persons are the following: (1) a less well developed sense of self esteem and body image; (2) a greater sensitivity or attentiveness to social contacts; (3) a tendency to conform to social norms and values, that is, they are more likely than field independent persons to

maintain values and attitudes that are popular; (4) a greater readiness to change their views in the direction of the attitudes and views of an authority figure; (5) a tendency to use less complex and less specialized forms of defenses (such as massive repression and primitive denial): (6) a tendency to have a low level of cognitive clarity, indicating that, to them, information and impressions are blurred, confused, unassimilated and unstructured; one of six indications of low level of cognitive clarity being the inability to abstract and generalize; (7) susceptibility to influence by suggestions. This means that they readily accept external standards in determining their attitudes and judgments; (8) an inclination towards subject areas that feature inter-personal relationships such as social science, counselling, elementary school teaching and selling; (9) less self-confidence and more uncertainty in their judgments and less self-assurance; (10) "a global field approach", that is, they readily submit to the structure of a prevailing field and are incapable of perceiving its parts analytically.

Field independent persons, in contrast, have characteristics opposite to those attributed to field dependent persons.

Sex differences have been reported in performance on the measures of field dependence described above.

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Greater field dependence in females in their performance on the RFT, EFT, RAT or the BAT has been observed in numerous groups of varied educational and socioeconomic backgrounds in the United States, in Western European countries, including England, Holland, France and Italy, in Japan, Hong Kong and Sierra Leone[12] as well as in India.[13] However, no significant sex differences have been noted among the Eskimos, whose child-rearing techniques emphasize self-reliance and independence for both boys and girls.[14,15] On the ABCS, on the other hand, females are reported to be superior to males.[16,17] Witkin explains that the unexpected

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[12] H. A. Witkin, "A Cognitive-Style Approach to Cross-Cultural Research," in International Journal of Psychology, Vol. 2, No. 4, 1967, p. 243.

[13] C. G. Pande, "Sex Differences in Field Dependence: Confirmation with Indian Sample," in Perceptual and Motor Skills, Vol. 31, 1970, p. 70.

[14] J. W. Berry, "Temne and Eskimo Perceptual Skills," in International Journal of Psychology, Vol. 1, 1966, p.58-64.

[15] R. S. MacArthur, "Sex Differences in Field Dependence for the Eskimo: Replication of Berry's Findings," in International Journal of Psychology, Vol. 2, No. 2, 1969, p. 139-140.

[16] N. L. Corah, "Differentiation in Children and Their Parents," in Journal of Personality, Vol. 33, 1965, p. 300-308.

[17] Faterson and Witkin, op. cit., 1970, p. 429-438.

reversal in the superior performance of females is very likely a function of the ABCS technique. High ratings on the scale emphasize details of clothing, hair treatment, etc., and this is more characteristic of human figures, especially female figures, drawn by girls than by boys.[18]

Several longitudinal and cross-sectional investigations led Witkin and his co-workers to consider the developmental aspect of the field dependence-independence. Young children were found to function in a relatively field dependent fashion. As age increased, it was noticed the children's scores on the tasks described above also increased indicating increasing field independence. However, individuals tended to maintain their relative positions within the group. Witkin suggests that a child's self-concept is initially undifferentiated and lacking in decisiveness in nearly all areas of functioning. However, as the child grows, he is more able to distinguish himself from others, objects from other objects, and time from other time. The theoretical formulation of the psychological differentiation hypothesis emerged from the connections made between perceptual and personality development.

The concept of psychological differentiation did not originate from Witkin. However, it appeared to him and

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[18] Ibid., p. 433.

his co-workers to provide a possible theoretical basis for their research findings. Werner's orthogenic theory[19] offered the desired framework. According to Werner, the development of differentiation may be considered to proceed from a relatively diffuse, global or undifferentiated state towards more differentiated and hierarchic integration.[20] Witkin and his associates followed Werner's orthogenic principle when they defined differentiation as:

> ... the complexity of a system's structure. A less differentiated system is in a relatively homogeneous structural state; a more differentiated system is in a relatively heterogenous state.[21]

Psychological differentiation in Witkin's terminology thus refers to the extent of complexity within the psychological field. Articulation, that is, the analysis and structuring of experience is used as a synonym for differentiation. A psychological field that is well differentiated is therefore described as structured and analytic as opposed to being diffused and global.

Another aspect of differentiation is "specialization". This term is used to describe the extent to which subsystems are capable of mediating specific functions so that specific

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[19] H. Werner, Comparative Psychology of Mental Development, New York, Science Editions, 1948, XII - 564 p.

[20] Ibid., p. 51.

[21] Witkin et al, op. cit., 1962, p. 9.

stimuli receive specific reactions. In a psychological field which is characterized by specialization, the various psychological areas may be separated from each other. For example, feelings are distinct from perceptions, thought is not necessarily fused with action and feelings and needs tend to be discrete.

Differentiation also implies the way in which a system is integrated. Integration refers to the creation of functional relationships within the system. While complexity of integration or the complexity of subsystems within the larger system is directly related to degree of differentiation, this is not necessarily true of effectiveness of integration -- hence it is possible to find maladjusted persons among those who possess a well-differentiated psychological field.

Differentiation is a pervasive characteristic that occurs in several areas of psychological functioning. It occurs in perceptual, intellectual and emotional functioning, in the use of defense structures for the discharge of impulses and it may be an important factor in social relationships.

Following Werner's organic rather than the mechanistic approach to developmental psychology, Witkin and his

associates[22] argue that progress towards greater differentiation involves the organism as a whole, rather than proceeding discretely in separate domains.

Witkin's perceptual measures thus operationally define the extent to which an individual's systems are differentiated. That is, a relatively field dependent person tends to have an undifferentiated psychological system. He tends to experience difficulty in overcoming the influence of the surrounding field in the RFT, the tilt of the room in the RAT and BAT, or the distracting lines in the EFT and to draw figures reflecting a little articulated concept of the body. On the other hand, a field independent person is expected to have a more differentiated psychological system. He is expected to be able to adjust the rod to the true vertical, orient himself to the vertical in space, locate a simple figure hidden in a complex one and to produce figures which indicate an articulated concept of the body. Witkin's use of the term "differentiation" has been criticized on several grounds.

In a critical review of Witkin's book, Psychological

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[22] H. A. Witkin and J. W. Berry, "Psychological Differentiation in Cross Cultural Perspective," in Journal of Cross Cultural Psychology, Vol. 6, No. 1, March 1975, p. 6.

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Differentiation, Zigler[23] argues that although several interesting relationships were discovered by Witkin and his colleagues, they were rendered uninterpretable because they lacked a theoretical base. He further suggests that the network of inter-relationships found by Witkin and his colleagues between measures of psychological differentiation and other measures are due to a common factor, namely, general intelligence and can be better accounted for by this factor. To this point, researchers who have examined the relationship between measures of psychological differentiation and measures of intelligence have indicated that:

1. Correlations between total intelligence scores and measures of psychological differentiation ranged from 0.20 to 0.57;[24,25,26]
2. Correlations between scores on verbal measures of intelligence and measures of psychological

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[23] E. Zigler, "A Measure in Search of a Theory?" in Contemporary Psychology, Vol. 8, 1963, p. 133-135.

[24] M. McCarrey, L. Dayhaw, and G. P. Chagnon, "Attitude Shift, Approval Need, and Extent of Psychological Differentiation," in Journal of Social Psychology, Vol. 84, 1971, p. 141-149.

[25] T. E. Dubois and W. Cohen, "Relationship between Measures of Psychological Differentiation and Intellectual Ability," in Perceptual and Motor Skills, Vol. 31, 1970, p. 411-416.

[26] James V. Spotts and B. Mackler, "Relationship of Field-Dependent and Field-Independent Cognitive Styles to Creative Test Performance," in Perceptual and Motor Skills, Vol. 24, 1967, p. 239-268.

differentiation ranged from 0.06 to 0.47;[27,28,29]

3. Correlations between scores on non-verbal measures of intelligence and measures of psychological differentiation ranged from 0.09 to 0.51.[30,31,32]

On the average, non-verbal measures of intelligence are more related to measures of psychological differentiation than verbal measures of intelligence. To offer an explanation for findings such as those cited above, Witkin has replied that the significant relationships reported between measures of psychological differentiation and total intelligence scores are very much a function of the intelligence subtests which require analytic ability. The results of a study by Goodenough and Karp[33] have, in fact, supported Witkin's explanations.

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[27] Ibid., p. 240.

[28] R. Elliot, "Interrelationships Among Measures of Field Dependence, Ability, and Personality Traits," in Journal of Abnormal and Social Psychology, Vol. 63, No. 1, 1961, p. 27-36.

[29] J. Bieri, W. Bradburn and Galinski, "Sex Differences in Perceptual Behaviour," in Journal of Personality, Vol. 26, 1958, p. 1-12.

[30] Elliot, op. cit., p. 30.

[31] Bieri et al, op. cit., p. 11.

[32] Spotts and Mackler, op. cit., p. 248.

[33] D. R. Goodenough and S. A. Karp, "Field Dependence and Intellectual Functioning," in Journal of Abnormal and Social Psychology, Vol. 63, No. 2, 1961, p. 241-246.

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They administered the RFT, EFT and BAT together with the Wechsler Intelligence Scale for Children to ten-year-old boys. They hypothesized that the scores on these three measures of psychological differentiation would load on the same factor as the Wechsler closure subtest scores (Block Design, Object Assembly and Picture Completion). Their results supported the hypothesis. However, Witkin had himself expressed some doubts about the independence of cognitive styles (psychological differentiation being one of them). In a discussion reported in Basic Cognitive Processes in Children,[34] he argued that cognitive styles are represented in standard tests of intelligence, and that controlling for intelligence in studies of cognitive style may not be an appropriate issue.

Another criticism of Witkin's theory has come from Gardner who argues that Witkin's use of the term "psychological differentiation" seems to "imply more generality than is warranted even by the notable consistencies described."[35] His criticism was based on the fact that some verbal and problem solving skills requiring analytic ability were found to be unrelated to Witkin's measures of psycho-

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[34] J. C. Wright, and J. Kegan (Eds.) Basic Cognitive Processes in Children, Monogr. Soc. Res. Child Development, Vol. 28, No. 2, 1963, p. 118-122.

[35] R. W. Gardner, "Book Reviews," in the American Journal of Psychology, Vol. 76, No. 4, 1963, p. 709-711.

logical differentiation. Witkin responded by arguing that evidence exists indicating that the development of some kinds of verbal skills may follow a different pathway than the development of mode of field approaches and other characteristics indicative of developed psychological differentiation.[36]

Gruen[37] argued that the personality-perception relationship has been too broadly interpreted even though only a few isolated traits were found. He further deplored the uni-dimensional description of behaviour characteristics inferred from performance on the spatial orientation tasks, pointing out that such a method of reporting probably conceals the possibility that the body may be used in different ways by the same as well as different individuals in these situations.[38]

Holtzman[39] and Anastasi[40] have indicated that knowledge of the subject's field dependence score might have

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[36] Witkin, et al, op. cit., 1962, p. 198.

[37] A. Gruen, "A Critique and Re-Evaluation of Witkin's Perception and Perception Personality Work," in Journal of General Psychology, Vol. 56, First Half, 1957, p. 73-93.

[38] Ibid., p. 85.

[39] W. H. Holtzman, "Review of H. A. Witkin, H. B. Lewis, M. Hertzman, K. Machover, P. Meissner and S. Wapner, "Personality through Perception," in American Journal of Psychology, Vol. 68, No. 3, 1955, p. 501-504.

[40] A. Anastasi, Differential Psychology, New York, MacMillan, 1958, p. 357.

confounded the results in the interpretation of the personality-perception relationship in Witkin et al's earlier work.

Other writers have defended Witkin from his critics. McCarrey,[41] for example, argues that there might have been earlier methodological weaknesses in Witkin's work but that the value of the psychological differentiation construct is evident by the abundance of data that have been analyzed and synthesized.

As with any theoretical framework, these criticisms, although pertinent, seem to be a good indication of a theory building process. It is also to be noted that Witkin's concept of psychological differentiation is attracting much interest and stimulating research. This is because it appears to measure objectively, a cognitive dimension which has important implications for personality and learning.

In the preceding section, a review has been made of the concept of psychological differentiation as conceived by Witkin and his co-workers. The main points considered may be summarized as follows:

In perceptual and intellectual functioning, a person's performance ranges along a continuum of being

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[41] M. McCarrey, Attitude Shift, Approval Need and Extent of Psychological Differentiation, unpublished Doctoral Thesis presented to the Faculty of Psychology of the University of Ottawa, 1969, p. 32.

relatively field dependent at one extreme to relatively field-independent at the other extreme.

Relatively field independent and relatively field dependent persons have certain personality characteristics which are found in their perceptual, intellectual, motivational, defensive and social functioning.

Field dependent persons are less analytic, have lower level of cognitive clarity, are more susceptible to suggestions and express more uncertainty in their judgments than their field independent counterparts. In addition, the extremely field dependent person demonstrates a poor and undifferentiated self-concept inclusive of the body. He tends to be unsure of himself, and to be reliant on others for guidance and support. He experiences difficulty in maintaining his own direction in the face of contradicting attitudes,opinions and beliefs. Further, his view of himself is unstable, varying significantly as he moves from one context to another.

Field independent persons are described as having characteristics opposite to those of field dependent persons. The attributes described suggest that there may be a linkage between degree of psychological differentiation and performance on conditional reasoning tasks. However, before such a link is attempted, conditional reasoning as it relates to other types of logic will be discussed. This

is done in the next section. In addition, some factors that have been found to affect logical reasoning ability are described.

2. Aspects of Logical Reasoning

In this section, two topics are discussed; first, the different types of logic commonly mentioned in logic books and second, some of the factors that have been found to affect logical reasoning ability.

a) Types of Logical Reasoning

Logical reasoning is generally divided into induction and deduction.[42,43,44] Inductive reasoning involves reasoning from the particular to the general. It involves the ability to establish generalizations and determine cause and effect relationships. Inductive generalization enables a person to make a general statement about all members of a given class from data on some of its members. The determination of a cause and effect relationship between two events requires the establishment of a causal connection between the two events.

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[42] M. C. Beardsley, Thinking Straight, Englewood Cliffs, New Jersey, Prentice Hall, Inc., 1966, p. ix-292.

[43] I. M. Copi, Introduction to Logic, New York, The MacMillan Company, 1953, p. vii-472.

[44] R. H. Ennis, Logic in Teaching, Englewood Cliffs, New Jersey, Prentice Hall, Inc., 1969, p. vii-520.

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In contrast to inductive reasoning, deductive reasoning is the ability to reason from the general to the particular. It is the ability to draw correct conclusions or assess conclusions drawn from some given information. Typically, the individual is provided with some information (sometimes called premises) which he is to assume to be true. He is then required to draw a conclusion from the given information or asked to judge if a specific conclusion follows necessarily from the given information.[45]

Three types of deductive logic are sentence, class and ordinal or quantificational logic.[46,47,48]

In sentence logic, sentences form the basic units or the building blocks. This means that distinct sentences often connected or modified by such logical connectives as "if", "only", "and", "or" and "both", appear essentially unchanged throughout the course of the argument.

In class logic, the basic units or building blocks of arguments are classes (collections) or individuals.

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[45] W. H. Burton, R. B. Kimbal and R. L. Wing, Education for Effective Thinking, New York, Appleton-Century-Croft Inc., 1969, p. 125.

[46] F. Harrison III, Deductive Logic and Descriptive Language, Englewood Cliffs, New Jersey, Prentice Hall, Inc., 1969, iii - 534 p.

[47] Beardsley, op. cit., p. 46-87.

[48] Ennis, op. cit., 1969, p. 11.

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The third type of deductive logic, ordinal or quantificational logic, is concerned with the quantitative relationships such as "greater than", "equal to", "less than", "not greater than", "faster than", etc.

Of these three types of deductive logic, sentence logic seems to be the most widely used in the English language.[49] Sentence logic is broken up into several types, depending on the connective used. If the connective used is "if", "only if", or "if and only if" or their synonyms, then conditional statements are obtained. An example of a conditional statement is as follows:

"If Jones is a dog, then he is an animal."

This conditional statement has two simple sentences: "Jones is a dog" and "he is an animal." Arguments that contain only conditional statements and simple sentences or their negations are called conditional arguments. Here is an example:

If Jones is a dog, then he is an animal.
Jones is a dog.
Therefore, Jones is an animal.

The first statement, called the major premise, takes the general form "if....then....." The second statement, "Jones is a dog," is called the minor premise. The statement

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[49] H. S. Leonard, Principles of Reasoning: An Introduction to Logic, Methodology and Theory of Signs, New York, Denver Publications, 1967, p. 531.

introduced by "if" is called the antecedent and the constituent part introduced by "then" is called the consequent. The conditional statement does not state categorically that what is asserted in the antecedent is true but that if what is asserted is taken to be true, then the consequent following must be true as well. A conditional argument, therefore, consists of a conditional statement in the major premise, the assertion or denial of the antecedent (or consequent) in the minor premise and the assertion or denial of the antecedent (or consequent) in the conclusion. Both major and minor premises may also be conditional statements.

Other common types of sentence logic are disjunctions (or alternations) and conjunctions.[50,51]

Among the various types of sentence logic that have been discussed, conditional reasoning was selected for this research. This was done for the following reasons:

1. Logical reasoning of the conditional type appears to be very widely used in the English language. [52]
2. The "if...then..." nature of conditional reasoning seems to provide a suitable situation for testing abstract reasoning ability.

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[50] M. R. Cohen and E. Nagel, An Introduction to Logic and Scientific Method, New York, Harcourt Brace & World Inc., 1934, p. 101.

[51] D. J. Sullivan, Fundamentals of Logic, New York, McGraw-Hill Book Company Inc., 1963, p. 162-164.

[52] Leonard, op. cit.

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3. The criteria for judging arguments in this form of logic are well developed and agreed upon.

In logical arguments, there is a distinction between the truth and the validity characteristic of the conclusion of an argument. This distinction is useful since it is often a source of confusion in making deductions and assessing conclusions made in deductive reasoning. The truth of a conclusion (or premise) refers to whether or not it agrees with common knowledge. In explaining the truth characteristic of a premise, Beardsley writes:

> To discover whether the premises are true, we see whether we can test them out in our experience, or support them by evidence, or perhaps deduce them as conclusions from other known premises. 53

The emphasis here is on whether the given conclusion (or premise) agrees with what is observable through experience. A conclusion that "Cows are smaller than flies" may follow necessarily from some given premises but is not true in terms of our daily experiences. On the other hand, the conclusion "Horses are bigger than cats" is a true statement in terms of our daily experiences but may not follow necessarily from some given premises.

The validity of an argument refers to whether or not the conclusion drawn follows necessarily from the given premises. An argument whose conclusion does not follow

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[53]Beardsley, op. cit., p. 47.

necessarily from its premises is said to be invalid.

Truth and validity of a conclusion are, therefore, two different things. A conclusion that is true in terms of daily experiences may or may not be a validly drawn conclusion. On the other hand, a conclusion that is valid may or may not be true.

In summary, the basic types of logical reasoning have been discussed. Reasons were given for the use of conditional logic in this research. In addition, a distinction was made between the truth and validity of a conclusion of an argument.

b) Factors Affecting Deductive Reasoning Ability

In this subsection, five different factors that have been observed to affect deductive reasoning ability are described. Type of content in which an argument is presented, type of pattern, attitudes and emotions, age and intelligence are the factors considered.

A review of the research literature indicates that content is an important determinant of the ability to reason logically. In an early study conducted by Burt,[54]

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54. C. Burt, "The Development of Reasoning in School," in Journal of Experimental Pedagogy, Vol. 5, No. 2 & 3, 1919, p. 68-77, 121-127.

four types of contents, namely, concrete-familiar, symbolic, unfamiliar and suggestive were defined. These types of contents which were later employed by Wilkins,[55] Roberge and Paulus,[56] Miller,[57] and Shipman[58] are operationally defined below:

In the concrete-familiar content, there are sentences which refer to concrete articles and/or qualities with which the subject is expected to be familiar. Moreover, the truth status of each sentence is neutral. This means that the subject is not expected to hold strong opinions about the truth or falsity of these sentences. An example of such a sentence is, "If the first sign is correct, then the second sign is correct."

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[55] M. C. Wilkins, "The Effect of Changed Material on the Ability to do Formal Syllogistic Reasoning," in Archives of Psychology, No. 102, 1928.

[56] J. T. Roberge and D. Paulus, "Developmental Patterns for Children's Class and Conditional Reasoning Abilities," in Developmental Psychology, Vol. 4, 1971, p. 191-200.

[57] W. A. Miller, The Acceptance and Recognition of Six Logical Inference Patterns by Secondary Students (Doctoral Dissertation, University of Wisconsin), Ann Arbor, Michigan, University Microfilms, 1968, No. 68-13651.

[58] J. R. Shipman, "Structural and Linguistic Variables that Contribute to the Difficulty of the Judgment of Deductive Arguments of the Conditional Type." Paper presented at the annual meeting of the American Educational Research Association, Washington, D. C., March 30 - April 3, 1975.

In the symbolic content, symbols such as letters of the English alphabet are used in place of the concrete objects or attributes of the concrete-familiar content. These symbols are not expected to have any specific meaning for the subject and can therefore stand for anything that the subject chooses. Here again, the truth status of the sentences containing these symbols is neutral. "If P, then Q" is an example of a sentence with this type of content.

The unfamiliar content is very similar to the symbolic content. The difference is that in the latter, symbols are replaced by meaningless words. An example of a sentence containing this type of content is, "If there is a glp, then there is an oolp."

In the suggestive content there are sentences with truth status familiar to the subject. More specifically, the subject knows, in terms of his daily experience, that the premises state something which is false. That is, the truth status of the conclusion (or premise) is in opposition to known facts. In this type of content then, the subject is required to draw and evaluate conclusions which contradict his factual knowledge. An example of a sentence with this type of content is "if Montreal is a city, then chickens have four legs."

The Graded Reasoning Test, constructed by Burt, includes items measuring the four contents discussed above.

Burt concluded that for his undergraduate sample, changing the type of content of a class logic argument affects its difficulty. According to Burt's[59] results, when the contents are ranked in increasing order of difficulty, their order is: concrete-familiar, suggestive, symbolic and unfamiliar.

Wilkins[60] found that, for adults, the ability to solve class logic problems was much influenced by the type of content in which the argument was presented. Arguments containing meaningless words tended to be most difficult and those containing concrete familiar words were easiest. Arguments in the symbolic form also appeared to be more difficult than arguments in the suggestive form.

Long and Welch[61] found similar results with children (ages 8-11) when they concluded that the "difficulty of applying a principle of reasoning increases as the meaningfulness of the terms decreases."

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[59]Burt, op. cit.

[60]Wilkins, op. cit.

[61]L. Long, and L. Welch, "Reasoning Ability in Young Children," in Journal of Psychology, Vol. 12, 1942, p. 42.

Some more recent studies,[62,63,64] provide support for these findings. Results of other studies have indicated different rankings of difficulty for the different types of contents. Berzonsky and Ondrako,[65] for example, found that for 6-7 year olds, the concrete-familiar content is easiest while the suggestive content is more difficult than the symbolic content.

The results from most of the studies cited above do confirm Burt's ordering of the difficulty of the various contents and do support the contention that the type of content in which an argument is presented affects an individual's logical reasoning ability.

The concrete-familiar, suggestive and symbolic contents were selected for this study. The unfamiliar content was dropped because both the unfamiliar and symbolic contents were conceived as belonging to a more general abstract content. It was therefore argued that little would be gained by including both contents.

The type of pattern (or form) in which an argument is presented has also been found to affect deductive reasoning ability. Two types of patterns of deductive logic are of particular interest. First, there are patterns in which a unique valid conclusion that follows necessarily from the premises can be drawn. These types of patterns

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[62] R. H. Ennis and D. Paulus, Critical Thinking Readiness in Grades 1-12, Phase 1: Deductive Reasoning in Adolescence, Ithaca, New York; The Cornell Critical Thinking Project, 1965.

[63] W. L. Gardner, An Investigation of Understanding of the Meaning of Logical Operators in Propositional Reasoning. Doctoral Dissertation, Cornell University, Ann Arbor, Michigan, University Microfilms, 1966, No. 66-4109.

[64] Miller, op. cit.

[65] M. D. Berzonsky and M. A. Ondrako, "Cognitive Style and Logical Deductive Reasoning", The Journal of Experimental Education, Vol. 43, No. 1, Fall 1974.

will be designated V-patterns. The assertion of the antecedent or denial of the consequent in the minor premise of a conditional argument, for example, allows for a unique conclusion from the premises. Secondly, there are also patterns in which no unique conclusion that follows necessarily from the premises can be drawn. These types of patterns will be designated I-patterns. The affirmation of the consequent or denial of the antecedent in the minor premise of a conditional argument produces I-patterns.

The results from many studies indicate that the V-patterns are relatively easy while the I-patterns are extremely difficult for children in elementary and secondary schools.

Ennis and Paulus[66] found significant differences in means, difficulty indices and percentage of mastery of V-patterns and I-patterns of class and conditional reasoning at given grade levels (4-12). For both types of reasoning, the I-patterns were significantly more difficult than the V-patterns. They reported also that the greatest improvement in the mastery of specific patterns from lower to upper grade levels is in the I-patterns.

Miller[67] used five patterns of conditional logic; three were V-patterns and two were I-patterns. In addition,

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[66]Ennis and Paulus, op. cit.

[67]Miller, op. cit.

he included a V-pattern from disjunctive reasoning. He reported that children in Grades 8, 10 and 12 do not find as much difficulty with items on the V-patterns as they do with items on the I-patterns which were extremely difficult for these age groups.

For Grade 8 students, Miller obtained an average item difficulty index of 0.74 for the V-patterns and 0.06 for the I-patterns. Similar results were obtained in an earlier study by the present investigator.[68] Thus, for this group of students at least, it may be argued that most of the children are able to respond correctly to items associated with the V-patterns. On the I-patterns however, the students do not have the necessary abilities and the scores obtained are of less than chance probability.

The type of pattern in which an argument is presented is therefore an important factor in determining success with logical reasoning tasks.

Attitudes and emotions have also been found to affect logical reasoning scores. Janis and Frick[69] tried

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[68] M. E. Amin, The Validation of a Conditional Reasoning Test, Interim Report presented to School of Graduate Studies, University of Ottawa, 1976.

[69] J. L. Janis and F. Frick, "The relationship between Attitude Towards Conclusions and Errors in Judging Logical Validity of Syllogism," in Journal of Experimental Psychology, Vol. 34, 1944, p. 73-77.

to assess the belief that people are likely to be satisfied with unsound arguments if they accept the conclusion to which arguments lead; and that conversely, they are likely to be unduly critical of, or even reject outright, the argument if they do not accept the conclusion. By using an attitude questionnaire, they assessed the attitudes of 19 graduate students on certain social issues. Later, a test on class logic with conclusions bearing on those social issues was administered to the students. It was hypothesized that if there is agreement with the conclusion, more errors will be made in judging logical validity by accepting invalid argumentation than by rejecting valid argumentation. A second hypothesis was that if there is disagreement with the conclusion, the reverse would be true. The results supported the two hypotheses.

Other studies[70,71,72] have also supported the hypothesis that personal convictions, attitudes and emotions do, in fact, affect the ability to reason logically. It seems

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[70] J. J. B. Morgan, and J. T. Morton, "The Distortion of Syllogistic Reasoning Produced by Personal Convictions," Journal of Social Psychology, Vol. 20, 1944, p. 39-59.

[71] A. Lefford, "The Influence of Emotional Subject Matter on Logical Reasoning," Journal of General Psychology, Vol. 33, 1946, p. 127-151.

[72] D. L. Thistlewaite, "Attitude and Structure as Factors in the Distortion of Reasoning," Journal of Abnormal Social Psychology, Vol. 45, 1950, p. 442-458.

appropriate to conclude that personal convictions and emotions do influence logical reasoning ability. The suggestive content of logical reasoning described earlier has premises which contradict common knowledge. This type of content is likely to arouse some subjects emotionally so that they judge the validity of conclusions drawn not in terms of the logical structure of the arguments but in terms of their agreement or non-agreement with the stated premises and conclusions.

Age relationships have been among the most frequent relationships that have been studies with respect to logical reasoning and thinking. In most of these studies,[73,74,75] Piaget's developmental theory[76] has provided a theoretical base.

Contrary to Piaget's expectation that hypothetical reasoning is not possible before 11-12 years of age, Hill[77] found that children (ages 6-8) were able to recognize valid

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[73] Miller, op. cit.

[74] D. Paulus, A Study of Children's Abilities to Deduce and Judge Deductions, Doctoral Dissertation. Cornell University, Ann Arbor, Michigan, University Microfilms, 1967, No. 67-16365.

[75] Gardner, op. cit.

[76] B. Inhelder, and J. Piaget, The Growth of Logical Thinking from Childhood to Adolescence, New York, Basic Books, 1958.

[77] S. A. Hill, A Study of the Logical Abilities of Children, Doctoral Dissertation, Stanford University, Ann Arbor, Michigan: University Microfilms 1961, No. 61-1229.

conclusions derived from hypothetical premises. In addition, she reported that the ability to reason logically increases with age for the three types of logic (sentence, quantificational, and class logic) included in her study.

Donaldson[78] conducted longitudinal studies with students 10-12 and 12-14 years of age. She presented these students with three verbal problems in class logic and found that their ability to solve problems involving V-patterns increased with age. They showed no improvement in the ability to solve problems involving I-patterns of logic.

Later studies by Gardner,[79] Paulus[80] Miller,[81] and Roberge and Paulus[82] have supported earlier findings that ability in logical reasoning increases with age. Age, then, seems to be an important factor in logical reasoning.

Intelligence, also, has been observed to influence logical reasoning ability. Paulus[83] argued that logical reasoning ability is essentially an intellectual trait and

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[78] M. Donaldson, A Study of Children's Thinking, London, Tavistock Publications, 1963.

[79] Gardner, op. cit. 1966.

[80] Paulus, op. cit.

[81] Miller, op. cit.

[82] Roberge and Paulus, op. cit.

[83] Paulus, op. cit., p. 67.

is therefore expected to correlate positively with intelligence test scores. He developed two forms of a conditional reasoning test, an assessing form in which the subjects assessed the validity of a drawn conclusion (evaluation), and a deducing form in which the subjects drew their own conclusions from given premises (convergent production). In each of the two forms of his conditional reasoning test, Paulus included six patterns of conditional reasoning, four V-patterns and two I-patterns. For each of the two forms, and for each of Grade 5, 7, 9 and 11, significant positive correlations were obtained between intelligence test scores and scores on the V-patterns. However, negative correlations were obtained between intelligence test scores and the scores on the I-patterns in Grades 5, 7 and 9, whereas these correlations were very low but positive for Grade 11.

In Miller's study reported above, he concluded as did Paulus, that for the grade levels studied, intelligence test scores correlate positively with the scores on the V-patterns. In addition, intelligence scores and I-patterns correlated negatively. The latter finding was especially common at lower grade levels.

Tucker[84] compared the performance of educable

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[84] R. C. Tucker, A Study of Logical Abilities of Children as a Function of Mental Age and Chronological Age. (Doctoral Dissertation, St. Louis University), Ann Arbor, Michigan, University Microfilms, 1971, No. 71-21429.

mentally retarded children with that of normal children of the same chronological age (6-8 years) on deductive reasoning problems, using V-patterns from sentence, class and ordinal logic. She found that normal children performed significantly better than mentally retarded children.

The results of these studies indicate that intelligence is related positively to performance on the V-patterns of deductive reasoning. The I-patterns scores, however, tend to correlate negatively with intelligence test scores especially at lower age levels. The explanation might be that less intelligent children feel more free to use the type of response which expresses uncertainty of judgment. The correct response to I-patterns items are of the form 'Maybe', 'Neither 1 nor 2 necessarily follows' etc. These responses express that one cannot be certain of a unique conclusion to be drawn from the premises.

In the foregoing section, conditional logic has been described in relation to other types of logic. In addition, some factors that have been observed to affect logical reasoning ability were discussed. The factors discussed included type of content, type of pattern, age, attitudes and emotions and intelligence.

It was discussed earlier that more psychologically differentiated (field independent) persons are more analytic,

more able to abstract and generalize and to rely on internal frames of reference in their judgment than less psychologically differentiated (field dependent) persons. These attributes are useful in solving problems in conditional reasoning. Hence, extent of psychological differentiation may be an important factor affecting conditional reasoning ability. Such a relationship is explored in the next section. In addition, empirical research bearing upon this relationship is reviewed.

3. Psychological Differentiation and Performance on Conditional Reasoning Tasks

This section begins with a description of the theoretical and empirical relationships between psychological differentiation and performance on conditional reasoning tasks in general. These relationships are then considered when the contents of conditional reasoning arguments are varied. The section concludes by relating the types of errors made on a conditional reasoning task to psychological differentiation.

The basic requirements for the solution of conditional reasoning tasks and other deductive tasks as well, are the ability to analyze the premises, re-structure them, and decide on an appropriate conclusion on the basis of the interrelationships amongst the premises.

Field independent persons are more analytic, have

a higher level of cognitive clarity and are therefore more able to re-structure problems than their field dependent counterparts. The former would, therefore, be expected to perform better than the latter on conditional logic tasks. The research findings bearing upon this expectation have, however, been inconclusive. Linton,[85] assessed the attitudes of college students towards several social issues. She then administered a group of class logic problems bearing on these social issues. The conclusions of the arguments sometimes coincided with and sometimes contradicted the subject's known social attitudes. Concrete-familiar items were also included. She used the RAT, BAT and the EFT as measures of psychological differentiation. She concluded that there are no significant differences between the performance of field-dependent and field-independent subjects on the concrete-familiar items.

In another study, Alexander[86] predicted a positive relationship between psychological differentiation and scores on class logic problems. One hundred male under-

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[85] H. B. Linton, "Dependence on External Influence: Correlates in Perception, Attitudes and Judgments," in Journal of Abnormal Social Psychology, Vol. 51, 1955, p. 502-507.

[86] S. Alexander. A Study of Perceptual and Verbal Differentiation Among Male College Students. Doctoral Dissertation, The George Washington University, Ann Arbor, Michigan, University Microfilms, 1970, No. 71-12,285.

graduates were administered the EFT, the Hidden Figures Test (HFT) and a verbal skills battery. The verbal skills battery was composed of two reference tests for each of the Guilford factors selected for the study, plus the vocabulary and comprehension subtests from the Wechsler Adult Intelligence Scale. The nonsense syllogism (class logic problems) represented the logical evaluation factor. The class logic scores did not emerge as a predictor of either the EFT or the HFT scores. Moreover, scores on the class logic problems loaded on a factor different from the one on which the two measures of psychological differentiation loaded. Thus, for this sample, class logic performance was found unrelated to extent of psychological differentiation.

In an earlier factor analytic study however, Pemberton[87] had found that for graduate students, scores on class logic problems loaded on the same factor as scores on the Concealed Figures Test (CFT). The results of the studies thus reviewed indicate that for adult subjects, at least, there may be little or no relationship between logical reasoning ability and extent of psychological differentiation. Since analytic ability is a basic requirement in solving logical reasoning problems, findings like some of the ones above, appear to contradict Witkin's descrip-

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[87] C. B. Pemberton, "The Closure Factors Related to Other Cognitive Processes," in Psychometrica, Vol. 17, No. 3, 1952, p. 267-287.

tion of field independent persons as 'analytic'. A possible explanation for the above results is that the test items might have been very easy for most of the adult subjects. Some insight may be gained by studying the relationship between psychological differentiation and performance on conditional logic when children in Piaget's formal operational stage are examined. Such children, expected to be capable of solving conditional logic problems, are not expected to have received any formal training in logic. Also, it was noted earlier that type of content and type of pattern are among the factors that affect logical reasoning ability. Therefore, the relationship between psychological differentiation and conditional logic performance may be further clarified by examining performance on different types of contents and patterns. Accordingly, in what follows, such a relationship will be explored.

As discussed above, field independent persons rely less on external source of information in defining their attitudes and judgments and have greater analytic ability than field dependent subjects. One would, therefore, expect field independent subjects to perform almost as well on conditional reasoning tasks having the suggestive or symbolic contents as tasks having concrete-familiar contents. However, performance of field dependent subjects is expected to be decreased considerably on tasks having the suggestive

or symbolic contents.

In Linton's study discussed above, she found that field dependent subjects made more errors on the items that contradicted their social attitudes than on the neutral items. Field independent persons however, were more able to overcome the "atmosphere effect" and to organize the material more in accordance with the requirement of the structure of the problem. This implies that field independent subjects may make fewer errors on conditional reasoning tasks when presented with the suggestive contents.

In another study, Witkin et al[88] correlated the scores of ten-year-old boys on the cognitive clarity scale with their field dependence scores and obtained a significant positive correlation ($r = .77$, $p < .01$, $N = 30$) between the two sets of scores. Field independent persons tended to have a higher level of cognitive clarity than field dependent persons. The ability to abstract and generalize is only one of six dimensions of the cognitive clarity scale. Witkin and his colleagues did not assign separate ratings to each of the dimensions. Rather, a global score, reflecting an individual's cognitive clarity was obtained. Nevertheless, it appears from this finding that field dependent persons may be more limited in their

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[88]Witkin et al, op. cit., 1962, p. 111.

abilities to abstract and generalize and therefore make many errors on the symbolic contents of conditional reasoning tasks.

When subjects do not know the correct answer to an item, differences between field-independent and field-dependent persons are to be expected in the choice of distractors. Field dependent persons have a greater tendency than field independent persons, to rely on authority, and on peer group in defining their judgments. They would therefore be expected to be more unsure of themselves, to have a more unstable self-view and express more uncertainty in their judgments than their field independent counterparts. It is therefore expected that on conditional reasoning tasks, field independent persons would tend to choose distractors which express certainty of judgment while field dependent persons choose those that express uncertainty of judgment. The studies reviewed below are supportive of this expectation.

Sanguiliano[89] tested the hypothesis that field independent persons express greater certainty in their judgment than field dependent subjects. She determined the extent of each of a subject's confidence in the judg-

89. I. Sanguiliano. An Investigation of the Relationship between the perception of the upright in space and several factors in personality organization, Unpublished Doctoral Dissertation, Fordham University, 1951, quoted by Witkin et al, op. cit., 1962, p. 168.

ments made in the BAT and RAT. Field independent persons were found to express significantly greater confidence and certainty in their judgments than field dependent subjects.

In another study, Gross[90] tested a group of subjects on the RFT with a plain glass placed in front of the apparatus. The subjects were told that the glass was a specially ground lens which distorts vision in unknown ways. At the end of the test, after being told about the supposed distorting effects of the lens, they were asked to check terms on an adjective checklist which best expressed their feelings. The very field dependent subjects most often checked "uncertainty" while the very field independent checked "expectancy".

In a later study, Elliott[91] administered the RFT and the EFT to 128 male undergraduates. Among other tests administered were the Maze Test (MT), the Self-Concept Differentiation Test (SCD) and the Independence of Judgment Scale (UJS). A measure of uncertainty was defined as the time in seconds spent by the subject on the first trial of the MT. Of the many hypotheses developed, those that are of interest were the following:

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[90] F. Gross, "The Role of set in perception of the upright," in Journal of Personality, Vol. 27,1959, p. 95-103.

[91] Elliot, op. cit.

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1. Field dependent subjects have a lower self-concept differentiation than field independent subjects.
2. Field dependent subjects score lower than field independent subjects on the measure of independence of judgment.
3. Field dependent subjects score higher than field independent subjects on the measure of uncertainty.

The results indicated that while hypothesis 1 was not supported, hypotheses 2 and 3 were supported. In particular, since field dependent subjects performed more poorly than field independent subjects on the MT, this poorer performance was accounted for by their relatively slow travel around the maze on the first trial and therefore an indication of greater uncertainty of judgment.

These results indicate that field independent subjects, compared to field dependent subjects, may make more errors on a conditional reasoning test by choosing a response of the form 'yes' or 'no', 'true' or 'false', which indicates that one is certain that the conclusion drawn follows or does not follow necessarily from some given information.

Erginel[92] attempted to relate types of errors made to extent of psychological differentiation. He administered a "critical thinking" test based on ideas from

[92]A. Erginel, The Relation of Cognitive Style and Intelligence to Achievement and Errors in Thinking (Doctoral Dissertation, Lehigh University) Ann Arbor, Michigan, University Microfilms, 1970, No. 70-1719.

science and social science. The subject was asked to mark a list of statements relating to the paragraphs as true, probably true, false or probably false, in the light of information given. The ABCS, the HFT and Thurstone's CFT were used to determine extent of psychological differentiation.

Erginel hypothesized that field dependent subjects make more errors by selecting the responses 'true' or 'false' while field independent subjects make more errors by selecting the responses 'probably true', or 'probably false'. His results failed to confirm the hypothesis. Such a hypothesis however, seems to contradict the expectation that field dependent subjects are unsure of themselves and tend to express uncertainty in their judgment. Another problem associated with the interpretation of Erginel's results lies in his use of the Chi-square test in analyzing the data when expected frequencies are less than five. When expected frequencies are very small, the Chi-square test yields only roughly approximate probability values.

To conclude, there appears to be several aspects of the relationship between psychological differentiation and logical reasoning that require study. These include the relationship between psychological differentiation and performance on conditional reasoning tasks in general and when

these tasks are varied over different types of contents and patterns. They also include relating the choice of distractors in these tasks to psychological differentiation.

The following research questions will therefore be studied:

1. Do field independent (FI) subjects perform better than field dependent (FD) subjects on the V-patterns of a conditional reasoning test?

2. Does the variation of the content and type of pattern of conditional arguments affect the performance of FD and FI persons to the same extent?

3. Do FI and FD persons make different types of errors on a conditional reasoning test?

4. Statement of Hypotheses

In order to examine the questions posed in the preceding section, it is hypothesized that psychological differentiation is related to performance on conditional reasoning tasks with different types of contents and patterns. It is also postulated that psychological differentiation is related to the types of errors made on a conditional reasoning test. These postulates are based on the following rationale.

On the concrete-familiar content of the conditional reasoning tasks, analytic ability is required for correct solution of the items. With the suggestive content, the items are constructed so that either the premises or the correct conclusion state something that the subject knows to be false. To respond correctly to items associated with this content, analytic ability, as well as ability to rely on internal frames of reference in defining one's attitude and judgment are required.

The subject makes an error if he utilizes factual

knowledge (i.e. relying on external frame of reference) in determining the validity of arguments.

On the symbolic content, in addition to analytic and restructuring ability, the subject is required to perform transformations by replacing letters of the English alphabet with simple sentences.

Field independent subjects are described as more analytic, more able to rely on internal frames of reference in defining their attitudes and judgment and more able to restructure problems than field dependent subjects. Therefore, on the V-patterns tasks where many have the necessary abilities, the former subjects are expected to perform better than the latter subjects. Moreover, on these tasks, field independent subjects are expected to perform almost as well on the suggestive and symbolic contents as they do on the tasks having concrete-familiar content.

However, one would expect the performance of field dependent subjects to be decreased considerably on the tasks having the suggestive or symbolic content. The following hypotheses are therefore developed:

1.- On the V-patterns of conditional reasoning where many subjects have the necessary abilities, FI subjects perform better than FD subjects.

2.- On the V-patterns of conditional reasoning, there is interaction between psychological differentiation and type of content. FI persons are not expected to be influenced in their performance on the different types of contents as much as FD persons.

When subjects do not know the correct answer, differences between field independent and field dependent subjects in their choice of distractors may be expected.

On the V-patterns tasks, two types of errors are possible; an error expressing uncertainty of judgment and one expressing certainty of judgment. With the extremely

difficult I-patterns tasks, only an error expressing certainty of judgment can be made. The response which expresses uncertainty of judgment is the only correct response for these items.

Field dependent persons are more 'people oriented', relying more on authority and peer group in defining their attitude and judgment than field independent persons. The former are likely to be more unsure of themselves and express greater uncertainty in their judgment than the latter.

Hence the following additional hypotheses are made.

3.- On the V-patterns tasks of a conditional reasoning test, the proportion of errors of the type expressing uncertainty of judgment is greater for FD persons than that for FI persons.

And because of the greater tendency in FD persons to choose distractors expressing uncertainty of judgment,

4.- On the I-patterns tasks, FD persons perform better than FI persons since the correct answer to these very difficult items is one which expresses uncertainty of judgment.

In the next chapter are described the procedures used in testing these four hypotheses.

CHAPTER II

EXPERIMENTAL DESIGN

This chapter begins with a description of the research subjects. The measuring instruments that were used are then described, with a discussion of their validity and reliability. Following this, the method of data collection is described. The chapter concludes with a description of the statistical techniques employed in testing the hypotheses stated in the null form.

1. Research Subjects

The research subjects included 302 eighth graders (142 boys and 160 girls), averaging 13 years 6 months in age from six schools of the Lanark, Leeds and Grenville Roman Catholic Separate School Board. The town with the largest population within this School Board is Brockville, with a population of nineteen thousand. The subjects may therefore be generally described as coming from a background that is rural or suburban.

2. Measuring Instruments

In this section, the four instruments that were administered are discussed. These include the Conditional

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Reasoning Test (CRT)[1], the Dominion Group Test of Learning Capacity (DGT),[2] the Group Embedded Figures Test (GEFT)[3] and the Articulation of Body Concept Scale (ABCS).[4]

The CRT consists of items measuring the ability to do conditional reasoning with three V-patterns and two I-patterns. These patterns, taken from a test originally developed by Miller,[5] are presented below in symbolic form to illustrate the nature of the logical inference pattern involved. Following convention, the ltters P, Q and R represent simple statements or any combination of such statements.

The five patterns are:

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[1]M. E. Amin, The Validation of a Conditional Reasoning Test, Interim Report presented to the School of Graduate Studies, University of Ottawa, 1976.

[2]The Dominion Group Test of Learning Capacity, Dept. of Educational Research, University of Toronto: Vocational Guidance Centre, Ontario College of Education, University of Toronto, 1934.

[3]H. A. Witkin, Philip K. Oltman, Evelyn Ruskin and Stephen A. Karp. Manual for Children's Embedded Figures Test and Group Embedded Figures Test. Consulting Psychologists Press Inc., Palo Alto, California, 1971.

[4]H. F. Faterson and Herman A. Witkin, "Longitudinal Study of the Development of Body Concept" in Development Psychology, Vol. 2, No. 3, 1970, p. 429-438.

[5]W. A. Miller, The Acceptance and Recognition of Six Logical Inference Patterns by Secondary Students, (Doctoral Dissertation, University of Wisconsin), Ann Arbor, Michigan, University Microfilms, 1968, No. 68-13651.

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1. LAW OF DETACHMENT (LD)

If P, then Q.
P.
∴

1. Q. (correct answer)
2. Not Q.
3. Neither 1 nor 2 necessarily follows.

2. CONTRAPOSITIVE INFERENCE (CI)

If P, then Q.
Not Q.
∴

1. Not P. (correct answer)
2. P.
3. Neither 1 nor 2 necessarily follows.

3. HYPOTHETICAL SYLLOGISM (HS)

If P, then Q.
If Q, then R.
∴

1. If P, then R. (correct answer)
2. If P, then not R.
3. Neither 1 nor 2 necessarily follows

I-Patterns:

4. AFFIRMING THE CONSEQUENT (AC)

If P, then Q.
Q.
∴

1. P. (usual error)
2. Not P.
3. Neither 1 nor 2 necessarily follows (correct answer)

5. DENYING THE ANTECEDENT (DA)

If P, then Q.
Not P.
∴

1. Not Q. (usual error)
2. Q.
3. Neither 1 nor 2 necessarily follows (correct answer)

EXPERIMENTAL DESIGN

Neither affirming the consequent nor denying the antecedent pattern (4 and 5 above) produces unique conclusions that follow necessarily from the premises. Therefore, these are I-patterns while the rest are V-patterns.

The selection of these patterns can be justified in several ways. First, a survey of newspaper editorials, supreme court decisions and auto mechanic handbooks conducted by the staff of the Cornell Critical Thinking Project[6] showed that these patterns were used frequently. Second, these patterns are almost always listed as being basic in logic books.[7] Further, the selection of these patterns is consistent with the research efforts of other investigators dealing with this area of logic.[8,9]

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[6] R. H. Ennis and D. Paulus. Critical Thinking Readiness in Grades 1-12, Phase 1: Deductive Reasoning in Adolescence, Ithaca, New York; The Cornell Critical Thinking Project, 1965.

[7] M. R. Cohen and E. Nagel, An Introduction to Logic and Scientific Method, New York, Harcourt Brace & World Inc., 1934, p. 98.

[8] D. Paulus, A Study of Children's Abilities to Deduce and Judge Deductions, Doctoral Dissertation. Cornell University, Ann Arbor, Michigan, University Microfilms, 1967, No. 67-16365.

[9] Miller, op. cit.

EXPERIMENTAL DESIGN

Although the I-patterns are extremely difficult for the grade eight students employed in this study, these patterns were included because the V-patterns and I-patterns have contrasting types of correct responses. On the V-patterns, the correct response is of the form 'Yes' or 'No' which expresses that one is certain the conclusion does or does not follow from the given premises. The response of the form 'Maybe', 'Neither 1 nor 2 necessarily follows', which expresses that one is not certain if the conclusion drawn follows necessarily from the premises is an incorrect response for the V-patterns and the correct response for the I-patterns.

Each item was written in such a way that the major and minor premises conform to one of the five patterns. Three possible conclusions, as presented above, are provided for each item. These include (1) a possible conclusion from the premises; (2) its negation; and (3) Neither 1 nor 2 necessarily follows. The subject's task is to select one of the three possible conclusions on the basis of the information given in the premises.

There are 60 items in the test. Twelve items measure each pattern and these are equally divided into the concrete-familiar, suggestive and symbolic contents. The items are randomly placed on the test. The construct validity and reliability estimates for this test had been

established for grade eight students in an earlier study.[10] The KR_{20} reliability estimates for the patterns subtests ranged from 0.82 to 0.85 and from 0.81 to 0.92 for the content subtests.[11] These indices fall within the range of reliability indices normally considered adequate for instruments of this type. In Appendix 1 are presented the instructions for answering the questions and a copy of the CRT. Presented in Appendix 2 is the distribution of the items for the various pattern/content subtests.

Intelligence test scores were obtained by administering the Dominion Group Test of Learning Capacity (DGT) (Form A Intermediate Level, Grades 7, 8, 9). The DGT consists of several types of items -- verbal opposites, word meaning, verbal analogies, verbal classification, verbal reasoning, spatial analogies, number sequence and arithmetic reasoning, designed to give a broad measure of a student's abilities in areas related to success in the more academic courses in school. The test has two equivalent forms, each with seventy items. The scores are given in terms of Intelligence Quotient (IQ) scores.

The authors argue for the validity of this test by indicating that scores from it correlate well with scores on similar tests variously named "intelligence",

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[10] Amin, op. cit.

[11] Ibid., p. 72.

"scholastic aptitude", "academic aptitude", "mental ability", etc. For nine Grade 8 classes, Russell and Dilling[12] report correlations ranging from 0.50 to 0.59 between IQ scores obtained from the DGT and those obtained from the Otis Quick-Scoring Mental Ability Test.

Tyler[13] reports a reliability coefficient of 0.95 (N = 1000) obtained by the equivalent forms method. It may be concluded that this test is a valid and reliable measure of general intelligence for the given age group.

Two measures of psychological differentiation were used in this study and are described below. The two instruments were used to provide a measure of two aspects of psychological differentiation -- psychological differentiation in the perceptual field and in the articulation of the body concept.

In determining the extent of psychological differentiation, Witkin uses mainly individually administered tests which are not practical for large-scale administration. There are two tests that can be group administered which Witkin developed for rapid assessment of psychological

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[12] H. H. Russell and H. J. Dilling, "Comparison of General Intelligence Tests Results and Student Achievement in Grade 8 and Grade 9 of Scarborough Schools" in Ontario Journal of Educational Research, Vol. 8, No. 3, 1966.

[13] F. T. Tyler, "Tests Reviews" in Buros (Ed.) The Third Mental Measurements Yearbook, Rutgers University Press, New Brunswick, 1949.

differentiation.[14] These are the Group Embedded Figures Test (GEFT)[15] and the Articulation of Body Concept Scale (ABCS).[16]

The GEFT was developed to provide an adaptation[17] of the individually administered EFT, which would make possible group testing. The GEFT and the ABCS (used for rating the human figure drawings) were therefore selected for the assessment of the extent of psychological differentiation. The GEFT which can be administered in a single 20 minute session, consists of 18 complex figures, 17 of which were taken from the EFT. As in the EFT, the subject is prevented from simultaneously seeing the simple figure and the complex figure containing it. This is accomplished by printing the simple figures on the back cover of the GEFT booklet and the complex figures on the booklet pages.

The GEFT contains three sections. The first section has seven simple items and it is primarily used for practice. The second and third sections each contain 9 more difficult items. Two minutes are allowed for the practice section and five minutes for each of the last two

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[14] H. A. Witkin, "Psychological Differentiation and Forms of Pathology" in Journal of Abnormal Psychology, Vol. 70, No. 5, 1965, p. 317-336.

[15] Ibid., p. 324.

[16] Ibid.

[17] Witkin et al, op. cit., 1971, p. 26.

sections. The subject's task is to trace the simple figure embedded in the more complex one, and his score is the total number of simple figures correctly traced in the second and third sections. The validity of the instrument was established by relating it to other measures of psychological differentiation. For men, it correlated 0.71 with the ABCS, and -0.82 with the EFT (solution time). For women, the correlation with the ABCS was 0.55 and -0.63 with the solution time of the EFT.[18] Witkin et al[19] report a split half reliability of 0.82 for 80 men and the same index for 97 females. For 213 eight graders, Amin[20] obtained a split half reliability of 0.86.

The ABCS, used as another measure of psychological differentiation, will now be discussed. In the ABCS, the subject is asked to draw a person and when that is done, he is asked to draw a person of opposite sex to the first. The drawings are rated according to a scale based on form, identity, sex differentiation and level of detailing. These criteria are used to provide a single rating on a five-point scale, ranging from the most sophisticated drawings to the most primitive and infantile.

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[18] Ibid., p. 29.
[19] Ibid.
[20] Amin, op. cit.

EXPERIMENTAL DESIGN

To establish the validity of the test, Witkin[21] correlated the pooled ratings of four judges with the mean of the Z-scores of the RFT, BAT and EFT and obtained a correlation of 0.64 ($p < .01$).

In a study conducted with 16 college men concerning the inter-judge reliability, Witkin[22] obtained inter-judge correlations for four psychiatrists ranging from 0.83 to 0.92. Other researchers,[23,24,25] employing larger samples, have obtained inter-judge reliability coefficients comparable with those indicated above.

The GEFT and ABCS may therefore be considered as valid and reliable measures of psychological differentiation.

In the next section are discussed the methods by which the data were collected.

3. Method of Data Collection

The general procedure followed in administering the four tests is described in Appendix 3. The experimenter

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[21] Witkin, op. cit., 1965, p. 320.

[22] A. Burton, and B. Sjoberg, Jr. "The Diagnostic Validity of Figure Drawings in Schizophrenia," in Journal of Psychology, Vol. 57, 1964, p. 3-18.

[23] N. L. Corah, "Differentiation in Children and Their Parents," in Journal of Personality, Vol. 33, 1965, p. 300-308.

[24] Witkin et al, op. cit., 1971.

[25] Amin, op. cit.

EXPERIMENTAL DESIGN

followed the specific procedures outlined for administering each of the tests.

The DGT which was administered first, took 30 minutes to complete. The CRT was then administered. This test had no time limits but it generally took about 25 minutes to complete. After this, there was a 15 minute break. The GEFT and the human figure drawing test (ABCS) were then administered, each taking about 20 minutes.

The total scores on the DGT were converted to Intelligence Quotient (IQ) scores, following the conversion table presented in the manual. For the CRT, content subtest scores for V-patterns and I-patterns total score were obtained for each individual. In addition, for the V-patterns, the frequency of errors of the type 'Neither 1 nor 2 necessarily follows' was determined for each subject.

Four doctoral students familiar with the ABCS and Witkin's theory of psychological differentiation formed two pairs of judges for the purpose of rating the human figure drawings. Each pair rated each of the male and female drawings together. The procedure which was repeated after one week, resulted in eight ratings for each subject. This was intended to provide information on intra-judge and inter-judge coefficients of reliability. The score for each subject on the ABCS was defined as the average of the eight scores.

EXPERIMENTAL DESIGN

To define the field dependent and field independent subjects, the correlation between the two measures of psychological differentiation was considered. The GEFT and ABCS correlated 0.55, indicating that only about 30% of the variance of one variable can be explained by the other variable. It was therefore decided that only those who scored in the top 50% of the distribution for both the GEFT and ABCS would be classified as field independent. Those who scored in the bottom 50% of each of the two scales were classified as field dependent. This resulted in 94 field independent and 121 field dependent subjects. The scores obtained by all the subjects on the V-patterns content subtests, I-patterns total score, DGT, GEFT and ABCS are presented in Appendix 4.

4. Planned Analysis

It was planned to test Hypotheses 1 and 2 in the null form by use of a two-group repeated measures multivariate analysis of covariance with repeated measures on the type of content (concrete-familiar, suggestive, and symbolic). The other independent variable was the extent of psychological differentiation (field dependent, field independent). The V-patterns content scores served as the dependent variables, with intelligence as the covariate.

EXPERIMENTAL DESIGN

It was proposed to test Hypothesis 3 using a one-way analysis of covariance, with psychological differentiation as the independent variable and intelligence as the covariate. The dependent variable was defined as

$$p = \frac{\text{No. of "Neither 1 nor 2 necessarily follows" errors}}{\text{Total number of errors}}$$

It was also proposed to test Hypothesis 4 in the null form by use of a one-way analysis of covariance with the I-patterns total scores as the dependent variable, psychological differentiation as the independent variable and intelligence as the covariate.

The usual assumptions associated with the use of repeated measures and analysis of covariance were tested. Statistical significance was set at the 0.05 level.

In this chapter, the design of the study was presented in sufficient detail so that the study could be replicated. This has been done by reference to the kind of research subjects, the instruments used, the administration of the instruments and the method of analyzing the data collected. The results of the investigation described here are presented and discussed in the next chapter.

CHAPTER III

PRESENTATION AND DISCUSSION OF RESULTS

The results of the empirical investigation that is described in the preceding chapter are presented and discussed in this chapter.

The chapter begins with a presentation of descriptive information on the various variables employed in the study. Following this, separate sections are devoted to the presentation and discussion of the first two hypotheses and the last two hypotheses. In each of these two sections, the relevant assumptions underlying the particular analysis are tested. The means and standard deviations obtained by field dependent and field independent subjects on the dependent variables and covariate are then presented. This is followed by a presentation of the results of the inferential test. In each case a discussion of the results, particularly in relation to Witkin's theory, concludes the section.

In the fourth section, some educational implications of the findings of this study are presented. In addition, suggestions for further research are given. The chapter ends with a summary and statement of conclusions.

1. Descriptive Data

Reliability estimates for the various tests and subtests utilized in this study, and the estimated correla-

tions among them are presented in this section.

In Table I are presented the reliability estimates. Estimated correlations among the five patterns of the CRT are presented in Table II, while those among the V-patterns content subtest scores, V-patterns and I-patterns total scores are presented in Table III.

The reliability estimates reported in Table I are of magnitudes comparable with those reported in Chapter II. Their sizes fall within ranges normally accepted as adequate for these types of tests.

The pattern of negative correlations between the I-patterns and V-patterns shown in Table II is similar to that obtained for Grade 8 students by earlier researchers.[1,2] These negative correlations indicate that students who perform well on the V-patterns tend to perform poorly on the I-patterns and vice versa. Correlations among the three V-patterns and between the two I-patterns, are, on the other hand, positive. These again, are supportive of the results

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[1]M. E. Amin, The Validation of a Conditional Reasoning Test, Interim Report presented to the School of Graduate Studies, University of Ottawa, 1976.

[2]W. A. Miller, The Acceptance and Recognition of Six Logical Inference Patterns by Secondary Students (Doctoral Dissertation, University of Wisconsin), Ann Arbor, Michigan, University Microfilms, 1968, No. 68-13651.

PRESENTATION AND DISCUSSION OF RESULTS

TABLE I

Reliability estimates for the DGT, GEFT, ABCS, V-patterns and I patterns Total Scores, and V-patterns Content Subtests of the CRT. (N = 302)

Test	Type of Reliability	Reliability Estimate
DGT	KR_{20}	0.91
GEFT *	Split-half	0.88
	Interjudge	0.55 to 0.85
ABCS	Intrajudge	0.68 to 0.85
C R T		
V-patterns		
Concrete-familiar		0.68
Suggestive		0.73
Symbolic		0.79
Total	KR_{20}	0.89
I-patterns total		0.78

* A split-half reliability estimate was calculated because, as indicated earlier, the score for the GEFT was obtained by adding the scores from sections two and three of the test. These two sections are equivalent.

PRESENTATION AND DISCUSSION OF RESULTS

TABLE II

Matrix of Estimated Correlations Among the Five Patterns of the Conditional Reasoning Test (N = 302)

	V-Patterns			I-Patterns	
	LD	CI	HS	DA	AC
LD	1.00				
CI	0.74	1.00			
HS	0.60	0.55	1.00		
DA	-0.50	-0.55	-0.40	1.00	
AC	-0.52	-0.56	-0.34	0.66	1.00

LD: Law of Detachment
CI: Contrapositive Inference
HS: Hypothetical Syllogism
DA: Denying the Antecedent
AC: Affirming the Consequent

PRESENTATION AND DISCUSSION OF RESULTS

obtained by researchers.[3,4] Moreover, the item difficulty indices ranged from 0.40 to 0.89 for the V-patterns and from 0.04 to 0.25 for the I-patterns. This indicates that while many subjects are able to respond correctly to items associated with the V-patterns, the I-patterns are extremely difficult. These results, together with the pattern of negative correlations between the V-patterns and I-patterns, support the contention that it is inappropriate to add the V-patterns and I-patterns scores when analyzing the data.

The investigator determined the correlation estimates presented in Table III in order to further examine the pattern of correlations among the other tests and subtests. The results indicate that while scores on the two measures of psychological differentiation and on IQ scores each correlate positively with V-patterns subtests of the CRT, the correlations are negative with the I-patterns scores. The pattern of positive correlations between V-patterns scores and IQ scores and negative correlations between I-patterns scores and IQ scores has been reported by Miller[5]

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[3] Ibid.

[4] D. Paulus, A Study of Children's Abilities to Deduce and Judge Deductions, (Doctoral Dissertation, Cornell University), Ann Arbor, Michigan, University Microfilms, 1967, No. 67-16365.

[5] Miller, op. cit.

PRESENTATION AND DISCUSSION OF RESULTS

TABLE III

Matrix of Estimated Correlations Among the V-patterns Total Scores, the GEFT, ABCS and IQ Scores (N = 302)

	CF	SUG	SYM	TOVAL	TOIN	GEFT	ABCS	IQ
CF	1.00							
SUG	0.65	1.00						
SYM	0.47	0.57	1.00					
TOVAL	0.80	0.88	0.82	1.00				
TOIN	-0.59	-0.56	-0.44	-0.61	1.00			
GEFT	0.45	0.48	0.41	0.53	-0.38	1.00		
ABCS	0.31	0.36	0.30	0.38	-0.42	0.55	1.00	
IQ	0.55	0.59	0.53	0.66	-0.30	0.55	0.35	1.00

CF: Concrete-familiar content score
SUG: Suggestive content score
SYM: Symbolic content score
TOVAL: V-patterns total score
TOIN: I-patterns total score
GEFT: Group Embedded Figures Test score
ABCS: Articulation of Body Concept Scale score
IQ: Intelligence Test score

and Paulus.[6] The positive correlations between the measures of psychological differentiation and the V-patterns scores indicate that high scorers on either the GEFT or the ABCS tend to do well on the V-patterns of the CRT. However, these individuals tend to perform poorly on the I-patterns task.

In the next section are presented and discussed the results of testing Hypotheses 1 and 2.

2. Presentation and Discussion of the Results of Testing Hypotheses 1 and 2.

The results of testing the first two hypotheses are presented and discussed in this section.

It was predicted that field independent subjects (FI) perform better than field dependent subjects (FD) on the V-patterns of the CRT and that there would be interaction between psychological differentiation and the V-patterns content subtests of the CRT. Field independent subjects were expected to perform more consistently than FD subjects across tasks with different contents.

The results presented and discussed in this section and the next are based on the 94 FI and 121 FD subjects obtained by using the 50% cut-off point of the distribution for each of the two measures of psychological differentiation.

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[6] Paulus, op. cit.

PRESENTATION AND DISCUSSION OF RESULTS

To test Hypotheses 1 and 2, a repeated measures analysis of covariance with repeated measures on the concrete-familiar, suggestive and symbolic contents of the V-patterns was used. The covariate was intelligence. Psychological differentiation was the other independent variable, with field dependent and field independent subjects forming the criterion groups. With this design, the univariate test of Hypothesis 1 is appropriate only when the hypothesis of no interaction is tenable.[7] However, an interaction (Hypothesis 2) was expected. Therefore, a multivariate analysis procedure, which does not require parallelism (or no interaction) was considered appropriate.[8] Furthermore, a multivariate analysis of repeated measures does not require the assumption of the symmetry of the pooled within groups variance covariance matrix associated with a univariate analysis.[9]

Hence the only assumptions considered necessary to check before analyzing the data in this section were:

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[7] N. H. Timm, Multivariate Analysis with Applications in Education and Psychology, Wadsworth Publishing Company, Inc., Belmont, California, 1975, p. 461.

[8] Ibid.

[9] Ibid., p. 453.

PRESENTATION AND DISCUSSION OF RESULTS

1. Assumption of a linear association between the dependent variables and the covariate.

2. Assumption of homogeneity of regression.

3. Assumption of the equality of the within group variance-covariance matrices.

The first two assumptions were checked by use of a computer program developed by Finn.[10]

To check assumption No. 1, the hypothesis of no association between the dependent variables and the covariate was tested. It was rejected ($F = 28.77$ with $df = 3,210$. $P < .05$). That is, there is a significant multiple correlation between the dependent variables and the covariate.

For assumption No. 2, the hypothesis of the homogeneity of regression was tested and found not rejected ($F = 1.15$ with $df = 5,633$. $p > .05$). It may thus be assumed that the regression line for each experimental group does not have different regression slope from the pooled regression line for all subjects.

For assumption No. 3, the hypothesis of the equality of the within group variance-covariance matrices, tested by use of the Box test[11] was not rejected ($X^2 = 6.60$, $df = 6$,) indicating that the within group variance-covariance matrices for the two groups of subjects may be assumed equal.

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[10] J. D. Finn, Multivariance-Univariate and Multivariate Analysis of Variance and Covariance: A Fortran IV Program, State University of New York, Buffalo, Version 4, June, 1968.

[11] Box, G. E. P., "Some Theorems on Quadratic Forms Applied in the Study of Analysis of Variance Problems II; Effects of Inequality of Variance and of Correlation Between Errors in the Two Way Classification," in Annals of Mathematical Statistics: Vol. 25, 1954, p. 484-498.

PRESENTATION AND DISCUSSION OF RESULTS

In Table IV are presented IQ and V-patterns content subtest means and standard deviations for FD and FI subjects. In addition, adjusted V-patterns means, when the effect of intelligence has been removed, are presented. It may be noted from Table IV that the differences between the adjusted means are in the predicted direction.

A multivariate analysis of covariance[12] was carried out to determine if these differences were significant. Four multivariate test-statistics, those of Wilks, Roy, Lawley-Hotelling and Pillai, were calculated.

In Table V, are presented the calculated and critical values of these test statistics for testing Hypothesis 1.

The results indicate that on all four criteria, FI subjects obtained a significantly higher vector of adjusted means on the V-patterns content subtests of the CRT than FD subjects. An analysis was carried out to determine if FI persons performed significantly better than FD persons on each of the three content subtests. Estimates of contrasts between the adjusted means obtained by FI and FD subjects on each of these subtests are presented in Table VI. In addition, are presented the estimates of standard errors of these contrasts and the 95% Roy-Bose confidence intervals.

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[12] J. E. Carlson and N. H. Timm, Full Rank: Multivariate Linear Model, Computer Program Manual. University of Pittsburg, 1974.

TABLE IV

Estimated IQ and Unadjusted V-patterns Content Subtest Means and Standard Deviations and Adjusted V-patterns Content Subtests Means for 121 and 94 FI Subjects.

			Unadjusted V-patterns Content Means and Standard Deviations				Adjusted V-patterns Content Means			
		IQ	Concrete-Familiar	Suggestive	Symbolic	Total	Concrete-Familiar	Suggestive	Symbolic	Total
FD	MEAN	93.02	8.40	6.00	4.47	18.87	8.92	6.88	5.05	20.85
	SD	11.82	2.60	3.08	2.96	7.21				
FI	MEAN	106.98	10.64	9.45	7.34	27.43	9.96	8.30	6.60	24.86
	SD	14.53	1.78	2.80	3.98	7.85				

TABLE V

Multivariate Analysis of Covariance Results for Testing Hypothesis 1, with V-patterns, Content Subtest Scores as Dependent Variables, Intelligence as the covariate and Psychological Differentiation as the Independent Variable

Test-Statistic	Calculated Value	Parameters	Critical Value
Wilks	0.778*	3, 1, 212	0.961
Roy	0.222*	1, 0.5, 104.5	0.035
Lawley-Hotelling	0.286*	1, 0.5, 104.5	0.072
Pillai	0.222*	1, 0.5, 104.5	0.035

* $P < .05$

TABLE VI

Contrast Estimate, Estimate of Standard Error and Roy-Bose 95% Confidence Intervals+ for Adjusted Means obtained by FI and FD Subjects on the V-Patterns, Concrete-familiar, Suggestive and Symbolic Content Subtests

	Contrast Estimate (ψ)	Estimate of Standard Error of Contrast ($\hat{\delta}_\psi$)	Roy Bose' 95% Confidence Interval	
			Upper Limit	Lower Limit
Concrete-familiar	1.04 *	0.13	1.40	0.68
Suggestive	1.42 *	0.14	1.81	1.03
Symbolic	1.56 *	0.20	2.11	1.01

* Contrast Estimate significantly different from zero

\+ Determined from $\psi \pm Co\,\hat{\delta}_\psi$

Where $Co = \left(N_e \left(\frac{\theta_a}{1 - \theta_a}\right)\right)^{\frac{1}{2}} = 2.76$ (Roy's critical constant)

and

$N_e = 212$ = error degree of freedom

PRESENTATION AND DISCUSSION OF RESULTS

The results indicate that even after the effect of general intelligence had been removed, field independent subjects still performed better than field dependent subjects on each of the three content subtests.

The first hypothesis was derived from Witkin's statement that field independent subjects are more analytic, less susceptible to suggestions and more capable of abstractions and generalizations than their field dependent counterparts. On the concrete-familiar content of the Conditional Reasoning Test, as in each of the other contents, the subject is required to analyze the premises and decide on an appropriate conclusion on the basis of the interrelationship among these premises. On the suggestive content, in addition, the subject is required to rely on the validity of the argument and not on the truth or falsity of the premises. Reliance on an external influence, such as the truth status of the premises, leads to poor performance on this type of content. With the symbolic content, the subject is required to restructure the sentences by replacing letters of the English alphabet with simple sentences. The premises are then analyzed.

If Witkin's description of field independent and field dependent subjects is true, then field independent subjects would be expected to perform better than field dependent subjects on each of these tasks.

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The test of the hypothesis supported the theory. In Chapter 1 it was explained that the inconsistencies in the findings,[13,14,15] relating measures of psychological differentiation and logical reasoning may be due to the fact that for the adult subjects employed, most of the test items might have been very easy. The significant difference between the adjusted means obtained by field dependent and field independent children on each of the three types of contents, supports such an explanation.

In Table VII, are presented the results of testing Hypothesis 2, using a repeated measures multivariate analysis of covariance technique.[16]

The results presented in Table VII indicate that the test of parallelism, implying an interaction between psychological differentiation and V-pattern content, is

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[13] H. B. Linton, "Dependence on External Influence: Correlates in Perception, Attitudes and Judgments," in Journal of Abnormal Social Psychology, Vol. 51, 1955, p. 502-507.

[14] S. Alexander, A Study of Perceptual and Verbal Differentiation Among Male College Students. Doctoral Dissertation, The George Washington University, Ann Arbor Michigan, University Microfilms, 1970, No. 71-12,285.

[15] C. B. Pemberton, "The Closure Factors Related to Other Cognitive Processes," in Psychometrica, Vol. 17, No. 3, 1952, p. 267-287.

[16] Carlson and Timm, op. cit.

PRESENTATION AND DISCUSSION OF RESULTS

TABLE VII

Multivariate Analysis of Covariance Results for Testing Hypothesis 2, (Parallelism) with Psychological Differentiation as independent variable, V-patterns Content Subtest Scores as Dependent Variables and Intelligence as Covariate.

Test statistic	Calculated Value	Parameters	Critical Value
Wilks	0.779 *	2, 1, 212	0.970
Roy	0.221 *	1, 0.0, 105.0	0.019
Lawley-Hotelling	0.284 *	1, 0.0, 105.0	0.028
Pillai	0.221 *	1, 0.0, 105.0	0.019

* $p < .05$

significant, when each of the four multivariate test-statistics is considered. This indicates that the differences between the adjusted means of the three V-patterns content subtests obtained by FI and FD subjects are not all equal.

As seen from the profile of adjusted means presented in Figure 1, the smallest difference between the adjusted means obtained by FD and FI persons is in the concrete-familiar content, while the biggest is in the symbolic content. The difference between the adjusted suggestive content means is greater than that of the concrete-familiar content but slightly less than that of the symbolic content.

The significant interaction reflects the differences in the cognitive behaviour of FD and FI persons. The former are likely to be attentive to, and make use of prevailing social frames in defining their attitudes and judgments. The latter, in contrast, are likely to be internally directed, that is, use internal frames of reference in their judgments. The items on the suggestive content were constructed in such a way that either the premises or the correct conclusion state something that the subject knows to be false. Hence, the utilization of factual knowledge in determining the validity of an argument in this content leads to the selection of an incorrect

PRESENTATION AND DISCUSSION OF RESULTS

Profile of Adjusted V-patterns Content Subtest Means for FI and FD Subjects

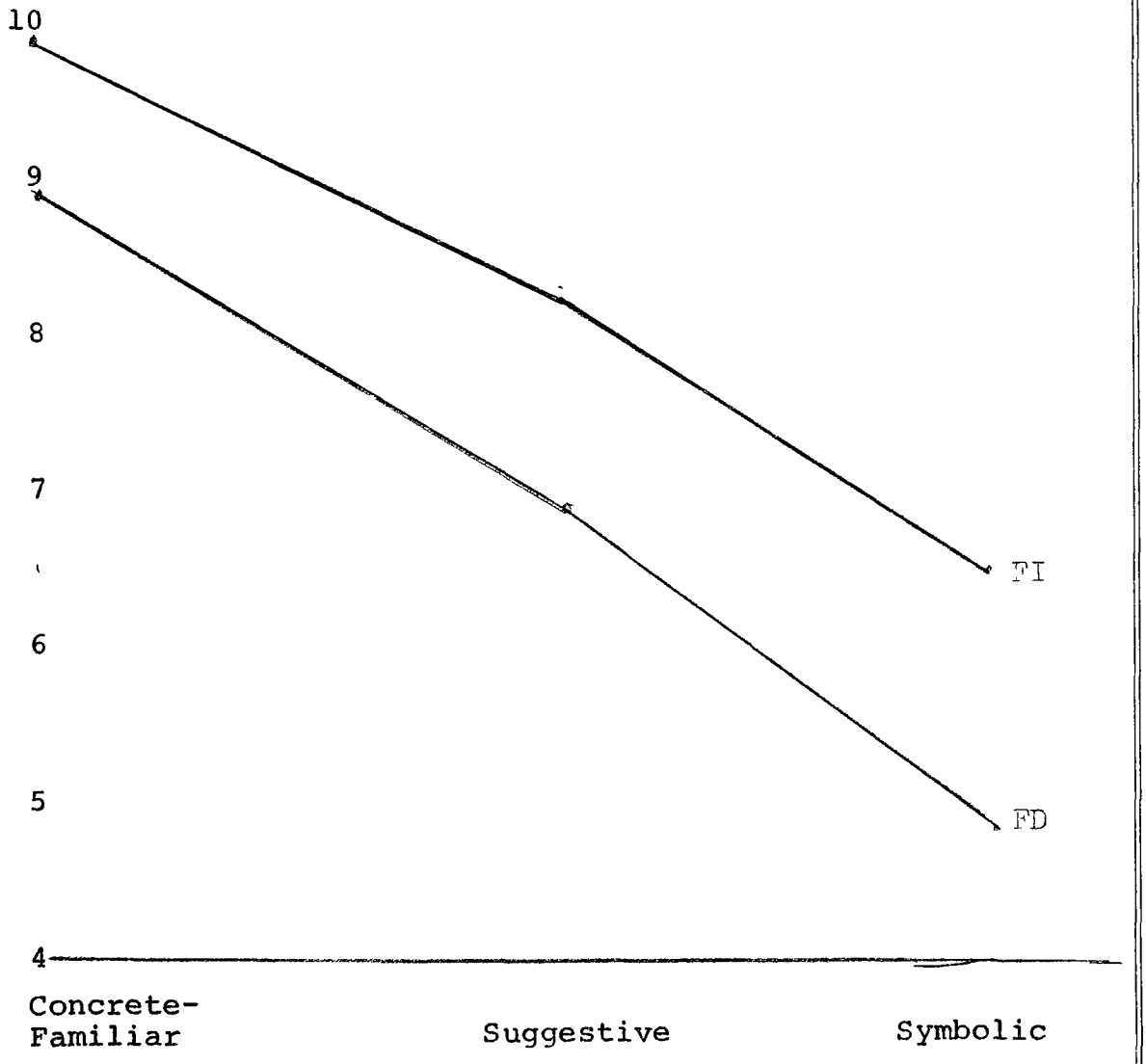

FIGURE 1

response. The results seem to indicate that FD subjects more often than FI persons, utilized their factual knowledge in judging the validity of the arguments in the suggestive content. Hence, the performance of FD from the concrete-familiar to the suggestive content was affected to a greater extent than that of FI persons.

In contrast to the 'with-people' orientation of field dependent persons, field independent persons are described as having a more impersonal orientation. Furthermore, they are described as "cold and distant with others," "individualistic" and "not sensitive to social undercurrents."[17] They are also interested in the abstract and theoretical.[18] Moreover, they are likely to analyze a field when the field is unorganized and impose structure when the field lacks organization. Field dependent persons are likely to leave the field 'as is' without the use of such mediational processes as analyzing, restructuring and transforming.

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[17] C. L. Pemberton, "The Closure Factors Related to Temperament" in Journal of Personality, Vol. 21, 1952, p. 159-175.

[18] J. B. Biggs, D. Fitzgerald and S. M. Atkinson, "Convergent and Divergent Abilities in Children and Teachers' Rating of Competence and Certain Classroom Behaviours," in British Journal of Educational Psychology, Vol. 41, 1971, p. 277-286.

PRESENTATION AND DISCUSSION OF RESULTS

On the symbolic content, in addition to the ability to analyze the premises, the subject is required to perform transformations by replacing the letters of the alphabet by simple sentences. Field independent subjects were more able to perform this operation than their field dependent counterparts and were therefore not affected as much as the latter in their performance from the concrete-familiar content to the symbolic content.

It may be concluded from the above results that analytic ability, ability to rely on internal sources of information in defining attitudes and judgments and restructuring abilities, accounts for differences in the cognitive behaviour of field dependent and field independent subjects.

In summary, the results support Witkin's statement that field independent persons are more analytic, less susceptible to suggestions and more able to abstract and generalize than field dependent persons. Moreover, it has been argued elsewhere that general intelligence is related to psychological differentiation. Hence, the significant results obtained when general intelligence was controlled for, indicate that the aspects of the psychological differentiation construct distinct from general intelligence account for differences in performance on conditional reasoning tasks.

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The results of testing the last two hypotheses are presented and discussed in the next section.

3. Presentation and Discussion of the Results of Testing Hypotheses 3 and 4.

In this section are presented and discussed the results of testing the last two hypotheses.

In Hypothesis 3, it was postulated that on the V-patterns of the CRT, the proportion, P, of errors of the type expressing uncertainty of judgment is greater for field dependent (FD) than for field independent (FI) subjects. Consequently, in Hypothesis 4, it was predicted that on the extremely difficult I-patterns tasks, where the correct response is one expressing uncertainty of judgment, FD subjects perform better than FI subjects.

The section begins with a presentation of the unadjusted P and I-patterns means and standard deviations obtained by FD and FI subjects. The assumptions relevant to testing the null hypotheses are then tested. The results of testing each of the hypotheses are presented and a discussion of the results concludes the section.

In Table VIII are presented the unadjusted P and I-patterns total score means and standard deviations obtained by FD and FI subjects.

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TABLE VIII

Estimated P* Means and I-patterns Total Score Means and Standard Deviations for FD and FI subjects

Unadjusted Means and Standard Deviations

		P	I-Patterns Total Score
FD	MEAN	0.47	4.18
	SD	0.22	3.37
FI	MEAN	0.29	1.24
	SD	0.31	2.46

* 12 FI Subjects made no errors on the V-patterns tasks. Hence the P means and standard deviations presented are based on 121 FD and 82 FI subjects.

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The P and I-patterns means presented are in the direction predicted. However, before carrying out a statistical test of the hypotheses, certain assumptions were checked.

For each of Hypotheses 3 and 4, the assumption that the dependent variable is significantly related to the intelligence scores was checked. This was done by testing the hypothesis that the pooled regression slope equals zero. The homogeneity of regression assumption was then tested. Following this, the assumption of homogeneity of variance was tested.

In Hypothesis 3, the dependent variable was P, the proportion of errors on the V-patterns of the CRT of the 'uncertain' type.

In Hypothesis 4, I-patterns total score was the dependent variable. In each case intelligence scores (IQ) served as the covariate.

The results of testing the three assumptions discussed above, using computer programs developed by Cooper and Pelletier,[19] are summarized in Table IX for P scores and I-patterns total scores.

The results in Table IX reveal that the hypothesis of zero regression slope was not rejected for P scores. That is, P scores are not significantly related to intelligence and so analysis of covariance is inappropriate in testing Hypothesis 3. Also, the homogeneity of variance assumption was violated.

The Mann-Whitney U Test, which is the non-parametric analogue of the t-test for independent samples, was

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[19] M. Cooper and A. Pelletier, INSTAPAK: A Package of Easy-To-Use Interactive Statistical Programmes in APL, University of Ottawa Press, 1977.

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TABLE IX

Results of Tests of Zero Regression Slopes and Homogeneity of Regression Using IQ Scores as Covariate and Homogeneity of Variance (Hartley F max) for P scores and I-patterns total scores

1. Regression Slope Equals Zero

dependent variable	df numerator, denominator	F
P+	1, 201	0.71
I-patterns total scores	1, 213	24.31 *

2. Homogeneity of Regression

dependent variable	df numerator, denominator	F
I-patterns total scores	1, 211	6.13 *

3. Homogeneity of Variance (Hartley F max)

dependent variable	df numerator, denominator	F max
P+	2, 120	2.11 *
I-patterns total scores	2, 120	1.87 *

* $p < .05$

\+ The 12 subjects who made no errors on the V-patterns were not included in this analysis.

therefore used in testing[20] Hypothesis 3. The rank means obtained by FD and FI subjects on the P scores were 119.68 and 74.65 respectively. The value of the Mann-Whitney U statistic was 2615 while the Z value was 5.71. It was thus concluded that the proportion of errors of the type expressing uncertainty of judgment is greater for field dependent than for field independent subjects.

An examination of Table IX also reveals that the hypothesis of zero regression slope was rejected for I-patterns total scores, indicating significant correlation between I-patterns total scores and intelligence scores. However, the assumption of homogeneity of regression was violated. That is, the regression slopes for each of the two groups are not equal. Hence a pooled regression equation could not be utilized. Hence an analysis of covariance was inappropriate. Furthermore, the assumption of homogeneity of variance was found to be violated. Therefore, the Mann-Whitney U Test for independent samples was also used in testing[21] Hypothesis 4.

The rank means obtained by FD and FI subjects on the I-patterns total scores were 139.64 and 71.58 respectively. The value of the Mann-Whitney U statistic was 1577

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[20] Ibid

[21] Ibid

while the Z value was 9.08. It was thus concluded that FD subjects perform significantly better than FI subjects on the I-patterns tasks.

It has been suggested that to be successful on each of the three types of contents, differing intellectual abilities may be necessary. It is therefore possible that the proportion of errors of the 'uncertain' type may be a result of the interaction between type of content and the extent of psychological differentiation of the subject. To check this possibility, a further analysis was performed.

The means of the proportions of errors of the 'uncertain' type obtained by FD and FI subjects on each of the V-patterns content subtests are presented in Table X.

The number of subjects involved in this analysis is much smaller than that used in testing Hypotheses 3 and 4 because of the restriction that subjects who made no errors on at least one of the V-patterns content subtests were excluded from the analysis. However, the averages of these proportions do not seem to be very different from those presented in Table VIII.

To determine if interaction effects exist between extent of psychological differentiation and type of content, three new dependent variables were defined. These were: (1) the proportion of 'uncertain' errors on the concrete-familiar content minus that for the suggestive content;

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TABLE X

Means of the Proportions of Errors of 'Uncertain' type obtained by 110 FD* and 39 FI* Subjects on the V-Patterns Content Subtests

	Concrete-Familiar	Suggestive	Symbolic
FD	0.56	0.44	0.50
FI	0.34	0.24	0.25

* Subjects who made no errors on any of the content subtests were excluded from this analysis.

(2) the proportion of 'uncertain' errors on the concrete-familiar content minus that for the symbolic content; and (3) the proportion of errors of 'uncertain' type on the suggestive content minus that for the symbolic contents.

In examining the three types of contents, it appears that the greatest difference in skills required for successful completion of the tasks is between the concrete-familiar and symbolic contents. This is because it is necessary not only to restructure but to also make transformations to be successful on the symbolic content items. Hence it is speculated that if interactions effects exist between extent of psychological differentiation and type of content, when the proportions of 'uncertain' errors are considered, they would be obtained by examining these two types of contents. However, the other two contrasts were included to examine other possible interaction effects.

A Mann-Whitney U Test for independent samples was then performed with each of these dependent variables to determine if there are differences between FD and FI subjects. The results of these analyses are presented in Table XI.

The results presented in Table XI indicate that none of the differences are significant. That is, there are no interaction effects between extent of psychological differentiation and the type of V-pattern content, when the

TABLE XI

Results of Mann-Whitney U Test for Testing Significant Differences between 110 FD* and 39 FI* Subjects on the Difference of Proportions of 'Uncertain' Errors between (1) Concrete-familiar and Suggestive Contents (2) Concrete-familiar and Symbolic Contents and (3) Suggestive and Symbolic Contents.

Dependent Variable (Difference between the proportion of 'uncertain' errors on the contents indicated)	Mann-Whitney U Statistic	Z (Large sample Approximation)
1 (Concrete-familiar and Suggestive)	2,031	-0.50
2 (Concrete-familiar and Symbolic)	2,063	-0.35
3 (Suggestive and Symbolic)	1,838	-1.33

* Subjects who made no errors on any of the V-patterns content subtests were not included in this analysis.

proportions of 'uncertain' type of errors are considered. It thus seems that the same type of response bias appears throughout the three types of contents.

The results presented in this section indicate support for Hypotheses 3 and 4. These results are now discussed.

The third research hypothesis was developed from the argument that field dependent persons having a greater tendency to rely on others would tend to be more unsure of themselves and be expected to express more uncertainty in their judgments than field independent persons. It was therefore reasoned that for the logical reasoning tasks presented, field dependent persons would choose the distractor "Neither 1 nor 2 necessarily follows" on the V-patterns of the CRT more often than field independent persons. The subjects were instructed that the choice of that response indicated an expression of uncertainty as to whether it is conclusion 1 or conclusion 2 that follows from the given premises.

The fourth research hypothesis was included to provide further support for the results anticipated by testing hypothesis 3. The rationale was that if field dependent persons choose the distractor expressing uncertainty of judgment more often than field independent subjects, the former would perform better than the latter on the I-

patterns tasks. It will be recalled that for each item, the difficulty was less than that expected by random guessing. Moreover, the correct response to these patterns is "Neither 1 nor 2 necessarily follows."

The results supported both hypotheses. This leads to the conclusion that at least for the tasks presented, field dependent persons express more uncertainty in their judgment than field independent persons. The subjects were instructed that the choice of the response "Neither 1 nor 2 necessarily follows" is an expression of uncertainty of judgment. On the other hand, it was indicated that the choice of the response of the form "Yes" or "No" is an expression of certainty of judgment. Field independent subjects choose the distractor of this form on the V-patterns more often than did the field dependent subjects. It could thus be concluded that field independent subjects expressed greater self-confidence in their judgments on these tasks than their field dependent counterparts.

It is not known however, whether these results reflect a general tendency in field dependent subjects to express uncertainty in their judgment and a tendency in field independent subjects to express certainty in their judgment. It may be possible that in tasks involving social skills and interpersonal relationships, where the field dependent person feels more competent, he would be

more certain of his judgment than the field independent person. A study utilizing such tasks would complement the present one. If field dependent persons are found to express more uncertainty in these tasks than field independent persons, this may imply that uncertainty of judgment is related to psychological differentiation in general. However, if field dependent persons express more certainty in their judgments than field independent persons on this type of task, it may imply that the relationship between uncertainty of judgment and psychological differentiation depends on the task at hand.

The expectation that field dependent subjects express greater uncertainty in their judgment than field independent subjects was further supported by the superior performance of the former on the I-patterns tasks. However, as seen from the frequency distribution of I-patterns total scores for field dependent and field independent subjects presented in Appendix 5, most of the scores for both groups are less than would be expected by random guessing. There were 24 I-patterns items and each with three possible conclusions. Hence a score of 8 would be expected by guessing.

The results indicate that in general, both groups of subjects do not choose the uncertain response as much

as if by guessing. Most subjects systematically avoided that response. It may thus be speculated that at the age level studied, children have a general tendency of avoiding responses which are indicative of uncertainty of judgment. However, as the results indicate, such a tendency seems to be greater with field independent subjects than with field dependent subjects.

It will be recalled that the measures of psychological differentiation, intelligence scores and V-patterns scores correlated positively among themselves and negatively with the I-patterns scores. It may also be recalled that the scores on the I-patterns were below those expected by random guessing, indicating it may be assumed that the subjects do not have the necessary abilities on these items.

The negative correlations obtained between the measures mentioned above and the I-patterns tasks may be explained, at least in part, in terms of a greater tendency in more psychologically differentiated (generally more intelligent) persons to show a response bias in the direction of choosing a response expressing certainty of judgment. Since the correct response on the I-patterns is one expressing uncertainty of judgment, such a response bias would lead to poor performance on these items.

Even though the subjects as a group tended to avoid the response expressing uncertainty of judgment, such a tendency was greater for the more psychologically differentiated than for the less psychologically differentiated (generally less intelligent) persons. Hence, the latter performed better than the former on the I-patterns tasks. This accounts for the negative correlations indicated above.

The results presented and discussed in Sections 2 and 3 of this chapter are supportive of Witkin's arguments that field independent persons are more analytic, rely less on external sources of information in making their judgments

and are more able to abstract and generalize than field dependent persons. These results also indicate that field dependent persons tend to express uncertainty in their judgments more often than field independent persons.

In the next section, the educational implications of these results will be discussed. In addition, some suggestions for further research will be given.

4. Educational Implications and Suggestions for Further Research

A conclusion derived from the findings discussed above is that for the Grade 8 students tested, when general intelligence is controlled, psychological differentiation can be used as a predictor of performance on conditional reasoning tasks. Another is that field independent subjects perform more consistently across tasks with different types of contents than field dependent subjects. Also, the errors made on such tasks are related to psychological differentiation.

It was also concluded that field independent subjects performed better than field dependent subjects on the V-patterns of conditional reasoning, while the reverse was true for the I-patterns. It was argued that the latter results were obtained not because field dependent subjects had the abilities to respond correctly to I-patterns items but because of their greater tendency to select responses expressing uncertainty of judgment.

It is therefore important that if programs are designed to increase the conditional reasoning abilities of children at this level, the children's individual differences in psychological differentiation should be considered. That is, while high scores on the V-patterns may be due to the student's mastery of these patterns, such scores, if any, on the I-patterns may mean that many field dependent subjects are selecting the correct response because of their greater tendency to choose responses expressing uncertainty of judgment. Some specific implications of this study are as follows:

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The data indicate that many of the students are able to respond correctly to items associated with the V-patterns. Therefore, it seems reasonable to suggest that the V-patterns of logic could be taught at the age level studied. Such emphasis would lead to the students' understanding of the nature of proof. This is because in the proof of a theorem, defined as a valid argument, one starts from axioms (premises) or previously proved theorems and then shows how the theorem in question follows from the given premises.

Differences were found in the types of errors made by field dependent and field independent subjects. The proportion of errors of the 'uncertain' type was greater for field dependent subjects than for field independent subjects. Such differences were interpreted as providing support for the contention that field dependent persons are more unsure of themselves than field independent persons in the tasks presented. The findings also indicate that field independent subjects chose the distractor expressing certainty of judgment on the V-patterns more often than did field dependent subjects, thereby indicating that field independent subjects express greater self-confidence in these tasks than the field dependent counterparts.

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It may then be necessary to structure learning situations in such a way that children at this age level, and particularly field dependent students, develop a sense of self-confidence.

It was also speculated that field independent subjects showed more consistent performance from the concrete-familiar to the symbolic contents than field dependent subjects, implying that the former may be more able to use mediators and transformations than the latter in their learning processes. In a learning situation, the material to be learned may not have a clear structure and thus require the learner to provide transformations and organization as an aid to learning. Field dependent persons may find difficulty in the learning of such material. In that case, examples with more concrete content may be utilized in introducing such material to the field dependent subjects. Also, field independent persons showed more consistent performance from the concrete-familiar to suggestive contents than field dependent persons. This speculation supports Witkin's statement that field dependent persons, more than field independent ones, rely on external social frames of reference in defining their attitudes and judgments. It implies that field dependent persons may be outer-directed in their learning strategies and prefer group learning while field independent persons may be inner-

directed and prefer individual learning. These results also indicate that field dependent persons have difficulty in separating their cognitive processes from physical world situations. Hence curriculum writers and teachers should consider this factor when developing materials for these students. That is, for field dependent subjects, concrete-familiar models should be used in introducing logic and other school subjects.

The results presented and discussed in Sections 2 and 3 of this chapter provided some answers to the following questions: Do field independent subjects perform better than field dependent subjects on the V-patterns of a Conditional Reasoning Test? Is the performance of field dependent and field independent subjects affected to the same extent when the contents of V-pattern conditional reasoning tasks are varied? Do field dependent and field independent subjects make different types of errors on conditional reasoning tasks? Further research may be carried out in this area by considering the following:

If, as Witkin claims, psychological differentiation is a pervasive and stable characteristic that plays a role in all levels of psychological functioning, do the results of the present study remain tenable over different age levels? Specifically, it is suggested that the above study be repeated at two other age levels. One age level would

be when the subjects do not have the abilities on either the V-patterns or I-patterns. A second age level would be adults and where the subjects are expected to have the abilities on both types of patterns.

It was assumed, through the instructions given and through emphasis, that the choice of the response "Neither 1 nor 2 necessarily follows" is an expression of uncertainty of judgment. It would be informative to construct a test in which the subjects provided their own responses. If the results obtained in this study are tenable under those conditions, field dependent subjects would then be expected to respond to I-patterns with responses expressing uncertainty of judgment and get V-patterns incorrect by providing similar responses.

It is also suggested that tasks requiring social skills in which field dependent subjects may be more competent should be constructed. The hypothesis that field dependent and field independent subjects make different types of errors could then be tested. If results similar to those in this study are obtained, it would imply that expression of uncertainty of judgment is a stable characteristic in field dependent persons and so independent of the task. However, if field dependent subjects express greater certainty in their judgments in these tasks, it would imply that the relationship between psychological

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differentiation and expression of uncertainty depends on the task.

The results showed that most subjects obtained scores on the I-patterns which are less than would be expected by chance. This indicated that the children systematically avoided the response expressing uncertainty of judgment. It is suggested that a study be conducted to determine why the children tend to avoid this type of response. Such a study could be conducted along the same lines as the present one. In addition, an interview, designed to elicit the children's reasons for choosing particular responses, could be conducted.

It is also suggested that a study be carried out to determine if people have a greater tendency to select responses which express certainty of judgment than those which express uncertainty of judgment. If so, does this tendency remain invariant over different types of tasks, at different age levels and with field dependent as well as field independent persons?

In Chapter I it was indicated that the measures of psychological differentiation correlate as highly with some intelligence test subscales as they do with each other. Despite this, a large number of studies of psychological differentiation fail to control for the effects of intelligence in their findings. It is therefore suggested that future studies check differences between FI and FD persons

in their performance on conditional reasoning tasks by controlling for (a) verbal IQ and (b) non-verbal IQ. In the present study, general intelligence was controlled. This allows the interpretation that when general intelligence is equalized, psychological differentiation still accounts for individual differences in conditional reasoning performance.

In this section, some implications of this study were discussed. In addition, some suggestions for further inquiry were given. A statement of summary and conclusions, to be presented next, concludes the chapter.

SUMMARY AND CONCLUSIONS

The aim of this study was to provide an empirical test of an important aspect of Witkin's theory of psychological differentiation. He postulated that more psychologically differentiated persons (field independent) are more analytic, less susceptible to suggestions, more able to abstract and rely less on authority and peer groups in defining their attitudes and judgments than their less psychologically differentiated (field dependent) counterparts.

The test of the theory involved four hypotheses:

1. On the V-patterns of conditional reasoning, where many subjects are expected to have the necessary abilities, field independent subjects perform better than field dependent subjects.

2. On the V-patterns of conditional reasoning, there is interaction between psychological differentiation and type of content (field independent subjects performing more consistently across the various contents than field dependent subjects).

3. On the V-patterns, the proportion of errors of the type expressing uncertainty of judgment is greater for field dependent persons than that for field independent persons.

4. On the extremely difficult I-patterns tasks, field

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dependent subjects perform better than field independent subjects (the correct response to these items is one which expresses uncertainty of judgment).

The research subjects included 302 Grade 8 students (142 boys and 160 girls), averaging 13 years 6 months in age. The students were administered the Dominion Group Test of Learning Capacity (DGT), a Conditional Reasoning Test (CRT) developed by the author, the Group Embedded Figures Test (GEFT) and the Articulation of Body Concept Scale (ABCS).

Field independent subjects were defined as those whose scores were in the top 50% of both the GEFT and ABCS distributions and field dependent subjects as those with scores in the bottom 50% of both scales. This resulted in 94 field independent subjects and 121 field dependent subjects.

The results supported the four hypotheses and the conclusions drawn are as follows:

1) Field independent subjects not only performed better than field dependent subjects but showed more consistent performance across tasks with different contents. These results were obtained on the V-patterns of the CRT.

2) On the V-patterns, the proportion of errors of the type expressing uncertainty of judgment was greater for field dependent subjects than field independent subjects.

3) On the I-patterns, items which are extremely difficult and where the correct response is one expressing uncertainty of judgment, field dependent persons performed better than field independent persons. The item difficulties are of less than chance probability. Hence these results are not interpreted as indicating that field dependent persons have the abilities necessary to respond correctly to these items, but in terms of a greater tendency in them to express uncertainty in their judgments.

Other conclusions drawn are as follows:

4) The differences between the proportions of errors of the 'uncertain' type obtained by FD and FI subjects on the V-patterns tasks are independent of the type of content in which the argument is presented.

5) Measures of psychological differentiation, intelligence test scores and V-patterns content subtest scores correlated positively among themselves and negatively with the I-patterns scores. The negative correlations are explained in terms of the possible existence of a response bias in which FI (generally more intelligent) subjects choose the option expressing certainty of judgment more often than FD (generally less intelligent) persons. Such a response bias leads to poorer performance of FI subjects on the I-patterns tasks in which a response expressing uncertainty of judgment is the correct response.

The above conclusions indicate that the hypotheses of the study have been supported. It is, however, important that the conclusions of this study be interpreted with care, since they are applicable only to the specific conditions of the research.

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In this book are treated many basic concepts in elementary logic. Many types of logical reasoning are presented and examples are provided to clarify the concepts.

-------- and Paulus, Dieter; Deductive Reasoning in Adolescence -- Critical Thinking Readiness in Grades 1-12 Phase 1, Cornell Critical Thinking Project, 1965.

The investigators were concerned with the concept of deductive logic and its use by adolescents, ages 10-18. Two empirical questions of concern in this study were (1) that of readiness for mastery of logic, and (2) that of matural-cultural development of mastery of logic; conditional and class logic. The testing of 803 subjects led to: (1) The specification of a set of patterns of the two types of logic; (2) Two logic tests; (3) A theory of operational definitions; and (4) An Analysis of Piaget's conception of logic.

Miller, W. A., The Acceptance and Recognition of Six Logical Inference Patterns by Secondary Students. (Doctoral Dissertation, University of Wisconsin), Ann Arbor, Michigan, University Microfilms 1968, No. 68-13651.

The purpose of this study was to examine the responses of Grades 8, 10 and 12 students to six logical inference patterns presented under four content variations. Four of the patterns were V-patterns and two were I-patterns. The test constructed has 120 items with 5 items measuring each content/pattern subtest. The present study utilized three of the V-patterns, the two I-patterns and three of the content variations (concrete-familiar, suggestive and symbolic).

Item difficulty and discrimination indices from Miller's study were used as the basis in selecting the four items in each content/pattern subtest in this investigation. This resulted in 60 items.

Witkin, H. A., H. B. Lewis, M. Hertzman, K. Machover, P. S. Meissner, and S. Wapner, Personality Through Perception, New York, Harper, 1954, xxvi-571 p.

First major work by Witkin and his associates which presents the origins of the field-dependence-independence construct and its distinctive features, in addition to the results of a large-scale research project relating style of cognitive functioning to personality variables and individual patterns of adaptation.

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--------, R. B. Dyke, H. F. Faterson, D. R. Goodenough, and S. A. Karp, Psychological Differentiation, New York, Wiley, 1962, v-418 p.

This is the second major publication by Witkin and his colleagues. It confirms and extends the findings in their first work, as well as situating the total research within a developmental framework under the guiding principle of psychological differentiation.

--------, "A Cognitive Style Approach to Cross-Cultural Research," in International Journal of Psychology, Vol. 2, No. 4, 1967, p. 233-250.

An expansion of a paper presented at a symposium on Intercultural Studies of Mental Development. It seeks to illustrate the value of a cognitive-style approach to cross-cultural research by considering the work done with the global-articulated dimension of cognitive functioning. Apart from reviewing earlier investigations in the 1962 publication, it cites more recent studies which have thrown new light on the role of socialization practices on the development of cognitive style in general and on sex differences in particular.

--------, D. R. Goodenough, and S. A. Karp, "Stability of Cognitive Style from Childhood to Young Adulthood," in Journal of Personality and Social Psychology, Vol. 7, No. 3, 1967, p. 291-300.

Report on a longitudinal study involving two groups of subjects (one from 8 to 13 years, the other from 10 to 24 years), intended to examine (i) expected increase of differentiation with age and (ii) relative stability in level of differentiation. Results confirm earlier contentions of Witkin et al. that differentiation increases with age up to about 17 years, that each individual tends to maintain his relative position among his peers in the distribution of measures of differentiation from age to age, and that individual self-consistency across tests of perceptual functioning is evident at all ages. It also suggests that the development of psychological differentiation tends to approach a plateau in young adulthood and that at some point between 24 years and old age, the process of de-differentiation begins, accelerating after the late 30's.

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Paper presented at a symposium on Cognitive Styles, Creativity and Higher Education. It reiterates the nature of cognitive style, discusses cognitive style as a factor in academic evolution, and examines teaching, learning and teacher-student interaction as a function of cognitive style. Also includes a fairly exhaustive bibliography.

APPENDIX 1

A Copy of the Conditional Reasoning Test (CRT)

I N S T R U C T I O N S

This is a test of a special kind of ability. It is an ability test to tell the difference between good and poor reasoning. Some individuals find this test very easy while others find it difficult. If it seems difficult to you, just do the best you can. Everyone can accomplish something with it.

Use the pencil provided throughout the test.

DO NOT MAKE ANY MARKS ON THE TEST BOOKLET. YOU WILL ANSWER EACH OF THE QUESTIONS BY DRAWING A CIRCLE AROUND THE CORRECT ANSWER OPPOSITE THAT QUESTION ON THE ANSWER SHEET PROVIDED.

Do not open this booklet until you are told to do so by the examiner.

DIRECTIONS:

On the following pages you will be presented with problems in logic. The items which you will be presented with are presented in verbal and symbolic form. Some verbal items may be tied to physical world situations, in others, the premises violate physical world situations.

The exercises will appear like this.

O. Art is smart.
Billy is not silly.

1) Art is not smart and Billy is not silly.

2) Art is smart and Billy is not silly.

3) Neither 1 nor 2 necessarily follows.

Or we may agree to replace the statement "Art is smart" by the letter "P" and the statement "Billy is silly" by the letter "Q". Then the above argument will be presented in symbolic form and look like this.

O. P.
Not Q.

1) Not P and not Q.

2) P and not Q.

3) Neither 1 nor 2 necessarily follows.

We place the period at the end of the line to remind you that "P" stands for a sentence. In the exercises, each of the letters A. B. C. etc. stands for any simple sentence. You should pretend that the two statements above the line are true.

DIRECTIONS FOR MARKING THE ANSWER SHEET:

The statements will appear as follows.

Question # 0

John Doe is a glub.
The earth is round.

1) John Doe is a glub and the earth is round.

2) John Doe is a glub and the earth is not round.

3) Neither 1 nor 2 necessarily follows.

If you reason that conclusion 1 is correct, circle 1 to the right of number 0 on your answer sheet. If you reason that conclusion 2 is correct, circle 2 to the right of number 0 on your answer sheet. If you reason that neither 1 nor 2 is correct, circle 3 to the right of number 0 on your answer sheet. In no case are you to mark more than one answer. If you are in doubt about the answers mark the answer that seems most logical to you. Always mark an answer because unanswered questions will be considered the same as if answered incorrectly.

Now circle your answer for question # 0 on your answer sheet. If you wish to change your answer, erase your first mark COMPLETELY and then circle your new choice.

REMEMBER: You decide on one of the three conclusions only on the basis of the statements above the line.

You choose conclusion 3 to indicate that you are not certain if it is conclusion 1 or conclusion 2 which follows necessarily from the statements above the line.

All statements above the line are to be accepted as true. For example, the statements "John Doe is a glub" and "The earth is round" should be accepted as true statements.

Keep these directions in mind as you determine the correct answer to each of the following questions.

If you have any questions, ask them now.

1. If it snowed yesterday, then schools were closed.
   If the schools were closed, then the students were happy.

   1) If it snowed yesterday, then the students were happy.
   2) If it snowed yesterday, then the students were not happy.
   3) Neither 1 nor 2 necessarily follows.

2. If Emily is ill, then Emily will stay home.
   Emily is ill.

   1) Emily will not stay home.
   2) Emily will stay home.
   3) Neither 1 nor 2 necessarily follows.

3. If Bill attends school, then Bill plays ball.
   Bill plays ball.

   1) Bill attends school.
   2) Bill does not attend school.
   3) Neither 1 nor 2 necessarily follows.

4. If Jack won the race, then Jack earned a trophy.
   Jack did not earn a trophy.

   1) Jack won the race.
   2) Jack did not win the race.
   3) Neither 1 nor 2 necessarily follows.

5. If ducks can fly, then ducks have four legs.
   Ducks do not have four legs.

   1) Ducks cannot fly.
   2) Ducks can fly.
   3) Neither 1 nor 2 necessarily follows.

6. If tigers are ferocious, then coal is white.
   Coal is white.

   1) Tigers are ferocious
   2) Tigers are not ferocious.
   3) Neither 1 nor 2 necessarily follows.

7. If X, then Z.
Not X.

1) Not Z.

2) Z.

3) Neither 1 nor 2 necessarily follows.

8. If Ed misses the plane, then Ed will go by train.
Ed did not go by train.

1) Ed missed the plane.

2) Ed did not miss the plane.

3) Neither 1 nor 2 necessarily follows.

9. If A, then B.
B.

1) A.

2) Not A.

3) Neither 1 nor 2 necessarily follows.

10. If a triangle is square, then a square is a rectangle.
A triangle is not square.

1) A square is not a rectangle.

2) A square is a rectangle.

3) Neither 1 nor 2 necessarily follows.

11. If the weather is nice, then I will play golf.
The weather is not nice.

1) I will play golf.

2) I will not play golf.

3) Neither 1 nor 2 necessarily follows.

12. If A, then B.
Not B.

1) Not A.

2) A.

3) Neither 1 nor 2 necessarily follows.

13. If sugar is sweet, then vinegar is sour.
Sugar is not sweet.

1) Vinegar is not sour.
2) Vinegar is sour.
3) Neither 1 nor 2 necessarily follows.

14. If Dick won the race, then Jack placed second.
Jack placed second.

1) Dick did not win the race.
2) Dick won the race.
3) Neither 1 nor 2 necessarily follows.

15. If pears are vegetables, then apples are fruits.
Apples are not fruits.

1) Pears are vegetables.
2) Pears are not vegetables.
3) Neither 1 nor 2 necessarily follows.

16. If X, then R.
R.

1) Not X.
2) X.
3) Neither 1 nor 2 necessarily follows.

17. If ducks have four legs, then ducks can fly.
Ducks have four legs.

1) Ducks can fly.
2) Ducks cannot fly.
3) Neither 1 nor 2 necessarily follows.

18. If R, then S.
Not R.

1) S.
2) Not S.
3) Neither 1 nor 2 necessarily follows.

19. If it rained, then the game was postponed.
The game was postponed.

1) It rained.
2) It did not rain.
3) Neither 1 nor 2 necessarily follows.

20. If X, then U.
If U, then Z.

1) If X, then not Z.
2) If X, then Z.
3) Neither 1 nor 2 necessarily follows.

21. If dogs purr, then cats bark.
Dogs purr.

1) Cats bark.
2) Cats do not bark.
3) Neither 1 nor 2 necessarily follows.

22. If horses have wings, then horses can fly.
Horses can fly.

1) Horses do not have wings.
2) Horses have wings.
3) Neither 1 nor 2 necessarily follows.

23. If the contract is legal, then Lanes is liable.
If Lane is liable, then Lane will go to jail.

1) If the contract is legal, then Lane will not go to Jail.
2) If the contract is legal, then Lane will go to jail.
3) Neither 1 nor 2 necessarily follows.

24. If two plus two equals five, then Columbus discovered America.
If Columbus discovered America, then one plus one equals two.

1) If two plus two equals five, then one plus one equals two.
2) If two plus two equals five, then one plus one is not equal to two.
3) Neither 1 nor 2 necessarily follows.

25. If Harry finds his meal ticket, then Harry can eat lunch.
Harry did not find his meal ticket.

1) Harry did not eat lunch.
2) Harry did eat lunch.
3) Neither 1 nor 2 necessarily follows.

26. If X, then R.
X.

1) Not R.
2) R.
3) Neither 1 nor 2 necessarily follows.

27. If the first sign is correct, then the second sign is correct.
The first sign is correct.

1) The second sign is correct.
2) The second sign is not correct.
3) Neither 1 nor 2 necessarily follows.

28. If I live in Manitoba, then I live in Quebec.
I do not live in Manitoba.

1) I live in Quebec.
2) I do not live in Quebec.
3) Neither 1 nor 2 necessarily follows.

29. If L, then M.
If M, then N.

1) If L, then N.
2) If L, then Not N.
3) Neither 1 nor 2 necessarily follows.

30. If Montreal is a city, then chickens have four legs.
Montreal is a city.

1) Chickens do not have four legs.
2) Chickens have four legs.
3) Neither 1 nor 2 necessarily follows.

31. If Alvin is a fish, then Alvin is a mammal.
If Alvin is a mammal, then Alvin is a goat.

1) If Alvin is a fish, then Alvin is not a goat.
2) If Alvin is a fish, then Alvin is a goat.
3) Neither 1 nor 2 necessarily follows.

32. If P, then Q.
Not Q.

1) P.
2) Not P.
3) Neither 1 nor 2 necessarily follows.

33. If P, then R.
If R, then S.

1) If P, then S.
2) If P, then not S.
3) Neither 1 nor 2 necessarily follows.

34. If M, then N.
M.

1) N.
2) Not N.
3) Neither 1 nor 2 necessarily follows.

35. If John likes modern art, then John will like this painting.
If John likes this painting, then John will buy this painting.

1) If John Likes modern art, then John will not buy this painting.
2) If John likes modern art, then john will buy this painting.
3) Neither 1 nor 2 necessarily follows.

36. If John misses the plane, then John will go by car.
John missed the plane.

1) John will not go by car.
2) John will go by car.
3) Neither 1 nor 2 necessarily follows.

37. If it snowed yesterday, then the schools were closed yesterday.
Schools were closed yesterday.

1) It snowed yesterday.
2) It did not snow yesterday.
3) Neither 1 nor 2 necessarily follows.

38. If the weather is clear, then the picnic will be held.
The picnic was not held.

1) The weather was not clear.
2) The weather was clear.
3) Neither 1 nor 2 necessarily follows.

39. If North America is a continent, then Italy is in North America.
Italy is not in North America.

1) North America is not a continent.
2) North America is a continent.
3) Neither 1 nor 2 necessarily follows.

40. If the door is locked, then Sandra is at home.
The door is not locked.

1) Sandra is at home.
2) Sandra is not at home.
3) Neither 1 nor 2 necessarily follows.

41. If roses are flowers, then peas are flowers.
If peas are flowers, then radishes are fruits.

1) If roses are flowers, then radishes are fruits.
2) If roses are flowers, then radishes are not fruits.
3) Neither 1 nor 2 necessarily follows.

42. If Sudbury is larger than Ottawa, then Sudbury is in Ontario.
Sudbury is in Ontario.

1) Sudbury is larger than Ottawa.
2) Sudbury is not larger than Ottawa.
3) Neither 1 nor 2 necessarily follows.

43. If P, then R.
Not R.

1) P.

2) Not P.

3) Neither 1 nor 2 necessarily follows.

44. If the car started, then we would go to the game.
We did not go to the game.

1) The car did not start.

2) The car started.

3) Neither 1 nor 2 necessarily follows.

45. If P, then Q.
Q.

1) P.

2) Not P.

3) Neither 1 nor 2 necessarily follows.

46. If birds have wings, then trees have wings.
Trees do not have wings.

1) Birds do not have wings.

2) Birds have wings.

3) Neither 1 nor 2 necessarily follows.

47. If July is a month, then June is a year.
July is a month.

1) June is not a year.

2) June is a year.

3) Neither 1 nor 2 necessarily follows.

48. If P, then R.
Not P.

1) R.

2) Not R.

3) Neither 1 nor 2 necessarily follows.

49. If there is smoke, then there is fire.
There is no smoke.

1) There is fire.
2) There is no fire.
3) Neither 1 nor 2 necessarily follows.

50. If Cornwall is a Province, them Pembroke is a Province.
Cornwall is not a Province.

1) Pembroke is not a Province.
2) Pembroke is a Province.
3) Neither 1 nor 2 necessarily follows.

51. If X, then Z.
Not Z.

1) Not X.
2) X.
3) Neither 1 nor 2 necessarily follows.

52. If Quebec is a Province, then Montreal is a Province.
Montreal is a Province.

1) Quebec is not a Province.
2) Quebec is a Province.
3) Neither 1 nor 2 necessarily follows.

53. If A, then B.
Not A.

1) Not B.
2) B.
3) Neither 1 nor 2 necessarily follows.

54. If S, then P.
S.

1) Not P.
2) P.
3) Neither 1 nor 2 necessarily follows.

55. If the ice is frozen on the lake, then I will go skating.
The ice is frozen on the lake.

1) I will go skating.
2) I will not go skating.
3) Neither 1 nor 2 necessarily follows.

56. If M, then N.
N.

1) M.
2) Not M.
3) Neither 1 nor 2 necessarily follows.

57. If Ann goes to the party, then Ann will buy a new dress.
If Ann buys a new dress, then Ann will spend her money.

1) If Ann goes to the party, then Ann will not spend her money.
2) If Ann goes to the party, then Ann will spend her money.
3) Neither 1 nor 2 necessarily follows.

58. If Daisies are flowers, then radishes are flowers.
If radishes are flowers, then potatoes are vegetables.

1) If daisies are flowers, then potatoes are vegetables.
2) If daisies are flowers, then potatoes are not vegetables.
3) Neither 1 nor 2 necessarily follows.

59. If A, then B.
A.

1) Not B.
2) B.
3) Neither 1 nor 2 necessarily follows.

60. If S, then T.
If T, then V.

1) If S, then V.
2) If S, then not V.
3) Neither 1 nor 2 necessarily follows.

APPENDIX 2

Distribution of items for the content/pattern subtests of the CRT

Content / Pattern	Concrete-familiar	Suggestive	Symbolic
LD	2	17	26
	27	30	34
	36	47	54
	55	21	59
CI	4	5	12
	8	15	32
	38	39	43
	44	46	51
HS	1	24	20
	23	31	29
	35	41	33
	57	58	60
DA	11	10	7
	25	13	18
	40	28	48
	49	50	53
AC	3	6	9
	14	22	16
	19	42	45
	37	52	56

APPENDIX 3

General procedures for administering the DGT, CRT, GEFT and ABCS

At the beginning of each testing session, the experimenter supplied each subject with an envelope containing a copy of the DGT, the CRT, the GEFT, a computer optical scanning sheet for supplying answers to the DGT and CRT, two blank sheets for the human figures drawings and a pencil. The students were then told they would not be allowed to take out any test from the envelope unless instructed to do so. The investigator who administered the tests, was assisted by the class teachers to ensure that the rules were adhered to.

The subjects were then told to take out the pencils and the optical scanning sheets. About 10 minutes were spent in educating them to use the optical scanning sheets in supplying information regarding their age, sex and making responses on the DGT and CRT.

The tests were then administered in the following order: DGT, CRT, GEFT and ABCS.

APPENDIX 4

Raw scores on V-patterns content subtests, I-patterns total scores, DGT, GEFT, ABCS for all subjects.[1]

CASE-N	ID	UD	IQ	CONVAL	SUGVAL	SYMVAL	TOVAL	TOIN	ABCS	GEFT
1	101	3	104	10	11	9	30	0	2	9
2	102	5	84	;6	10	5	21	4	2	9
3	103	11	80	9	3	6	18	2	2	6
4	104	4	95	10	8	10	28	2	2	11
5	105	5	94	11	8	2	21	4	2	16
6	106	4	105	11	11	8	30	0	3	6
7	107	7	78	9	4	6	19	0	3	7
8	108	3	107	11	11	2	24	1	2	8
9	109	4	99	9	11	6	26	4	2	6
10	111	0	109	11	12	11	34	0	3	12
11	113	10	82	5	6	9	20	2	2	8
12	114	2	110	12	10	10	32	0	3	9
13	115	3	104	11	10	10	31	7	2	7
14	116	9	90	10	7	2	19	0	3	7
15	117	2	112	12	10	9	31	0	5	10
16	118	10	82	10	6	5	21	3	2	1
17	119	2	110	10	10	12	32	1	4	10
18	121	3	84	6	8	5	19	2	3	8
19	123	10	92	7	3	1	11	4	2	9
20	124	0	112	12	12	11	35	0	2	15
21	125	2	82	9	3	4	16	0	1	9
22	126	12	90	8	8	2	18	6	2	6
23	127	5	96	10	9	0	19	5	4	9
24	128	0	122	12	12	12	36	0	3	18
25	129	7	95	8	9	6	23	6	2	12
26	130	7	96	8	2	5	15	2	4	15
27	131	0	125	12	12	10	34	0	3	11
28	134	0	97	11	10	5	26	0	3	9
29	137	20	72	3	3	2	8	11	1	1
30	138	1	110	12	11	1	24	0	3	13
31	139	10	97	9	6	6	21	1	4	15
32	140	14	108	6	3	4	13	10	1	0
33	141	0	110	12	12	11	35	0	3	17

CASE-N	ID	UD	IQ	CONVAL	SUGVAL	SYMVAL	TOVAL	TOIN	ABCS	GEFT
34	202	2	105	11	12	9	32	2	2	6
35	203	13	90	8	6	5	19	5	3	8
36	204	9	108	8	7	1	16	4	2	8
37	205	2	91	9	5	4	18	3	3	6
38	206	9	119	10	8	4	22	4	4	18
39	207	6	111	11	10	9	30	0	2	3
40	208	1	101	12	10	11	33	0	2	7
41	210	7	116	10	10	6	26	1	3	10
42	211	4	111	7	7	8	22	1	3	12
43	212	1	98	10	6	4	20	5	2	10
44	213	0	145	12	12	12	36	0	4	18
45	214	11	100	8	7	1	16	0	4	6
46	205	0	84	10	5	5	20	0	2	7
47	216	2	92	8	2	5	15	2	2	1
48	217	2	94	11	10	8	29	1	2	5
49	218	8	99	10	8	4	22	6	2	7
50	219	10	91	8	4	3	15	0	3	15
51	220	12	94	8	3	0	11	7	1	2
52	221	0	92	11	12	12	35	0	3	12
53	222	4	105	7	10	10	27	0	3	7
54	223	12	82	8	5	5	18	6	2	1
55	224	2	97	11	10	5	26	0	2	9
56	225	7	139	10	10	9	29	5	3	14
57	226	2	111	12	12	10	34	2	3	12
58	227	2	114	11	10	12	33	1	2	9
59	228	2	96	11	6	1	18	4	5	11
60	229	11	84	6	6	5	17	1	2	4
61	230	0	117	11	12	11	34	1	3	4
62	231	3	91	11	10	8	29	1	2	4
63	232	2	95	11	4	1	16	1	3	7
64	233	5	73	10	9	3	22	3	2	6
65	234	12	90	6	3	9	18	4	2	9
66	235	1	112	12	12	6	30	0	2	16

CASE-N	ID	UD	IQ	CONVAL	SUGVAL	SYMVAL	TOVAL	TOIN	ABCS	GEFT
67	237	1	96	10	12	11	33	1	3	6
68	240	15	73	4	1	3	8	11	1	0
69	241	7	112	10	7	6	23	2	3	12
70	243	1	124	12	12	11	35	0	4	18
71	245	7	96	10	4	8	22	0	2	5
72	246	0	133	12	12	12	36	5	3	18
73	247	0	145	12	12	12	36	0	3	15
74	248	2	94	10	9	4	23	1	3	9
75	249	3	90	7	9	7	23	0	2	12
76	250	0	110	11	12	12	35	0	3	7
77	251	16	109	8	6	5	19	7	3	11
78	252	20	99	6	3	2	11	7	2	3
79	253	2	115	11	10	8	29	0	2	13
80	254	9	88	8	6	2	16	2	3	1
81	256	3	94	9	3	4	16	2	2	5
82	257	11	107	9	8	7	24	0	4	7
83	258	0	116	10	11	9	30	0	3	11
84	259	7	91	7	5	6	18	7	3	3
85	302	0	101	11	11	5	27	0	3	11
86	303	7	86	9	5	1	15	5	4	7
87	304	4	92	6	3	4	13	2	3	14
88	305	3	100	9	11	7	27	0	3	16
89	306	1	109	10	12	8	30	1	4	14
90	307	1	97	10	11	11	32	1	3	7
91	308	1	117	12	12	11	35	0	4	15
92	309	2	95	8	8	7	23	1	5	9
93	311	2	98	11	11	3	25	0	3	8
94	312	2	103	12	10	11	33	1	3	12
95	313	19	73	5	2	2	9	10	1	1
96	314	3	102	9	6	4	10	3	3	13
97	315	4	103	10	10	7	27	0	4	13
98	316	2	88	11	10	8	29	1	4	12
99	318	7	91	10	5	2	17	11	2	9

CASE-N	ID	UN	IQ	CONVAL	SUGVAL	SYMVAL	TOVAL	TOIN	ABCS	GEFT
100	319	11	105	12	12	1	25	8	2	14
101	321	1	110	12	11	12	35	1	3	8
102	323	1	105	9	12	2	23	0	4	9
103	325	0	86	12	7	8	27	0	3	9
104	326	3	100	12	11	6	29	4	2	8
105	327	0	107	9	11	10	30	0	4	5
106	328	3	92	7	8	6	21	0	4	6
107	329	5	82	8	7	7	22	2	3	10
108	331	11	95	8	6	4	18	3	1	33
109	332	23	112	3	2	2	7	14	1	22
110	333	0	124	12	12	12	36	0	4	10
111	334	6	89	9	11	1	21	0	2	4
112	336	7	106	12	2	2	16	6	1	4
113	337	14	108	8	5	5	18	5	5	2
114	338	1	103	11	7	6	24	2	2	6
115	339	7	102	10	7	0	17	4	3	0
116	340	2	81	11	9	4	24	0	3	6
117	342	7	112	8	9	2	19	0	3	8
118	343	13	89	6	2	2	10	11	2	4
119	344	8	86	11	6	6	23	1	2	2
120	345	6	118	11	8	4	23	1	3	4
121	346	0	122	10	11	12	33	2	4	11
122	347	5	95	11	9	5	25	2	3	8
123	348	20	78	3	3	1	7	12	1	2
124	349	7	92	11	9	6	26	3	2	0
125	350	2	115	11	11	11	33	0	2	4
126	352	2	121	10	10	11	31	0	5	10
127	354	0	113	12	12	12	36	1	4	16
128	401	0	103	12	5	0	17	0	4	14
129	402	0	122	12	12	12	36	0	3	14
130	403	1	137	12	10	8	30	0	3	14
131	404	5	112	12	10	9	31	1	3	9
132	405	5	78	9	6	6	21	5	1	3
133	406	10	84	9	6	5	20	4	2	6

CASE-N	ID	UN	IQ	CONVAL	SUGVAL	SYMVAL	TOVAL	TOIN	ABCS	GEFT
134	407	3	108	12	9	12	33	0	4	14
135	408	1	99	10	9	3	22	0	2	14
136	412	0	119	11	12	12	35	0	4	15
137	413	3	113	9	4	4	17	1	3	7
138	414	2	102	11	4	4	19	00	3	13
139	415	4	103	11	10	4	25	0	3	11
140	416	3	139	10	7	8	25	18	3	11
141	417	4	120	9	6	8	23	3	2	4
142	418	0	132	12	12	11	35	0	5	12
143	420	1	130	12	11	11	34	2	5	16
144	422	3	113	10	8	1	19	1	4	12
145	423	8	88	8	6	9	23	0	3	9
146	424	1	114	12	9	9	30	0	4	12
147	425	1	105	10	12	3	25	0	4	9
148	426	1	110	11	11	10	32	3	3	13
149	428	3	119	10	10	9	29	1	3	7
150	502	5	107	12	10	9	31	1	4	6
151	503	8	91	7	2	5	14	2	3	11
152	504	0	99	12	11	0	23	0	3	8
153	506	8	121	11	8	8	27	0	3	10
154	507	8	109	9	8	1	18	5	3	17
155	508	4	92	7	7	8	22	4	3	7
156	509	0	104	12	12	4	28	0	4	12
157	510	1	123	12	10	12	34	6	2	5
158	511	0	96	10	11	11	32	0	3	16
159	512	5	73	11	1	4	16	3	2	5
160	513	2	94	11	2	5	18	1	4	15
161	514	17	85	1	4	2	7	4	2	13
162	515	3	95	9	9	8	26	2	3	4
163	517	3	76	11	9	3	23	6	5	10
164	518	0	119	12	12	12	36	0	2	17
165	520	2	95	9	5	4	18	1	2	7
166	521	0	99	12	11	12	35	0	4	10
167	522	8	82	5	4	2	11	6	3	9

CASE-N	ID	UN	IQ	CONVAL	SUGVAL	SYMVAL	TOVAL	TOIN	ABCS	GEFT
168	523	10	98	4	8	0	12	6	4	10
169	524	0	105	11	11	3	25	0	4	12
170	526	1	82	7	66	5	18	0	3	11
171	527	1	74	7	5	3	15	0	4	9
172	528	9	121	12	12	12	36	0	3	16
173	529	0	134	12	12	12	36	0	2	13
174	530	0	124	11	12	7	30	1	4	8
175	531	2	120	9	4	33	16	3	3	16
176	533	11	83	10	6	0	16	5	2	2
177	535	0	117	12	12	11	35	0	4	16
178	537	8	114	12	10	4	26	5	3	18
179	538	0	95	11	12	10	33	0	4	9
180	539	1	112	11	10	8	29	3	4	16
181	541	9	97	7	10	8	25	1	3	6
182	563	6	94	7	4	4	15	5	3	6
183	543	0	106	11	12	8	31	0	2	9
184	544	17	93	4	8	0	12	8	3	6
185	545	15	109	5	2	5	12	8	3	6
186	546	8	93	6	7	3	16	1	5	17
187	547	2	100	10	7	1	18	0	3	11
188	550	0	110	12	11	12	35	0	3	3
189	551	3	85	8	9	4	21	4	2	3
190	533	10	92	9	8	8	25	1	2	0
191	601	0	134	12	12	12	36	0	4	17
192	602	11	87	8	2	2	12	4	2	1
193	603	9	72	6	3	0	9	3	2	1
194	604	0	118	12	12	12	36	0	4	11
195	605	0	100	12	12	12	36	0	3	11
196	608	6	87	8	6	3	17	3	3	8
197	609	6	99	11	9	3	23	0	2	6
198	611	6	119	11	8	0	19	0	4	12
199	612	0	99	11	11	1	23	0	3	12
200	613	13	80	4	5	4	13	12	2	7

CASE-N	ID	UN	IQ	CONVAL	SUGVAL	SYMVAL	TOVAL	TOIN	ABCS	GEFT
201	614	9	99	5	5	0	10	12	2	8
202	617	0	113	12	12	2	26	0	2	6
203	618	0	113	12	12	12	36	0	5	15
204	619	5	88	4	8	7	19	3	3	6
205	621	0	125	12	12	12	36	0	4	11
206	624	0	107	12	12	4	28	0	4	10
207	625	0	115	12	12	12	36	0	3	12
208	626	13	92	4	3	1	8	10	2	1
209	627	10	111	11	5	4	20	10	2	16
210	628	3	98	12	11	10	33	0	4	10
211	629	6	129	8	10	9	27	8	3	15
212	630	3	103	11	9	0	20	0	3	6
213	631	19	83	6	3	0	9	8	1	3
214	632	0	111	12	12	8	32	0	4	15
215	633	5	134	11	8	10	29	5	2	14
216	634	4	97	11	4	4	19	7	4	10
217	635	4	110	9	7	8	24	5	2	7
218	637	11	98	4	7	5	16	3	4	6
219	638	10	78	11	2	4	17	3	1	2
220	639	5	103	12	11	8	31	1	4	11
221	640	7	94	8	4	3	15	1	3	2
222	644	4	116	8	9	7	24	0	3	15
223	645	0	105	11	10	6	27	1	3	7
224	646	1	103	12	3	7	22	2	3	11
225	648	14	108	8	7	6	21	3	3	16
226	649	9	104	6	5	5	16	4	3	1
227	650	0	118	12	10	12	34	0	5	11
228	651	10	88	10	2	2	14	2	3	1
229	652	0	121	12	12	9	33	0	3	17
230	653	2	95	12	11	6	29	1	3	6
231	701	3	118	11	10	12	33	2	2	5
232	702	0	110	12	12	12	36	0	3	9
233	704	2	97	11	9	8	28	0	2	4
234	705	5	110	10	10	2	22	7	3	16

CASE-N	ID	UN	IQ	CONVAL	SUGVAL	SYMVAL	TOVAL	TOIN	ABCS	GEFT
235	706	4	102	9	6	5	20	3	3	7
236	707	11	85	6	1	4	11	7	2	6
237	708	2	95	12	11	7	30	0	4	16
238	709	2	90	10	5	3	18	2	4	11
239	710	11	108	8	3	2	13	5	3	0
240	711	1	102	10	10	2	22	0	3	8
241	712	0	122	12	12	12	36	0	3	11
242	715	0	102	12	12	12	36	0	4	16
243	716	1	113	11	10	12	33	0	4	15
244	717	5	113	11	10	10	31	1	2	5
245	718	0	117	12	12	2	26	0	3	8
246	720	0	115	12	10	10	32	1	4	10
247	721	16	82	3	4	0	7	8	2	4
248	722	7	91	12	8	1	21	5	2	2
249	723	10	85	4	4	3	11	8	1	1
250	724	0	106	10	9	8	27	1	1	8
251	725	11	83	7	4	4	15	6	3	6
252	726	7	93	3	3	3	9	8	2	4
253	727	7	75	6	3	5	14	7	2	4
254	728	6	81	10	10	5	25	4	1	0
255	729	7	96	9	4	7	20	6	2	10
256	730	5	95	9	10	5	24	2	3	4
257	732	14	87	6	4	3	13	4	3	6
258	733	8	85	6	5	4	15	2	2	1
259	734	13	94	4	3	4	11	6	2	4
260	735	4	101	8	3	5	16	1	1	5
261	736	11	88	8	5	4	17	5	2	4
262	737	9	80	6	3	1	10	3	3	6
263	738	10	82	9	5	4	18	4	2	2
264	236	17	89	7	2	2	11	8	1	3
265	238	11	109	11	3	5	19	3	2	5
266	310	11	75	7	1	4	12	10	1	2
267	137	0	89	11	10	11	32	0	4	9
268	322	11	105	10	8	1	19	6	3	9

CASE-N	ID	UN	IQ	CONVAL	SUGVAL	SYMVAL	TOVAL	TOIN	ABCS	GEFT
269	421	6	92	5	4	5	14	5	3	9
270	540	2	106	7	7	7	21	2	2	10
271	713	1	109	12	10	2	24	0	5	11
272	136	3	110	11	10	10	31	1	2	12
273	534	6	76	5	5	4	14	2	2	1
274	335	0	88	10	9	12	31	2	3	12
275	552	9	84	4	2	4	10	9	3	1
276	409	9	80	11	3	4	18	3	2	1
277	501	14	76	4	0	3	7	11	2	4
278	549	16	83	1	5	3	9	5	2	3
279	623	12	81	3	6	2	11	9	2	5
280	532	7	87	9	6	5	20	7	1	2
281	516	15	78	4	3	2	9	11	4	4
282	643	16	98	8	2	2	12	8	2	2
283	647	3	94	8	2	8	18	1	3	7
284	642	11	88	6	5	5	16	4	2	5
285	242	7	101	9	7	8	24	1	2	6
286	330	6	89	7	9	5	21	6	2	3
287	714	15	88	9	4	0	13	11	2	1
288	110	7	107	11	8	4	23	2	1	3
289	112	13	81	6	4	5	15	8	2	2
290	120	4	103	11	9	6	26	2	2	4
291	122	6	106	12	10	7	29	1	2	5
292	132	14	95	11	8	1	20	7	1	1
293	201	10	111	10	6	3	19	5	2	4
294	209	6	83	10	9	0	19	4	2	2
295	239	11	90	7	3	1	11	4	1	2
296	410	7	111	11	9	4	24	5	2	5
297	419	9	105	9	7	3	19	9	1	3
298	519	9	84	10	6	0	16	0	2	3
299	536	12	84	9	7	0	16	0	1	2
300	615	6	98	9	5	1	15	3	2	5
301	641	11	90	11	5	3	19	2	2	2
302	133	12	88	7	3	3	14	7	1	0

1
Meaning of Variables:

UN = No. of "Neither 1 nor 2 necessarily follows" errors on the 36 V-patterns items.

CONVAL = V-patterns concrete familiar items
SUGVAL = V-patterns suggestive items
SYMVAL = V-patterns symbolic items
TOVAL = V-patterns total score
TOIN = I-patterns total score

P, the proportion of errors of the type "Neither 1 nor 2 necessarily follows" was calculated as follows:

$$P = \frac{UN}{(36 - TOVAL)}$$

This proportion is undefined for individuals who have a score of 36 on the V-patterns.

APPENDIX 5

Frequency Distributions of I-patterns Total Scores for FI and FD subjects.

FI		FD	
Score	Frequency	Score	Frequency
0	54	0	15
1	15	1	17
2	12	2	15
3	3	3	14
4	2	4	13
5	2	5	9
6	2	6	7
7	3	7	9
18	1	8	8
		9	2
		10	4
		11	5
		12	2
		14	1