

# CANADIAN THESES ON MICROFICHE

I.S.B.N.

# THESES CANADIENNES SUR MICROFICHE



National Library of Canada  
Collections Development Branch

Canadian Theses on  
Microfiche Service

Ottawa, Canada  
K1A 0N4

Bibliothèque nationale du Canada  
Direction du développement des collections

Service des thèses canadiennes  
sur microfiche

## NOTICE

The quality of this microfiche is heavily dependent upon the quality of the original thesis submitted for microfilming. Every effort has been made to ensure the highest quality of reproduction possible.

If pages are missing, contact the university which granted the degree.

Some pages may have indistinct print especially if the original pages were typed with a poor typewriter ribbon or if the university sent us a poor photocopy.

Previously copyrighted materials (journal articles, published tests, etc.) are not filmed.

Reproduction in full or in part of this film is governed by the Canadian Copyright Act, R.S.C. 1970, c. C-30. Please read the authorization forms which accompany this thesis.

THIS DISSERTATION  
HAS BEEN MICROFILMED  
EXACTLY AS RECEIVED

## AVIS

La qualité de cette microfiche dépend grandement de la qualité de la thèse soumise au microfilmage. Nous avons tout fait pour assurer une qualité supérieure de reproduction.

Si manque des pages, veuillez communiquer avec l'université qui a conféré le grade.

La qualité d'impression de certaines pages peut laisser à désirer, surtout si les pages originales ont été dactylographiées à l'aide d'un ruban usé ou si l'université nous a fait parvenir une photocopie de mauvaise qualité.

Les documents qui font déjà l'objet d'un droit d'auteur (articles de revue, examens publiés, etc.) ne sont pas microfilmés.

La reproduction, même partielle, de ce microfilm est soumise à la Loi canadienne sur le droit d'auteur, SRC 1970, c. C-30. Veuillez prendre connaissance des formules d'autorisation qui accompagnent cette thèse.

LA THÈSE A ÉTÉ  
MICROFILMÉE TELLE QUE  
NOUS L'AVONS REÇUE

A STUDY OF THE RELATIONSHIP BETWEEN LOCUS OF CONTROL  
OF REINFORCEMENT AND PERFORMANCE ON DEDUCTIVE  
CONDITIONAL REASONING TASKS

by Faika Kalmoni-Baassiri

A thesis presented to the School of Graduate  
Studies and Research of the University of  
Ottawa in partial fulfillment of the require-  
ments for the Degree of Doctor of Philosophy

Ottawa, Ontario, Canada  
December 1981



F. Kalmoni-Baassiri, Ottawa, Canada, 1982

## ACKNOWLEDGEMENTS

The author is most grateful to and appreciative of the encouragement, guidance, and the constructive commentary received from the chairman of her thesis committee, Dr. André D. J. Côté. The author would like to thank Dr. J. M. Dionne for his constructive commentary on the statistical measures, and the Ottawa Roman Catholic Separate School Board, principals, teachers, and the students for their cooperation in providing the settings for the research.

TABLE OF CONTENTS

Chapter	page
INTRODUCTION . . . . .	v.
I.- REVIEW OF LITERATURE . . . . .	1
Summary and Hypotheses	28
II.- DESIGN OF THE STUDY . . . . .	32
Sample	32
Measuring Instruments	34
Data Collection	40
III.- RESULTS AND DISCUSSION . . . . .	43
Descriptive and Inferential Data	43
Discussion of the Data	49
SUMMARY AND CONCLUSION . . . . .	59
REFERENCES . . . . .	62
Appendix	
A. CHILDREN'S NOWICKI-STRICKLAND INTERNAL-EXTERNAL SCALE AND THE CONDITIONAL REASONING TASK . . . . .	68
B. ABSTRACT OF <u>A study of the relationship between locus of control of reinforcement and performance on deductive conditional reasoning tasks</u> . . . . .	89

## LIST OF TABLES

Table	page
1. Means and Standard Deviations of Internal and External Males and Females on CNS-IE and on Three Contents of Valid and Invalid Patterns . . .	44
2. Pearson Correlation Coefficients between Locus of Control of Reinforcement and the Content Dimensions for Valid and Invalid Patterns of Argumentation . . . . .	45
3. Two-Way Univariate Analysis of Variance for Locus of Control of Reinforcement, Sex, and Content Dimensions for Valid Patterns of Argumentation .	48
4. Two-Way Univariate Analysis of Variance for Locus of Control of Reinforcement, Sex, and Content Dimensions for Invalid Patterns of Argumentation.	50

## INTRODUCTION

The literature reveals a growing interest among educators in the subjective aspects of human behavior as reflected in research dealing with individual differences. The present investigation is concerned with a particular aspect of individual differences involving constructs related to the perception that an individual has of his ability to control his personal environment and how such a variable affects his behavior in school related tasks. More specifically, the present thesis enquires whether or not the personality characteristic of locus of control of reinforcement, as formulated from Julian Rotter's (1954, 1966) social learning theory is related to the inferential ability of students as reflected in their capacity to engage in deductive conditional reasoning tasks.

In Rotter's formulation, locus of control of reinforcement, viewed as a generalized expectancy variable, reflects the degree to which an individual perceives that reinforcements he experiences are contingent upon his own behavior or attributes as opposed to the degree to which he perceives that such reinforcements are contingent upon forces outside of himself thereby occurring independently of his own behavior (Rotter, 1966). Rotter's underlying notion places an emphasis on the instrumentality of behavior as reflected in the strength of contingency between acts and their effects. Perceptions that individuals have of the causal

relationship between their efforts and the outcomes of such efforts are, according to Rotter, distributed along a continuum the extremes of which are termed Internal Locus of Control (Internals) and External Locus of Control of Reinforcement (Externals).

The concept of locus of control of reinforcement, which involves the beliefs that one has about the control or lack of control of important events occurring in one's life space should be of great significance to educators. It seems self evident that the extent to which a child believes his own behavior to be instrumental in achieving academic success will undoubtedly affect his concrete efforts towards that success. It is reasonable to expect that the child who is inclined to believe that success and failure are a result of his own behavior will show more initiative in seeking intellectual rewards and will show greater effort and persistence in intellectual tasks and situations. On the other hand, the child who is inclined to believe that success and failure in schoolwork are the result of external circumstances such as the whims of the teachers and other uncertainties might well conclude that there is no reason to exert himself in an effort to obtain reward and avoid punishment.

Teachers characteristically try to encourage children by using approaches that are tacitly based upon the assumption that they (children) have an internal locus of control. They do so by emphasizing that effort and outcome are

causally linked and by using precepts such as "if you study hard enough, you will pass the test." Moreover; most teachers appreciate and in large part require that their students be actively involved in pursuing their own educational objectives. Emphasizing these approaches, they may overlook or not understand that some children are unable to perceive that their successes and/or failures in school tasks are based on their personal efforts and not on external factors such as luck, teachers' whims, influence of powerful others and so forth. A child manifesting a belief in an external locus of control of reinforcement is not likely to derive optimum benefit from the usual educational approaches because his fundamental view of the world does not include a coherent grasp of the causal link between his efforts and their outcome. It seems not unreasonable to conclude that this creates a major impediment to learning for the child with an external locus of control. However, a child manifesting a belief in an internal locus of control of reinforcement finds support and encouragement, in what might be called the characteristic school situation, thereby benefiting from such precepts and approaches.

The concept of locus of control of reinforcement includes the assumption that an individual employs some cause-effect analysis of events in his life. External locus of control individuals who by definition attribute control to external non-personal factors are expected to attempt

nothing more than a superficial cause-effect analysis. On the other hand, internal locus of control individuals who by definition attribute control to internal personal factors are expected to attempt a more in-depth cause-effect analysis simply as a function of their preferred mode of perceiving themselves in relation to their world. Consequently, a history of regarding the causal nature of behavior-outcome sequences presents opportunities to the individual to acquire and improve his ability to perform cause-effect analysis; whereas a history of a non-regard of the causal nature of behavior-outcome sequences results in an individual's ability to perform cause-effect analysis to be underdeveloped.

Though the bulk of the research on the measurement of internal-external locus of control of reinforcement has focused on adult students, research of this personality construct as manifested in children is on the increase. The review of the literature reveals that internal-external locus of control of reinforcement has been related to various personal attributes such as: cognitive variables, (Lefcourt et al., 1971); learning strategies, (Julian and Katz, 1968; Lefcourt, Lewis, and Silverman, 1968; Petzel and Gynther, 1970; and Watson and Baumal, 1967); problem-solving skills, memory and recall skills, (Davis and Phares, 1967; Phares, 1968, 1973; Seeman, 1963; Seeman and Evans, 1962); personality variables, (Davis and Phares, 1967; Joe, 1971; and Lefcourt et al., 1968). The aforementioned

research reveals that internals, in contrast to externals, rely more on past experiences, are more attentive to stimuli and cues in their psychological environment, are more cognitively active and are more eager to seek knowledge that will help personal successes. Also, internals were found to be more able than externals to retain and to recall information which is important for later outcomes.

Interestingly, the literature reveals that there is a lack of research that directly attempts to relate internal-external locus of control of reinforcement to inferential ability. From the aforementioned research findings and assumptions, it seems not unreasonable to postulate the existence of a relationship between an individual's standing on the locus of control of reinforcement dimension and some measure of his inferential ability. The measure of inferential ability used in the present study is a deductive conditional sentence reasoning task. Such a task was selected for three main reasons: First, deductive reasoning involves the organization or interrelationship of facts or information from which the individual concludes a necessary third relation. Such an activity requires the individual to accurately recall a hierarchy of causal relations in order to arrive at the correct conclusion. Second, such deductive reasoning tasks offer an objective measure of inferential ability because of the existence of agreed upon criteria for judging the truth and validity of its conclusion

which must of necessity follow specific logical rules. And third such reasoning tasks are an integral part of many school-related subjects such as mathematics, the sciences, and even literature.

It is suggested that a deductive conditional reasoning task is likely to reveal differences in inferential ability manifested by subjects with either internal or external locus of control of reinforcement since the very nature of the task seems to require just the sorts of abilities which internals have been shown to possess in greater measure than externals (Joe, 1971; Lefcourt, 1966; Rotter, 1975). The general hypothesis of the present study is that an individual's standing on the locus of control of reinforcement personality dimension will be related to that individual's performance of a deductive conditional reasoning task.

The procedure for the first chapter will be to trace the development of the construct locus of control of reinforcement, to discuss deductive conditional reasoning, to present related research on locus of control of reinforcement, and to formulate an hypothesis regarding a relationship between locus of control and conditional reasoning ability. The remaining chapters will elaborate on the design, report the results, discuss the results, and summarize the study.

## CHAPTER I

### REVIEW OF LITERATURE

The construct of locus of control of reinforcement developed out of Rotter's social learning theory and empirical findings on the effect of reinforcements on expectancies and their functional relationship to individual differences.

Rotter's social learning theory concerns itself with the instrumentality of behavior, which he holds to be a function of strength of contingency between acts and their effects. Rotter's theory, which utilizes both an expectancy construct and the empirical law of effect, has as its basic postulate that the potential for any behavior to occur, in any psychological situation, is a function of the person's cognitive expectancy that the behavior will secure the available reinforcement in that situation and of the value of the available reinforcement for that person (Phares, 1976; and Rotter, 1954, 1966). Accordingly, the four classes of variables in Rotter's social learning theory are: 1) behavior, 2) expectancies, 3) reinforcement, and 4) psychological environment. Among these variables, a greater determining role is given to the expectancy variable which is defined as the cognitive anticipation held by the individual that a particular reinforcement will occur as a function of a specific behavior on his part in a specific

situation. In other words, the expectancy variable refers to the anticipation of contingency between acts and their effects. Rotter (1954, 1966) further argues that expectancies associated with such causal relations between behavior and its reinforcement can be expected to generalize to other situations perceived as similar by the individual. This generalized expectancy of locus of control of reinforcement, as formulated from Rotter's theory, is viewed than to reflect the degree to which an individual perceives that reinforcements he experiences in his life space are contingent upon his own behavior or attributes versus the degree to which he perceives that reinforcements are contingent upon forces outside of himself and thereby occurring independently of his own behavior (Rotter, 1954, 1966, 1975). Thus the concept of locus of control of reinforcement is defined by Rotter, as follows:

When a reinforcement is perceived by the subject as following some action of his own but not being entirely contingent upon his action, then, in our culture, it is typically perceived as the result of luck, chance, fate or under the control of powerful others, or as unpredictable because of the great complexity of the forces surrounding him. When the event is interpreted in this way by an individual, we have labeled this belief in "external" control. If the person perceives that the event is contingent upon his own relatively permanent characteristics, we have termed this a belief in "internal" control. (Rotter, 1966, p. 1)

According to Rotter (1966, 1975) perceptions that individuals have of the causal relationship between their actions and the outcomes of such actions are distributed

along a continuum the extremes of which are termed internal locus of control reinforcement and external locus of control reinforcement.

As a situational variable, internal-external locus of control was formulated in a series of studies which dealt with the effects of behavioral tasks defined as chance or skill-determined on the formation and extinction of expectancies. This series of empirical studies was based on the hypothesis derived from Rotter's theory that the effect of a reinforcement following some behavior on the part of an individual is functionally related to the individual's perception of causal relationship between his own behavior and its outcome. In other words, the nature of the effect of reinforcement of future expectancy and consequently on future behavior is determined by the degree to which the individual perceives that reinforcement follows his own behavior versus the degree to which he feels that reinforcement is controlled by forces outside himself.

A common feature to all the studies of internal-external locus of control as a situational variable is that skill-determined tasks are expected to establish the locus of control as "internal." That is, the subject in such tasks is led to believe that receiving reinforcement depends on his own behavior (skill, capabilities) rather than on external factors. Chance-determined tasks, on the other hand, are expected to establish the locus of control

as external. That is, the subject is led to believe that reinforcement depends on factors beyond the subject's control. Consistent evidence regarding the effects of such manipulation of the perceived situational internal-external locus of control has been obtained using such behavioral tasks (Joe, 1971; Lefcourt, 1966; Phares, 1976, 1980; Rotter, 1966, 1975).

Concomitantly, attempts were made to develop a questionnaire to measure a "generalized expectancy" for internal-external locus of control of reinforcement (James, 1957; Phares, 1957; Rotter, Liverant, and Crowne, 1961). Scores on these scales are assumed to reflect an acquired personality trait relating to the individual's characteristic perception of the locus of control of reinforcement in a number of real-life situations.

As a personality trait, internal-external locus of control of reinforcement is held to be a generalized expectancy which individuals express in different manners. An individual who perceives no causal link between his behavior and the reinforcement that follows his behavior and who attributes the occurrence of outcomes in his psychological environment to non-personal, external factors is considered to express a generalized expectancy for external locus of control. Conversely, an individual who perceives causal links between his behavior and its outcome and who attributes the occurrence of outcomes in his psychological environment

to personal characteristics, is considered to express a generalized expectancy for internal locus of control.

In the present study, internal locus of control individuals will be referred to as internals and external locus of control individuals will be referred to as externals.

Essentially, then, the study of Rotter's locus of control of reinforcement concept has taken two general directions. In the first instance, it has been manipulated, measured or inferred in behavioral task situations, where a subject's responses and expectancies for success are analyzed for reflections of locus of control. The second approach involves the measurement of generalized expectancies for internal or external orientation and the establishing of relationships with other variables such as individual or group differences. The latter approach is used in the present study.

The general conclusion which follows from a careful review of the literature is that the locus of control of reinforcement construct is a measurable psychological dimension which is in some way related to cognitive performance. The findings reported in the literature reviews of Rotter (1966) Lefcourt (1966) Ryckman (1979) Phares (1980) provide evidence of relationships between the concept of internal-external locus of control of reinforcement and variables such as: academic achievement; need to control; motivational characteristics; variation in perceptual threshold;

and the ability to persuade others. The reported findings also indicate a number of areas where internals and externals differ on dimensions other than locus of control. Although internal-external locus of control of reinforcement has been related to different areas important in the learning process and although the concept of causality is inherent in the definition of locus of control, it is interesting to note that there appears to be no reported research that deals directly with the relationship between an individual's standing on the locus of control dimension and his standing on some measure of inferential ability.

According to the ample research accumulated on locus of control of reinforcement and its relationships to cognitive, personality and performance variables, subjects described as internals were found to exhibit characteristics which distinguish them from those subjects described as externals (Joe, 1971; Lefcourt, 1966, Phares, 1976, 1980; Rotter, 1966; and Ryckman, 1979). Many of these empirically established cognitive, personality and performance characteristics of internals and externals tend to advantage the former and disadvantage the latter in the efficient performances of deductive reasoning tasks.

It seems reasonable to expect that the characteristic cognitive response of internals coupled with their ability to grasp cause-effect relations should allow them to outperform externals in tasks which focus on antecedent

consequent relationships such as deductive reasoning tasks. The present study is intended to establish the validity of such a claim.

To recapitulate briefly the preceding part of this section has presented some theoretical background to the construct of locus of control of reinforcement. A postulate derived from the construct is that an individual's belief of whether or not he controls the occurrence of events in his psychological environment has a differential effect on his behavior. As a measurable psychological dimension it has been related to many cognitive, performance variables, as well as other personality variables. The following section justifies the selection of deductive conditional sentence reasoning as a measure of inferential ability.

Most authorities (Copi, 1972; Gibson, 1976; Ginsburg and Opper, 1979; Guilford, 1967; and Wohlwill, 1968) agree that the most common types of inferential ability are inductive and deductive reasoning. Inductive reasoning involves reasoning from the particular to the general. The issue involved when discussing inductive reasoning is whether to regard it as a process or as a method of reasoning. As a process, induction deals with objects of sense experience and as such it is regarded to be of the same nature as conception. As a method of reasoning, induction involves what is referred to in the literature as scientific methods of discovery and hypothesis testing. Given

that the conclusions of the inductive reasoning process may be extraordinarily divergent and probabilistic (Copi, 1972), it is not surprising that reliable and valid instruments purporting to measure it are rare if not non-existent. Because there are no definitely agreed upon criteria for measuring the inductive reasoning process, the present study will restrict its investigation of inferential ability to a study of the deductive reasoning process.

Deductive reasoning which involves reasoning from the general to the particular requires the ability to draw correct conclusions or assess conclusions drawn from some given information. Typically, the individual is provided with some information which he is to assume to be true. From this, he is then required to draw a conclusion or to judge if a specific conclusion follows necessarily from the given information (Copi, 1972; and Ennis, 1969). Deductive reasoning, then, is that sort of reasoning in which the conclusion must necessarily follow from what is given.

Ennis (1969), Copi (1972), Revlis (1975), and Johnson-Laird (1975) state that, in its traditional form, deductive reasoning presents an argument which consists of two propositions called premises and a third proposition which may logically follow from the premises, called the conclusion. They also assert that arguments may be either valid or invalid. Arguments in which unique conclusion follows necessarily from the given premises are referred to as valid

arguments. Arguments in which no unique conclusion necessarily follow from the given premises are referred to as invalid arguments.

It is generally accepted (Copi, 1972; Ennis, 1969; Ennis and Paulus, 1965; Evans, 1978; and Taplin and Staudenmayer, 1973) that the most widely used type of deductive reasoning in the English language is sentence reasoning. Depending on the connective used, sentence reasoning is further divided into four forms which are: 1) disjunction, 2) alteration, 3) conjunction, and 4) conditional. Among these different forms of sentence reasoning, conditional sentence reasoning is the most common (Ennis and Paulus, 1965; and Evans, 1978). In fact, many school subjects utilize and encourage conditional sentence reasoning. It is fundamental to arithmetic, mathematical theorems and the generating of hypotheses for testing in science.

In the present study conditional sentence reasoning was selected as a measure of inferential ability because this type of reasoning is commonly used in daily life as well as in school tasks, and because of the availability of reliable measure of it, which has been validated for Ottawa-Carleton region grade eight students (Amin, 1977).

A conditional sentence argument is formed when the connective used is "if, then." The sentence which follows the word "if" is called the antecedent and the part which

follows the word "then" is the consequent. The normal convention in formal logic is that the "if, then" connective represents a relation between the antecedent and the consequent (Evans, 1978; Johnson-Laird, 1975; and Revlis, 1975).

According to Ennis and Paulus (1965), Johnson-Laird (1975), and Evans (1978), the four most basic and accepted rules of inferences associated with deductive conditional sentence reasoning are: 1) affirming the antecedent, 2) denying the consequent, 3) denying the antecedent, and 4) affirming the consequent. Studies by the above authors showed that adults as well as children identify and are able to regularly make these basic logical inferences.

The following paragraphs provide illustrations of those logical inferences in symbolic form together with a brief description of each.

Given a conditional sentence argument containing antecedent and consequent statements where both must be accepted as true, if the antecedent is established (affirmed), then the consequent must be established. This type of inference is called affirming the antecedent and it reveals a valid pattern of argumentation.

If p, then q

p

∴ q

(valid argument)

Given a conditional sentence argument containing antecedent and consequent statements where both must be accepted as true, if the consequent is denied, then the antecedent

must also be denied. This type of inference is called denying the consequent and it also reveals a valid pattern of argument.

If p, then q

not q

∴ not p

(valid argument)

Given a conditional sentence argument containing antecedent and consequent statements where both must be accepted as true, if the antecedent is denied, then the consequent is not necessarily denied or affirmed. This type of inference is called denying the antecedent and it reveals an invalid pattern of argumentation.

If p, then q

not p

∴ not necessarily not q or q (invalid argument)

Given a conditional sentence argument containing antecedent and consequent statements where both must be accepted as true, if the consequent is affirmed, then the antecedent is not necessarily affirmed or denied. This type of inference is called affirming the consequent and it reveals an invalid pattern of argumentation.

If p, then q

q

∴ not necessarily p or not p (invalid argument)

The review of the literature on deductive reasoning reveals that the type of pattern and the type of content of argumentation affect performance. These two factors are inherent in deductive reasoning tasks (Amin, 1977; Ennis and

Paulus, 1965; Evans, 1973, 1978; Henle, 1962; Johnson-Laird, Legrenzi and Legrenzi, 1972; Osheron, 1973; Revlis, 1975; Roberge and Paulus, 1971; Staudenmayer, 1975; Taplin and Staudenmayer, 1973; and Wason and Johnson-Laird, 1972).

It was previously discussed that patterns in which a unique conclusion, following necessarily from the given premises, can be drawn are designated as valid patterns of argumentation. Whereas, patterns in which no unique conclusion, which follows necessarily from the given premises, can be drawn are designated as invalid patterns of argumentation. As regards the relation between valid and invalid patterns of argumentation and performance, studies by Ennis and Paulus (1965), Miller (1968), Ceraso and Provitera (1971), Taplin and Staudenmayer (1973), Johnson-Laird (1973) and Evans and Wason (1976) have shown that problems of the valid pattern type resulted in the least amount of error. Whereas, most of the errors resulted from problems of the invalid type of pattern. On examining these findings it appears that where a unique conclusion is available the task of forming an inference seems less difficult and subjects tend to make less errors. Problems of the invalid type where more alternatives are available as conclusions, that may follow from the premises, seem to introduce an element of confusion; hence solving such problems may seem more difficult and subjects tend to make more errors. What is required on the part of the individual to solve problems

of deductive conditional sentence reasoning is to cognitively generate deductions and hypotheses as probable conclusions to premises, retain and sort them, then select the correct conclusion(s) that necessarily follows from the given premises (Roberge and Paulus, 1971; and Wohlwill, 1968).

In relation to content, the four types of content commonly referred to in deductive reasoning experiments are: 1) concrete-familiar, 2) suggestive, 3) symbolic, and 4) unfamiliar. The following paragraphs present a brief explanation of each.

Concrete familiar includes sentence premises which refer to concrete articles with which the subject is expected to be familiar. The truth status of each sentence is neutral in the sense that the reader is not expected to hold strong opinions about the truth or falsity of these sentences.

Suggestive content includes sentences where part of the sentence premises, either the antecedent or the consequent, have truth status familiar to the reader while the other part states something which is false in terms of daily experiences.

Symbolic content includes premises where letters of the English alphabet are used in place of concrete objects or attributes. These symbols are not expected to have any specific meaning except what the reader chooses it to be.

Unfamiliar content includes sentence premises where nonsense syntax is used. The reader is required to give meaning to the statements.

In the present study only the first three contents will be used. The unfamiliar content is deleted from the study because it is not currently used in reported research nor is it greatly differentiated from the symbolic content. In current research practice symbolic content is more commonly used than unfamiliar content in deductive reasoning experiments. Most importantly the measuring instrument employed in the present study includes only the first three contents.

As regards the relationship between types of content and reasoning behavior, it is held that in using a more realistic or concrete context the meaningfulness of the conditional premises is strengthened thus allowing the subject to more readily interpret the premises and infer the conclusion (Ennis and Paulus, 1965; Evans, 1978; Johnson-Laird, Legrenzi and Legrenzi, 1972; Staudenmayer, 1975; Taplin and Staudenmayer, 1973; Roberge and Paulus, 1971; and Wason and Johnson-Laird, 1972). In using suggestive content where part of the sentence premises state something true in daily experience and the other part states something untrue, the reader is required to draw conclusions which contradict his factual knowledge. In such a situation, the ability to distinguish between logical validity and

factual knowledge becomes critical. That is, the selective abstraction by the reader of relevant from irrelevant information is an element essential to effective performance. In using symbolic content the interpretation of the context-free sentences cannot be readily attributed to semantic relation between the propositions. The semantic meaning of the conditional premises and conclusion in symbolic form is whatever the subject chooses to ascribe to the sentences. Such situations obviously present difficulties for some subjects. In solving symbolic content problems, the subject has to rely on and generalize from his past experiences. In such a situation memory plays an important part. The efficient retrieval of generalizations, concepts and other cognitive information stored in long term memory becomes vital.

The above discussion of types of patterns and types of content is included because they have been shown to affect deductive reasoning performance. It is held that their inclusion in the analysis of responses would provide a more robust measure of the subjects' performance. Accordingly, the present study will advance hypotheses related to both.

In the foregoing the structure, organization, and nature of deductive conditional sentence reasoning paradigm were discussed. In the following section some factors found in the literature to be related to deductive conditional

reasoning performance will be presented with the intent to establish links between the performance potential of internals as compared to externals on deductive conditional sentence reasoning tasks. Since there is no reported research that deals specifically with the relationship between internal-external locus of control of reinforcement and inferential ability, a detailed presentation of research on locus of control of reinforcement relating characteristics regarded as essential for solving deductive conditional reasoning tasks will be given next.

The two earliest studies (Seeman and Evans, 1962; and Seeman, 1963) on cognitive activity as a function of internal-external locus of control centered around how internal and external locus of control individuals attend to and recall information that is immediately present in their environment. The researchers in the 1962 study matched two groups of hospitalized tuberculosis patients on socio-economic status, on IQ measure and hospital experiences. Measuring their knowledge of their illness, the extent to which they questioned doctors and nurses, and their satisfaction with the information given them about their condition, Seeman and Evans found that internals, as compared to externals, were more knowledgeable about their condition; asked more questions about their illness; and were less satisfied with the information given about their condition. This was followed by Seeman's (1963) study. In

a prison setting, Seeman investigated the retention by internal and external reformatory prisoners of various kinds of information related to parole, to present reformatory setting, and to long-range prospects for a non-criminal career. As predicted, there was a significant correlation, independent of intelligence between scores on the Internal-External scale and the amount of information recalled. Internals were found to retain more information particularly that regarding parole materials which concern the intermediate and foreseeable future. The findings from these two studies not only showed that internal locus of control individuals learn and recall more information than their external locus of control counterparts; the findings also indicate that internals more so than externals appear to be more motivated to acquire more knowledge. Support for this conjecture is found in the Davis and Phares (1967) study which tested the hypotheses that differences in behavior exist between internal and external locus of control individuals in acquiring information, and that differences exist between the two groups in actively seeking out additional relevant information present in their respective environments. Internals having a generalized expectancy that reinforcements in their psychological environment are contingent upon their own behavior would make attempts to more effectively control their environment through asking questions and seeking out relevant information. Externals,

on the other hand, would have less need to acquire information since outcomes tend to be perceived by them as being less dependent on their actions. These hypotheses were tested in a social setting where the subjects were told that their task was to change the opinion and attitude of another person on the war in Vietnam. The dependent measures were the number of questions the subjects asked about the person before meeting him. As predicted, individuals with internal locus of control of reinforcement orientation did in fact ask a significantly greater number of questions than did individuals with external locus of control. Also the former group expressed a preference for additional information more so than the latter group.

In a subsequent study of Phares (1968) and Lefcourt, Lewis, and Silverman (1968), the tendencies of internals and externals to retain, recall and utilize given information in decision-making were compared. Subjects in Phares' (1968) study were presented materials which they learned to no error recall. After a period of one week, the subjects were brought back and were given a matching task, the solution of which required the utilization of material learned previously. After each matching task subjects were asked to state the reasons for their matching. The results showed that internal locus of control individuals, gave significantly more reasons for the matches ( $t = 2.56$ ,  $df = 27$ ,  $p < .05$ ) and they gave more correct reasons. This

finding suggests that internals tend to utilize information more effectively. Similarly, in Lefcourt et al. (1968) study, internals were found to recall more correct items, pay more attention in skill-determined tasks, take a longer time in decision-making and report more task-relevant thoughts than task-irrelevant thoughts. Internals, then, were shown to recall more information that was relevant and correct.

To test the hypothesis that internal locus of control individuals are more motivated to acquire information and have a greater need to control occurrence of outcomes in their environment, Lefcourt and Wine (1969) investigated the ways in which internals and externals attempt to learn about another person. The experimental subjects had to interview two target persons. One target person behaved in a rather puzzling way by avoiding eye contact throughout the interview. The second target person behaved in a more conventional way with regard to eye contact. As predicted internals as opposed to externals attempted more often to maintain eye contact and were more observant during the interviews particularly with the puzzling target person. Attempting to maintain eye contact and being more observant are taken as an indication of greater need of internals to attend to information providing cues to help clear uncertainties. Consistent with the above findings Sutherland (1972) found that internals ask significantly

more questions than externals, especially in low information group problem-solving situations.

In summary, the findings reported in the above mentioned research reveal internal locus of control individuals, in contrast to external locus of control individuals, to be 1) more eager to acquire information, 2) retain and recall relevant and correct information which is important for later outcome, 3) ask more questions as a method to acquire more information and to clarify uncertainties, and 4) more observant. These findings indicate that internals are more cognitively active and are more likely to seek out and employ different strategies to achieve success and control of outcomes.

The ability to reason and to recall relevant and correct information that will likely be useful in the future and helpful in controlling the occurrence of outcomes implies a tendency to be sensitive to cues in one's environment. Results obtained from the studies of Lefcourt (1967), Lefcourt and Wine (1969) and Sutherland (1972) reveal the greater attentiveness of internals to cues in their environment.

In the second part of their 1969 study Lefcourt and Wine divided their internal and external locus of control subjects into two groups under two cue-explicit conditions. Each group was composed of both internals and externals. In the low-cue condition, subjects initially met in a

classroom in which some items were placed purposely to attract their attention. While in the room, they were asked to write down the first fifty words that came to their mind. Later they were taken to another room and asked to describe the previous room. In the high-cue condition, using the same room with the items, the subjects were told that the experiment is on attention and were asked to describe their own living quarters. Later they were taken to another room and asked to describe the previous room. The results obtained showed that internals exceeded the externals in the number of items observed under the low-cue condition. No significant difference was obtained between the two under the high-cue condition. The findings of this study support the findings of a previous study by Lefcourt (1967).

Using Rotter's level of aspiration board, Lefcourt (1967) divided his experimental subjects (both internal and external) into three groups under three cue-explicit conditions. The task was the same for all three conditions; and it was an achievement oriented task. In low-cue condition the subjects were told that the task is an amusement game for children and the purpose is to find out how adults perform. In the moderate-cue group, the subjects were told that the task is related to motor control skill and were told how to earn points. In the high-cue group, the subjects were told that the task is achievement-related and

good performance is important. As predicted the results showed no difference in behavior among internals across conditions. What this means is that internals rely on their interpretation of whether a task is skill-determined or a game; they seem not to require any external assistance in interpreting the nature of the task. Other results of this study were a significant difference among external subjects across the three explicit-cue conditions, the greatest being between the low- and high-cue conditions, and a general difference between internal and external subjects. On closer examination of the general difference, internals under the low- and moderate-cue conditions performed better than the externals; however under the high-cue condition, it was the externals who exceeded the internals. What this means is that externals seem to benefit more from external prodding and when told explicitly what to do. According to Lefcourt this difference reflects that

the individual with external control expectancies does not adequately search for reinforcement opportunities and that he fails to maintain the kind of internal dialogue that would facilitate the cognitive sorting and categorizing of the situations so that the opportunities for reinforcement would be more self-evident. The more explicit directions in the high-cue condition allow for the missing cognitive link for the external control subjects. (1967, p. 377)

The above finding on the perceptual sensitivity of internals to cues was replicated in a later study. Lefcourt, Gronnerud, and McDonald (1973) investigated the differential

awareness of internal and external locus of control individuals to double entendres within a word association test. Traditionally, in word association tests long response time indicates conflict in responding which in this study resulted from the cognition of the double entendre words. As predicted by the authors, internal locus of control individuals showed a longer response time earlier than did the external locus of control individuals. What this means is that internals were first to cognize the double entendre words. Analyzing the recordings of signs of attitude change toward the task and other visible reactions showed that it was the internals who displayed the first notable change. Once again, the claim that internals show greater sensitivity to cues and are more effective in their cognitive functioning was supported.

It is generally accepted that the principal cognitive operations underlying deductive reasoning are analysis, abstraction, generalization, forming class concepts, and forming inferences (Falmagne, 1975; Guilford, 1962; Vansson, 1974; Wason and Johnson-Laird, 1972; and Wohlwill, 1968). Cognitive sorting, ordering, categorizing, remembering are regarded as processes that mediate effective functioning of the above operations (Sawrey and Telford, 1968). In addition, deductive reasoning tasks always involve the ability to conduct an internal dialogue with the purpose of analyzing the interrelationships of the premises and the

the conclusion before selecting the correct conclusion that necessarily follows from the premises (Copi, 1972; Evans, 1973; 1978; Jansson, 1974; Johnson-Laird, 1975; and Wason and Johnson-Laird, 1972). The significance of the Lefcourt et al. (1967) and the Lefcourt et al. (1973) studies lies in the fact that if externals lack the ability to perform an internal dialogue that would facilitate cognitive sorting and categorizing then they would likely be at a disadvantage should they be given tasks such as deductive reasoning tasks, that focus on such activities.

An examination of the research findings reported in this review reveals that most of the dimensions documented in the foregoing in which the behavioral performance of internals and externals were compared seem to relate to some aspect of information processing ability. Gibson (1976) and Hilgard and Bower (1975) assert that the processes involved in acquiring, retaining, recalling, and abstracting relevant from irrelevant information and in showing greater attentiveness to cues in the environment are important in effective and efficient information processing.

The reported superiority of internals as compared to externals in the acquisition, retention, and utilization of relevant information and their greater sensitivity to cues in their environment support the claim that internals and externals appear to differ in their information

processing ability and that internals are endowed with a superior information processing ability.

Efficient information processing plays an important role in forming inferences. In fact, it is one of the underlying cognitive operations in deductive reasoning that mediates the comprehension and interpretation of the given material from which conclusions can be drawn (Fvans, 1978; and Revlis, 1975). Memory is particularly necessary in the collection, combining, and retention of information which are summed up and expanded in a generalization. In deductive reasoning tasks memory is also important in holding two propositions in mind in order to infer the conclusion (Copi, 1972).

Other complementing dimensions important to forming inferences are relying on and generalizing from past experiences, power of observation, reliance on internal standards, and a belief in the consistency or uniformity of events occurring in one's environment (Amin, 1977; and Falmagne, 1975). Internals, more so than externals, were found to possess a greater power of observation and to rely on their own standards (Cork, 1978; Lefcourt, 1972; Lefcourt and Wine, 1969; Lefcourt et al., 1967; Lefcourt et al., 1973). By definition external control individuals are those individuals who adopt the expectancy that they do not control the occurrence of reinforcements in their environment. In keeping with this definition, it seems more likely that

internals would adopt a belief in the consistency of events occurring in their environment; otherwise it would not be feasible to exercise any control of the occurrence of those events. Externals, on the other hand are more likely to adopt the belief that the occurrence of events and outcomes in their environment are unpredictable (Rotter, 1966, 1975). Moreover, when a person adopts the expectancy that he does not control the occurrence of reinforcement, he will be less likely to rely on and generalize from past experiences and hence will fail to use increasing experiences to develop better learning and coping strategies. Whereas, when a person adopts the expectancy that he controls the occurrence of reinforcement, he will be more likely to rely on and generalize from past experiences to develop better learning and coping strategies (Phares, 1979, 1980; and Rotter, 1975).

The different modes of cognitive functioning presented in the above discussion are held to promote effective performance by the individual on deductive conditional reasoning tasks. In solving deductive conditional sentence reasoning tasks, it is required of the individual to correctly comprehend and interpret the premises and the given conclusions, generate deductions and hypotheses as probable alternative conclusions to the premises, retain these alternative conclusions and finally select the correct conclusion(s) that necessarily follow(s) from the premises. It was previously advanced that the type of content of

argumentation affect performance. In addition to the above cognitive activities, the subject, in solving suggestive content, is required to differentiate logical validity from factual truth; hence, the ability to abstract relevant from irrelevant information and sensitivity to task demands becomes important. It will be recalled that in solving abstract content problems the subject has to rely on his past experiences to attribute some meaning to the symbols used; hence retrieval of generalizations, concepts, and other perceptual and cognitive information stored in memory become important. Internals and externals have been shown in the foregoing discussion to differ on these and other modes of cognitive functioning regarded important to effective performance. Internals, as compared to externals, were found to generate more deductions; to be better at abstracting, retaining, recalling, and utilizing relevant information; to be more sensitive to task demands; to be less distracted by irrelevant thoughts while performing a task; and to have better memory skills.

In summary, the present study contends that internals and externals have differing characteristic modes of cognitive functioning; and that the effects of these differences will be, in part, revealed by the superior performance of internals on deductive conditional sentence reasoning tasks.

### Summary and Hypotheses

The personality concept of a generalized expectancy of internal or external locus of control of reinforcement is derived from Rotter's social learning theory. The general principle is that internal locus of control individuals are those who perceive reinforcements as being a consequent of their own actions and thereby under their control; whereas external locus of control individuals are those who perceive reinforcements as being unrelated to their own behaviors and therefore are beyond personal control. The importance of perceived causality or control in determining individual behavior has been validated in a large number of studies reviewed by Joe (1971), Lefcourt (1976), Phares (1980), and Rotter (1975).

To recapitulate, internal and external locus of control individuals have been found to differ in many areas. For example, they have been found to differ in their capacity to: 1) acquire, retain, and recall relevant information, 2) generate questions as a method to acquire more information and to clarify uncertainties, 3) utilize information in decision-making, 4) detect embedded cues in their environment, and 5) adopt behavior patterns and strategies which may facilitate control over their environment. They were also found to differ in their 1) reliance on external explication of task requirement, 2) abstraction of relevant

from irrelevant information, and 3) motivation to know more and need to control (Cork, 1978; Davis and Phares, 1967; Joe, 1971; Lefcourt, 1967; Lefcourt, Gronnerud, and McDonald, 1973; Lefcourt, Lewis, and Silverman, 1968; Lefcourt and Wine, 1969; Phares, 1968, 1975, 1980; Pines and Julian, 1972; Rotter, 1966, 1975; Ryckman, 1978; Seeman and Evans, 1962; and Seeman, 1963).

The findings suggest that internals when compared to externals: 1) generate more hypotheses and deductions (Davis and Phares, 1967; Lefcourt et al., 1967; Seeman, 1963; and Seeman and Evans, 1962); 2) have superior encoding and decoding abilities (Joe, 1971; Lefcourt, 1976; Phares, 1980; and Rotter, 1975); 3) rely on internal standards (Cork, 1978; Lefcourt, 1972; and Lefcourt and Wine, 1969); 4) possess a greater power of observation (Lefcourt et al., 1967, Lefcourt et al., 1973); and 5) have a greater tendency to disregard irrelevant information (Lefcourt, 1972; and Lefcourt and Wine, 1969).

The cognitive processes which are essential for efficient deductive reasoning performance, include the ability to: 1) analyze the antecedent-consequent interrelationships of the premises and the necessary conclusions; 2) correctly comprehend and interpret the premises and the conclusion; 3) disregard incidental information that may interfere with drawing conclusions from the given premises; and 4) have superior memory skills particularly that of

retention. Also important are the ability to generate deductions, a belief in consistency of occurrence of events, and a reliance on internal standards (Copi, 1972; Ennis, 1969; Evans, 1978; Revlis, 1975; and Wohlwill, 1968).

The research findings discussed in the preceding section of the review of the literature reflect on a number of important dimensions of effective cognitive functioning, the comparative standing of internal and external control individuals on the aforementioned abilities.

Based on the literature one can postulate a relationship between an individual's standing on the locus of control of reinforcement dimension and his/her performance on deductive conditional sentence reasoning tasks. In other words, subjects scoring at the internal end of the locus of control of reinforcement scale are more likely to score higher on a deductive conditional reasoning task than are subjects scoring at the external end of the scale.

Taking into consideration types of patterns of argumentation and types of content, the following specific hypotheses are made:

- 1) Given the valid pattern of argumentation, internal locus of control individuals display more ability on concrete-familiar, suggestive, and symbolic contents than do external locus of control individuals.

It was previously discussed in the review on deductive conditional reasoning that the rules of inference used in the present study were found to be basic among both adults and children. It was also mentioned that more errors are committed by respondents when solving problems requiring inferences of the invalid pattern of argumentation. In other words, problems of the invalid pattern were found to be more difficult than those of the valid pattern. In the review, it was suggested that in the case of invalid patterns of argumentation where no unique conclusion necessarily follows from the given premises, more alternative responses would

be deduced as probable conclusions to the given premises. In such a situation performance would be aided by cognitively generating more deductions as probable conclusions and cognitively verifying their validity as appropriate conclusions to the given premises before selecting the correct response(s).

In the literature internals, as compared to externals, were found to prefer, select and perform better under skill or ability determined situations (Ryckman, 1979); they were also found to generate more deductions, rely on internal frame of reference and perform better in situations that require cognitive mediators and transformations. In view of this, it is held that internals, congruent to their cognitive style preferences, would be more likely than externals to regard tasks of the invalid pattern type as being skill or ability determined. Accordingly, it is consistent with the theoretical rationale of the present study to advance the following specific hypothesis:

2) Given the invalid pattern of argumentation, internal locus of control individuals display more ability on concrete-familiar, suggestive, and symbolic contents than do external locus of control individuals.

In this chapter, a review of the literature of locus of control of reinforcement, as well as a description of deductive conditional sentence reasoning format and the characteristic modes of cognitive functions regarded as essential for effective performance were presented. General and specific hypotheses were formulated. The next chapter presents details of the design of the study adopted.

## CHAPTER II

### DESIGN OF THE STUDY

In this chapter a description of the procedures followed for the collection and analysis of data is presented. The description will include an account of the sample used, the measuring instruments used in collecting the data, the method by which data was gathered, and the statistical techniques adopted for the analysis of the data.

#### Sample

The original pool of subjects from which the experimental sample was selected was made up of 700 grade eight students of both sexes from five junior high schools of the Ottawa Roman Catholic Separate School Board. These schools being situated in three different geographical areas of the city, it is held that their students represent different levels of the socio-economic status. Moreover, these schools from which the subjects came cater to the bilingual language needs of their respective communities. The subjects included in the pool came from classes where students were considered by the school administrators and teachers to be of average scholastic ability. Therefore, it is contended that the findings may be generalized to other grade eight students residing in large urban communities within the province of Ontario.

All subjects in the original pool were administered the Children's Nowicki-Strickland Internal-External Scale (CNS-IE) followed by the Conditional Reasoning Test (CRT). These two measuring instruments were combined in one booklet.

Subjects were divided into internal and external locus of control groups according to their scores on the CNS-IE scale. Each item has either a Yes or No response which indicates either an internal or external orientation. In scoring the scale, scores are obtained in the direction of "external" orientation. The subject's score is the total number of "external" choices. Therefore, the more "external" choices are checked, the higher the score. In the present study the cut-off criteria used to form the two extreme groups was the 25th and 75th percentile. This produced a sample size of 312 subjects of both sexes. Subjects whose scores were equal to or less than 10 were defined as internals ( $n = 142$ ,  $\bar{x} = 8.17$ ,  $s.d. = 1.68$ ). Subjects whose scores were equal to or greater than 18 were defined as externals ( $n = 170$ ,  $\bar{x} = 20.135$ ,  $s.d. = 2.195$ ). The remaining subjects were not used in the present study.

When the extreme groups of internals and externals were differentiated in terms of sex, equal numbers of males ( $n = 71$ ) and females ( $n = 71$ ) among internals and equal numbers of males ( $n = 85$ ) and females ( $n = 85$ ) among externals were obtained. It should be observed that the balancing of male and female subjects was a pure coincidence.

## Measuring Instruments


### Locus of Control Reinforcement

According to Rotter, the first person to attempt to measure individual differences among adults in generalized expectancy or belief in external control as a psychological variable was Phares (Rotter, 1966). He developed a Likert-type scale composed of 13 internally and 13 externally oriented items which were established a priori. With this scale he found some supporting evidence in predicting behavior within a behavioral task situation. James (1957) enlarged and improved on Phares' (1957) scale. His new scale proved to be more predictive in research dealing with correlates of individual differences in generalized expectancy (Rotter, 1966). Finally, after a series of revisions, Rotter, Liverant, and Crowne (1961) developed a 29 item scale in the form currently used in research. The present scale did away with the idea of having subscales and has a better control for social desirability. This scale is commonly known as Rotter's I-E scale and is a forced-choice scale in which the subject reads a pair of statements and indicates with which of the two he or she agrees more strongly (Rotter, 1966).

The items of Rotter's I-E scale are scored in the direction of belief in external locus of control. The score is the total number of external choices made. The

scores range from 0 to 23 (the remaining 6 are used as fillers intended to make somewhat more ambiguous the purpose of the test). A score of 0 means that respondents have not selected any items that indicate an external control orientation. These subjects are referred to as Internals. A score of 23 indicates that the respondents have selected all of the items that indicate external control orientation. These subjects are referred to as Externals. As Rotter (1966) has indicated these are the extremes of a continuum.

Considering the extensive body of research with adults using Rotter's I-E scale, it seemed appropriate to extend an investigation of the locus control variable to children. The first I-E scale for children was constructed by Bialer and Cromwell (1961). The scale is a 23 item questionnaire with yes-no responses. The second scale was constructed by Battle and Rotter (Rotter, 1966). This scale is more projective in nature; it presents the subject with six situations based on the Posenzweig picture frustration approach. The third questionnaire, the Intellectual-Academic-Responsibility (IAR) was developed by Grandall, Katkovsky, and Grandall (1965). Their scale is a more specific scale aimed at assessing children's beliefs in reinforcement exclusively in intellectual-academic-achievement situations. The items in this scale (IAR) attempt to determine whether or not the child believes that



he, rather than other persons, usually causes the successes and failures he experiences in intellectual achievement situations.

The limitation among these scales developed, is that none attempted to provide a global measure of the internal-external dimension (Strickland, 1973). The main criticism of Bialer-Cromwell's scale for children is that it lacks standardization. Battle and Rotter's scale is said to be difficult to administer to large groups and it lacks information about its reliability coefficient scores. Crandall et al.'s IAR scale is weakened by the fact that it measures only perceptions of personal versus outside control of intellectual achievements which is a specific measure. With the objective of providing a global measure of the internal-external dimension, across various situations the Nowicki-Strickland scale for children was developed (Strickland, 1973). This scale has shown substantial construct validity, internal consistency, and reliability.

The Children's Nowicki-Strickland Internal-External (CNS-IE) scale consists of 40 items that are answered either YES or NO by placing a mark next to the selected answer. The questions asked describe reinforcement situations across interpersonal and motivational areas such as dependency, affiliation, and achievement (Strickland, 1973). The internal-external personal characteristics that the CNS-IE attempts to measure is based on Rotter's definition of the

internal-external locus of control dimension. Similar to Rotter's scale and method of scoring, scores are obtained in the direction of external control orientation and the subject's score is the arithmetic sum of external choices selected. A high score is an indication of an external locus of control.

To test the reliability and validity of CNS-IE, it was given to over 2,000 children from grades 3 to 12. Internal consistency coefficients via the split-half method, corrected by the Spearman-Brown formula has been found to be  $r = .63$  (for grades 3, 4, and 5),  $r = .63$  (for grades 6, 7, and 8),  $r = .74$  (for grades 9, 10, and 11), and  $r = .81$  (for grade 12) (Strickland, 1973). The test-retest reliability measures reported for a 6 week period are .65 for the 3rd grade, .66 for the 7th grade, and .71 for the 10th grade.

To investigate the construct validity of the Nowicki-Strickland scale, it was related to other measures of locus of control. The correlation coefficient with IAR scale were  $r = .31$  ( $n = 182$ ) for 3rd grade and  $r = .51$  ( $n = 171$ ) for 7th grade. The correlation with the Bailer-Cromwell score was significant  $r = .41$  ( $n = 29$ ) for children aged 9 to 11 and with Rotter's scale the coefficient score in two studies were  $r = .71$  ( $n = 76$ ) and  $r = .38$  ( $n = 46$ ).

Conditional Reasoning Test (CRT)

The Conditional Reasoning Test (CRT) is based on five basic principles of deductive conditional reasoning. These principles of reasoning include three valid patterns of argumentation and two invalid patterns of argumentation. The five principles of reasoning are presented below in symbolic form to illustrate the nature of the logical inferences involved:

1. Affirming the antecedent

If P, then Q  
P

- \*1. Q
- 2. Not Q
- 3. Neither 1 nor 2 necessarily follows

2. Denying the consequent

If P, then Q  
Not Q

- \*1. Not P
- 2. P
- 3. Neither 1 nor 2 necessarily follows

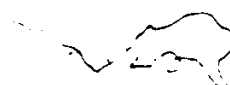
3. Hypothetical Syllogism

If P, then Q  
If Q, then R

- \*1. If P, then R
- 2. If P, then not R
- 3. Neither 1 nor 2 necessarily follows

---

\* indicates the correct answer.



## 4. Affirming the Consequent

If P, then Q

Q

1. P
2. Not P
- \*3. Neither 1 nor 2 necessarily follows

## 5. Denying the Antecedent

If P, then Q

Not P

1. Not Q
2. Q
- \*3. Neither 1 nor 2 necessarily follows

In the first three patterns of argumentation, a unique conclusion necessarily follows from the given premises, therefore they are valid patterns of argumentation. In arguments four and five, no unique conclusion necessarily follows from the given premises and therefore they are invalid patterns of argumentation.

Each item of the CRT is written such that the major and the minor premises conform to one of the five principles of inferences. Three possible conclusions are provided for each item. The subject's task is to select one of the three as the correct conclusion to the given premises.

There are 60 items in the test. These items are divided into 36 items measuring valid patterns of argumentation and 24 items measuring invalid patterns of argumentation. Each type of inference includes 12 items equally divided into the concrete-familiar, suggestive, and symbolic

contents. The student's score on each principle of inference ranged from 0 to 12. Items associated with concrete-familiar content have conclusions which state facts within the children's experience. The truth status of these items is neutral. An example is: "if the first sign is correct, then the second sign is correct." Items associated with the suggestive content have conclusions which refer to things within the children's experience but which contradict known facts. An example is: "if Ottawa is a city, then chickens have four legs." Items associated with symbolic content have conclusions which contain symbols. Meanings to these symbols are what the reader chooses them to be. An example is: "if x, then y."

The reliability estimates for the CRT have been established for grade 8 students in a study done by Amin (1977). The  $KR_{20}$  reliability estimates for the valid and invalid patterns subtests ranged from .82 to .85. For the concrete-familiar, suggestive, and symbolic content subtests, the reliability coefficients ranged from .81 to .92. These indices fall within the range of reliability indices normally considered adequate for instruments of this type (Amin, 1977).

#### Data Collection

The experimenter followed the procedures outlined for administering each of the tests. Complete protocols of the

instruments are provided in Appendix A. The CNS-IE scale and the CRT instrument were combined into one booklet and administered during one class session of 45-50 minutes.

The Children's Nowicki-Strickland Internal-External (CNS-IE) scale was read aloud while the subjects checked either YES or NO on an answer sheet. According to Nowicki and Strickland (1973), this allows for more understanding of the items. In answering the CRT, the subjects worked at their own rate and were allowed all the time available in order to finish. Those subjects who could not finish the CRT, even when more time was given, were not included in the original pool of subjects.

As detailed previously in chapter one, types of patterns and types of content of argumentation were found to affect performance. To allow for a better study of the relationship between the independent variable locus of control of reinforcement and performance on deductive conditional reasoning task, neither items of valid and invalid patterns nor items of the concrete-familiar, suggestive, and symbolic contents were respectively combined to yield global performance scores. In addition, studies by Amin (1977), Ennis and Paulus (1965), and Miller (1968) report negative correlation coefficients between valid and invalid pattern items. Also, it appears from the discussion on the types of content that higher levels of cognitive functioning are required to solve reasoning tasks as one moves from

concrete-familiar to suggestive to symbolic contents. For these reasons, the multivariate analysis approach was selected as the statistical measure. Scores for concrete-familiar, suggestive, and symbolic contents were computed for valid as well as for invalid patterns. This yielded six performance scores for each extreme groups.

To test the hypotheses, two two-way multivariate analyses of variance were computed using locus of control of reinforcement and sex as independent variables and concrete-familiar, suggestive, and symbolic as dependent variables of both valid and invalid patterns of argumentation. To provide additional information, two univariate analyses of variance were computed using the same program which yielded the multivariate analysis. The selected alpha level of significance was set at .05 which is consistent with common practice in related research.

## CHAPTER III

### RESULTS AND DISCUSSION

This chapter includes a presentation of descriptive data followed by the results of testing the hypotheses. The chapter concludes with a discussion and summary.

#### Descriptive and Inferential Data

Internal locus of control individuals were operationally defined as those subjects who scored 10 or less on the Children's Nowicki-Strickland Internal-External (CNS-IE) scale ( $n = 142$ ,  $\bar{x} = 8.16$ ,  $s.d. = 1.67$ ), whereas external locus of control individuals were defined as those subjects who scored 18 or more ( $n = 170$ ,  $\bar{x} = 20.13$ ,  $s.d. = 2.19$ ). These two extreme groups represented the top and bottom 25% of the total subjects tested.

Table 1 displays the means and standard deviations for the two extreme groups on the CNS-IE as well as the descriptive statistics for concrete-familiar, suggestive, and symbolic contents for valid and invalid patterns of argumentation.

Table 2 displays the Pearson correlation coefficients between the independent variable locus of control of reinforcement and the dependent variables concrete familiar content, suggestive content, and symbolic content for valid and invalid patterns. It is observed that negative

Table 1  
 Means and Standard Deviations of Internal and External  
 Males and Females on CNS-IE and on Three Contents  
 of Valid and Invalid Patterns

	Internals						Externals					
	Males (71)		Females (71)		Males (85)		Females (85)		$\bar{x}$	s.d.	$\bar{x}$	s.d.
	$\bar{x}$	s.d.	$\bar{x}$	s.d.	$\bar{x}$	s.d.	$\bar{x}$	s.d.				
CNS-IE	7.9	1.8	8.4	1.5	20.1	2.1	20.1	2.1	20.1	2.2	2.2	
Valid patterns	C-F	8.9	2.8	10.0	2.2	7.4	2.8	8.5	2.7	2.7	2.7	
	SUG	8.2	3.2	9.1	2.7	6.0	3.4	6.6	3.5	3.5	3.5	
	SYM	5.8	3.7	6.3	4.2	4.0	2.9	4.5	3.4	3.4	3.4	
Invalid patterns	C-F	0.7	1.1	0.5	1.0	1.2	1.6	0.9	0.4	0.4	0.4	
	SUG	0.6	0.9	0.4	1.1	1.2	1.6	0.9	1.4	1.4	1.4	
	SYM	1.39	1.7	1.3	2.0	2.6	2.5	2.0	2.3	2.3	2.3	

C-F = concrete familiar  
 SUG = suggestive  
 SYM = symbolic

Table 2

Pearson Correlation Coefficients between Locus of Control of Reinforcement and the Content Dimensions for Valid and Invalid Patterns of Argumentation

	Valid			Invalid		
	C-F	SUG	SYM	C-F	SUG	SYM
CNS-IE	-0.27	-0.33	-0.25	0.13	0.18	0.19
Valid C-F		0.70	0.40	-0.56	-0.57	-0.44
Valid SUG			0.53	-0.48	-0.55	-0.55
Valid SYM				-0.30	-0.35	-0.51
Invalid C-F					0.70	0.48
Invalid SUG						0.57
Invalid SYM						

N = 312  
 C-F = concrete-familiar  
 SUG = suggestive  
 SYM = symbolic

correlation coefficients were obtained between locus of control of reinforcement and the three content for valid patterns; whereas positive correlation coefficients were obtained for invalid patterns.

Table 2 also shows negative correlation coefficients between the valid and invalid patterns of argumentation.

To test, in its null form, the hypothesis that, under the condition of valid patterns, there is no difference in performance between internal and external locus of control individuals on concrete-familiar, suggestive, and symbolic contents of a deductive conditional reasoning task, a two-way multivariate analysis of variance was used. The program used to compute the analysis was the Full Rank Multivariate Linear Model (FRMLM) by Carlson and Timm (1974). The variables used were locus of control of reinforcement and sex as the independent variables and concrete-familiar, suggestive, and symbolic contents as the dependent variables. The results of the multivariate analysis of variance yielded the following F statistics: .14 for the interaction between the independent variables; 4.75 for the independent variable sex and 15.13 for the main independent variable locus of control of reinforcement. The degrees of freedom for all three F statistics was (3, 306). For the interaction effect, a non-significant ( $p > .05$ ) F ratio was observed, whereas significant ( $p < .05$ ) F ratios were observed for the variables locus of control of reinforcement and sex.

To provide additional information, a univariate analysis of variance was computed using the same program as that used for the multivariate analysis (FRMLM). The same independent and dependent variables were used. The results of the univariate F statistics are reported in table 3.

Table 3 shows a significant F-ratio for the locus of control variable, a non-significant ( $p > .05$ ) ratio for the effect of the sex factor on symbolic content and significant ( $p < .05$ ) ratios on suggestive and symbolic contents.

To test, in its null form, the second hypothesis that, under the condition of invalid patterns, there is no difference in performance between internal and external locus of control individuals on concrete-familiar, suggestive, and symbolic contents of a deductive conditional reasoning task, a two-way multivariate analysis of variance was used. The same FRMLM program as that used for the invalid patterns, with locus of control of reinforcement and sex as independent variables and concrete-familiar, suggestive, and symbolic contents as dependent variables. The multivariate F statistics obtained were: .59 for the interaction between the independent variables, 1.23 for the effect of the independent variable sex, and 6.33 for the effect of the independent variable locus of control of reinforcement. The degrees of freedom for all three F statistics was (3, 306). Non-significant ( $p > .05$ ) F ratios were observed for the interaction and sex effects. A

Table 3

Two-Way Univariate Analysis of Variance for Locus of Control of Reinforcement, Sex, and Content Dimensions for Valid Patterns of Argumentation

<u>Variables</u>				
<u>Dependent</u>	<u>Independent</u>	<u>df</u>	<u>MS</u>	<u>F</u>
	CNS-IE	(1,308)	180.72	26.98**
C-F	SEX	(1,308)	94.80	14.15**
	CNS-IE x SEX	(1,308)	0.04	0.02
	CNS-IE	(1,308)	454.25	42.76**
SUG	SEX	(1,308)	52.17	4.91*
	CNS-IE x SEX	(1,308)	1.75	0.17
	CNS-IE	(1,308)	237.09	18.77*
SYM	SEX	(1,308)	19.93	1.57
	CNS-IE x SEX	(1,308)	0.02	0.00

\*  $p < .05$

\*\*  $p < .0005$

C-F = concrete familiar

SUG = suggestive

SYM = symbolic

significant ( $p < .05$ ) F ratio was observed for locus of control of reinforcement effect.

To provide more information, a univariate analysis of variance was computed using the same FRMLM program which was also used for the multivariate analysis. The results are reported in table 4 where the independent variables are locus of control of reinforcement and sex and the dependent variables are concrete-familiar, suggestive, and symbolic contents. In table 4, it is observed that non-significant ( $p > .05$ ) F ratios were obtained for the interaction between the independent variables as well as for the sex factor, whereas, a significant ( $p < .05$ ) F ratio was obtained for the locus of control of reinforcement factor.

The above section reported the descriptive data as well as the results of the multi- and univariate analyses. In the next section, a discussion of the results of testing the hypotheses is presented.

#### Discussion of the Results

The non-significant ( $p > .05$ ) F ratios obtained for the interaction between locus of control of reinforcement and sex, respectively, for valid and invalid patterns of argumentation, as shown in tables 3 and 4, indicate that locus of control of reinforcement does not interact with the sex of the subjects of the present study to affect performance on logical reasoning. The non-significant effect

Table 4

Two-Way Univariate Analysis of Variance for Locus of Control of Reinforcement, Sex, and Content Dimensions for Invalid Patterns of Argumentation

<u>Variables</u>				
Dependent	Independent	df	MS	F
	CNS-IE	(1,308)	14.28	8.16*
C-F	SEX	(1,308)	6.05	3.47
	CNS-IE x SEX	(1,308)	0.05	0.03
	CNS-IE	(1,308)	23.05	13.32*
SUG	SEX	(1,308)	4.67	2.70
	CNS-IE x SEX	(1,308)	0.18	0.11
	CNS-IE	(1,308)	74.06	16.17**
SYM	SEX	(1,308)	5.81	1.27
	CNS-IE x SEX	(1,308)	7.07	1.54

\* p < .05

\*\* p < .0005

C-F = concrete-familiar

SUG = suggestive

SYM = symbolic

of the sex factor on performance on concrete-familiar, suggestive, and symbolic contents of the invalid patterns indicate that the sex of the subject is unrelated to his or her performance on deductive conditional reasoning tasks particularly of the invalid patterns of argumentation. However, the significant effect observed for this factor on performance of the valid patterns of argumentation indicate that the sex of the subject is related to deductive conditional reasoning performance but only for the concrete-familiar and suggestive contents of the valid patterns of argumentation. This finding is contrary to studies by Ennis and Paulus (1965), Miller (1968), and Roberge and Paulus (1971), which used a measuring instrument similar to CRT, but reported no effect of sex on logical reasoning performance. In the present study the sex variable was included for the purpose of clarity and as a control measure for any probable confounding effect on the performances of the respondents on deductive conditional reasoning tasks. The F statistics for the sex factor (table 3) and the corresponding performance mean scores obtained by internals and externals on valid patterns indicate that internal and external females scored significantly higher than their male counterparts on the concrete-familiar and suggestive contents (table 1). No significant mean difference was observed between males and females on the symbolic content of the valid patterns. This superior performance of females imply that at this

stage of their development, grade 8 girls seem to be more able than boys to perform deductive conditional reasoning tasks of the valid patterns of argumentation using concrete-familiar and suggestive contents. However, when using symbolic content which presents a more difficult task, no differential performance potential appears to exist between the two sexes. This information, which suggests that different learning strategies should be employed for boys and girls, could be significant to both teachers and curriculum planners.

The significant ( $p < .05$ ) F ratio associated with the factor locus of control of reinforcement and the content dimensions for valid patterns of argumentation, as shown in table 3, indicate that the personality dimension is related to performance on deductive conditional reasoning tasks. This result allows for the rejection of the null hypothesis of no difference in performance between internals and externals under valid patterns of argumentation. The corresponding performance mean scores for internals and externals on the valid patterns as shown in table 1, indicate that internals performed better than externals on concrete-familiar contents, suggestive contents, and symbolic contents of the valid patterns of argumentation. This supports hypothesis one.

It will be recalled that the main task in deductive conditional reasoning requires the respondent to infer

logically valid conclusions. A characteristic related to logical reasoning that arises whenever the validity criterion is applied to the logical arguments is the truth of the premises and the conclusion in terms of daily experiences. Thus, in solving logical reasoning tasks, it is important for the respondent to be able to distinguish between logical validity and truth. It was previously noted that in concrete-familiar content the truth status is neutral, and in suggestive content the respondent has to infer a conclusion which contradicts factual knowledge, whereas in symbolic content the respondent attributes personal meaning to the symbols. The finding which shows the superior performance of internals tends to indicate that internals have a greater capability to differentiate between the validity status and the truth status of an argument. Moreover, it indicates their greater ability to make abstraction of and retrieve their past experiences especially when effective performance requires them to do so.

Though table 4 reveals a significant main effect of the factor locus of control of reinforcement on deductive reasoning performance, the performance mean scores reported in table 1 indicate that under invalid patterns of argumentation it is the externals rather than the internals who scored higher on the three contents. This finding is contrary to the stated hypothesis that internals perform better than externals. Failing to reject the null hypothesis of

no difference in performance between internals and externals the following probable explanation is presented. It is held that the reasons behind the better performance of externals on tasks involving invalid patterns of argumentation lies partly in the nature of the type of responses required by the deductive conditional reasoning tasks employed in the present study and partly in the personality characteristics of the respondents. In the reviews of the research on locus of control of reinforcement by Joe (1971), Lefcourt (1966), Phares (1976), and Rotter (1966), it is stated that internals have been found to prefer skill-determined situations whereas externals prefer situations defined as chance-determined. Accordingly, it would seem that as the task becomes more difficult and more skill-based, internals would be more inclined to select answers which appear to them to reflect skill or ability. On the other hand, externals, given such a situation, would be more inclined to select answers which appear to them to reflect chance. Since internals most likely would regard the task of solving invalid pattern items as skill-determined, they would most likely hesitate to choose the response "neither 1 nor 2 necessarily follows," for such a response to a skill task might be taken as an indication of uncertainty and would therefore be unacceptable to them. In contrast, externals because of their tendency to prefer chance-determined elements, may more readily accept and select

just such a response. Consequently, such a response set would result in externals scoring higher than internals on the invalid pattern items and lower on the valid pattern items. If it is to be argued that externals have the necessary skills or are more able than the internals to solve problems of the invalid patterns, then certainly they should be able to solve problems of the valid patterns which, as stated previously, are easier to solve than the invalid type. However, this does not appear to be the case as revealed by the significantly greater performance of internals on all three contents of the valid patterns. The present study, therefore, is inclined to conclude that the higher scores obtained by the externals are based primarily on their greater inclination to select chance-related responses which in this particular situation happen to be the correct response for the invalid pattern items.

The marked decrease in mean scores for internals and externals on all three contents from valid to invalid patterns of argumentation and the negative correlation coefficients observed in table 2 for valid and invalid patterns seem to imply that different inferential abilities may be involved for solving items of the valid and invalid patterns of argumentation. Moreover, the above observations and the reversed performance behaviors of internals and externals on valid and invalid patterns support the findings of Amin (1977), Ennis and Paulus (1965), and Miller (1968) studies

where it was found that those who scored high on the valid patterns scored low on the invalid patterns of argumentation. This finding seems to indicate that most grade 8 school children have not fully grasped the "if, then" suppositions of the deductive conditional reasoning of the invalid type of argumentation. In other words, their ability to generate many alternative hypothetico-conditional deductions of the invalid pattern of argumentation is limited. The pedagogical significance of this finding is that it provides specific information on the limitations of the ability of grade 8 students to perform deductive conditional reasoning of the invalid type in the absence of formal classroom instructions. This information should be valuable to teachers as well as to curriculum planners.


It is observed in table I that the performance mean scores obtained for internals and externals decreases from concrete-familiar content to suggestive content to symbolic content of the valid patterns of argumentation. This may indicate that the hierarchy of difficulty of the content dimensions, that is from the least to the most difficult is concrete-familiar, suggestive, and symbolic. This finding is consistent with other findings reported in the literature which show that reasoning tasks using symbolic content are more difficult than reasoning tasks using either suggestive content or concrete-familiar content. It is therefore implied that content plays an important role in

deductive reasoning and that conditional reasoning ability varies with respect to the content in which the argument is presented. Such information should be important to teachers when planning and selecting their teaching strategies since it indicates possible sources of difficulty that may be related to deductive reasoning performance.

A noteworthy observation that may indicate a difference between internal's and external's is revealed by the significantly greater magnitude obtained for the performance mean differences for the suggestive content of the valid patterns (see table 1). It was previously stated that in using suggestive content where part of the premises states something true in terms of daily experiences while the other part states something false, the respondent is required to infer conclusions which contradict factual knowledge. It is held that the above observation reflects the ability of internal's, more so than external's, to differentiate between logical validity and factual knowledge. This finding clearly supports the contention that internal's have more effective cognitive functioning because it is an indication of their greater cognitive differentiation and ability to perform deductive reasoning.

Though the hypothesis stating the better performance of internal's on the invalid patterns of argumentation was not supported by the findings of this study, the hypothesis which stated an indication of the superior performance of

internals in solving deductive conditional reasoning tasks of the valid pattern of argumentation was strongly supported. In general, it is reasonable to conclude that under contemporary classroom conditions where no formal instructions in logical reasoning is given, an individual's standing on the locus of control of reinforcement dimension is related to deductive conditional sentence reasoning tasks using the valid patterns of argumentation. Furthermore, the findings imply that the cognitive functioning characteristics that distinguishes internals from externals favors them in the performance of deductive conditional reasoning tasks.



## SUMMARY AND CONCLUSION

The purpose of the present study was to explore a relationship between the personality dimension of locus of control of reinforcement as postulated by Rotter and performance on deductive conditional reasoning tasks. The existence of such a relationship was posited as a function of the congruence of certain personality characteristics and certain necessary cognitive processes involved in the solving of deductive conditional reasoning tasks.

The sample used consisted of 312 grade 8 students of both sexes. The locus of control measure was obtained by administering the Children's Nowicki-Strickland Internal-External Scale (CNS-IE). Subjects scoring in the upper and lower 25% of the scores obtained from the locus of control measure were included in the sample for testing the hypotheses. Subjects scoring 18 or more were operationally defined as externals ( $n = 170$ ,  $\bar{x} = 20.13$ ,  $s.d. = 2.19$ ), and subjects scoring 10 or less were operationally defined as internals ( $n = 142$ ,  $\bar{x} = 8.16$ ,  $s.d. = 1.67$ ). Performance scores were obtained by administering the Conditional Reasoning Test (CRT). Valid patterns of argumentation include items of sentence conditional arguments where a unique conclusion necessarily follows from the given premises. In the present test, there were 36 such items. Invalid patterns of argumentation include items of sentence conditional arguments where no unique conclusion necessarily

follows from the given premises. In the present test there were 24 such items.

To test the hypotheses, two two-way multi- and univariate analyses of variance were used with the level of significance set at .05. The two independent variables were locus of control of reinforcement and sex, and the dependent variables were the subcontents concrete-familiar, suggestive, and symbolic repeated for both valid and invalid patterns.

The results obtained supported the hypothesis that an individual's standing on the locus of control of reinforcement dimension is related to ability in deductive conditional reasoning tasks using valid patterns of argumentation. The relationship was such that those individuals who scored toward the internal end of the scale performed better than those individuals who scored toward the external end. The hypothesis of no difference in performance between internals and externals on reasoning tasks for the invalid patterns of argumentation was not rejected. Accordingly, it was proposed that the better performance of externals might be attributed to their tendency to prefer and select chance-related responses. Since this is only a speculation, further research is needed to study whether internals and externals do in fact perceive such conclusions differently. This may be achieved by studying the type of logical errors made on deductive conditional tasks as used in the present study and the frequency rate of selecting the conclusion

"neither 1 nor 2 necessarily follows."

As for the effect of the variable sex on the performance of internals and externals, significant effects were found only for the concrete-familiar content and suggestive content for the valid patterns of argumentation. It is suggested that additional research is needed to further clarify the role that the sex of the subject plays in deductive reasoning performance. In the present study the sex variable was included primarily as a precautionary measure, and the results support the need for caution.

The general conclusion of the present study is that, under contemporary conditions of formal classroom instruction, a child's belief of whether or not he controls the occurrence of outcomes may be used to predict performance on deductive conditional reasoning tasks, particularly where valid patterns of argumentation are employed. To allow for generalizations regarding the inferential ability of internals and externals, it is suggested that future research study their performance of other types of reasoning tasks. In addition some study should be made of the reasons advanced in support of their inferred conclusions. When it is possible to advance such a formulation no doubt a deeper understanding of those aspects of the child's psychological functioning will enable concerned educators to respond more effectively to the individual needs of the learner. It is hoped that the findings of the present study contribute in some small manner to the achievement of this objective.

## REFERENCES

- Amin, M. E. The relationship between psychological differentiation and performance on conditional reasoning tasks. Doctoral dissertation, University of Ottawa, Ottawa.
- Bialer, I. Conceptualization of success and failure in mentally retarded and normal children. Journal of Personality, 1961, 29, 303-320.
- Carlson, J. E., & Timm, N. H. Full Rank Multivariate Linear Model. Program manuals: FRULM and FRMLM computer programs. University of Pittsburgh, 1974.
- Ceraso, J., & Provitera, A. Sources of error in syllogistic reasoning. Cognitive Psychology, 1971, 2, 400-410.
- Copi, I. M. Introduction to logic. Collier-Macmillan International Editions, 1972, 4th Ed.
- Cork, F. F. The effect of the personality variable locus of control on imitation learning. Unpublished doctoral dissertation, University of Ottawa, 1978.
- Crandall, V. C., Katvosky, W., & Crandall, V. J. Children's belief in their control of reinforcement in intellectual-academic achievement situations. Child Development, 1965, 36, 91-109.
- Davis, W. L., & Phares, E. J. Internal-external control as a determinant of information-seeking in a social influence situation. Journal of Personality, 1967, 35, 547-561.
- Ennis, R. H. Logic in teaching. Englewood Cliffs, N.J., 1969.
- Evans, J. St. B. T. The psychology of deductive reasoning. In A. Burton & M. Radford, Thinking in perspective. London, England: McThuen, 1978.
- Evans, J. St. B. T. On the problems of interpreting reasoning data: Logical and psychological approaches. Cognition, 1973, 1, 373-384.
- Evans, J., & Wason, P. C. Rationalization in a reasoning task. British Journal of Psychology, 1976, 67, 479.
- Falmagne, R. J. (Ed.). Reasoning: Representation and process in children and adults. New Jersey: Lawrence Erlbaum Associates, 1975.
- Gibson, J. T. Psychology for the classroom. Englewood Cliffs, N.J.: Prentice-Hall, 1976.

- Ginsburg, H., & Opper, S. Piaget's theory of intellectual development: An introduction. Englewood Cliffs, N.J.: Prentice-Hall, 1979.
- Guilford, J. P. The nature of human intelligence. New York: McGraw-Hill, 1967.
- Herle, Mary. On the relation between logic and thinking. Psychological Review, 1962, 69(4), 366-378.
- Hilgard, E., & Bower, G. Theories of learning. New York: Meredith, 1975.
- James, W. H. Internal versus external control of reinforcement as a basic variable in learning theory. Unpublished doctoral dissertation, Ohio State University, 1957.
- Jansson, L. C. The development of deductive reasoning. A paper presented at the annual meeting of the American Educational Research Association, Chicago, April 1974.
- Joe, V. C. Review of the internal-external control construct as a personality variable. Psychological Reports, 1971, 28, 619-640.
- Johnson-Laird, P. N. Models of Deduction. In R. J. Falmagne (Ed.), Reasoning: Representation and process. New Jersey: Erlbaum Ass., 1975.
- Johnson-Laird, P. M., Legrenzi, P., & Legrenzi, M. S. Reasoning and sense of reality. British Journal of Psychology, 1972, 63, 395-400.
- Julian, J. W., & Katz, S. B. Internal versus external control and the value of reinforcement. Journal of Personality and Social Psychology, 1968, 8, 89-94.
- Keith, V. Design and analysis in experimentation. Ottawa: University of Ottawa Press, 1972.
- Lefcourt, H. M. Internal versus external control of reinforcement: A review. Psychological Bulletin, 1966, 65, 206.
- Lefcourt, H. M. Effects of cue explication upon persons maintaining external control expectancies. Journal of Personality and Social Psychology, 1967, 5, 372.
- Lefcourt, H. M. Recent developments in the study of locus of control. In B. A. Maher (Ed.), Progress in experimental personality research. New York: Academic Press, 1972.

- Lefcourt, H. M. Locus of control: Current trends in theory and research. Hillsdale, N.J.: Lawrence Erlbaum Associates, 1976.
- Lefcourt, H. M., Gronnerud, P., & McDonald, P. Cognitive activity and hypothesis formation during a double entendre word association test as a function of locus of control and field dependence. Canadian Journal of Behavioral Science, 1973, 5, 161.
- Lefcourt, H. M., Lewis, J., & Silverman, I. W. Internal versus external control of reinforcement and attention in a decision-making task. Journal of Personality, 1968, 36, 663-682.
- Lefcourt, H. M., & Telegdi, M. Perceived locus of control and field dependence as predictors of cognitive activity. Journal of Consulting and Clinical Psychology, 1971, 37, 53-56.
- Lefcourt, H. M., & Wine, J. Internal versus external control of reinforcement and the deployment of attention in experimental situations. Canadian Journal of Behavioral Science, 1969, 1, 167-181.
- Miller, W. A. The acceptance and recognition of six logical inferences patterns by secondary students. Doctoral Dissertation, University of Wisconsin. Ann Arbor, Michigan: University Microfilms, 1968.
- Nowicki, S., & Strickland, B. R. A locus of control scale for children. Journal of Consulting and Clinical Psychology, 1973, 40, 148-155.
- Osherson, D. N. Logical abilities in children. Potomac, Md.: L. Erlbaum Associates, 1974.
- Petzel, T. P., & Gynther, M. D. Effects of internal-external locus of control and skill or chance instructional sets on task performance. Journal of General Psychology, 1970, 82, 87-93.
- Phares, E. J. Expectancy changes in skill and chance situations. Journal of Abnormal and Social Psychology, 1957, 54, 339-342.
- Phares, E. J. Differential utilization of information as a function of internal-external control. Journal of Personality, 1968, 36, 649-662.
- Phares, E. J. Locus of control in personality. Morristown, N.J.: General Learning Press, 1976.

- Phares, P. J. Locus of control. In H. London & J. Exner (Eds.), Dimensions of personality. New York: Wiley-Interscience, 1978.
- Phares, J. Defensiveness and perceived control. In L. Permuter & R. Monty (Eds.), Choice and perceived control. Hillsdale, N.J.: Lawrence Erlbaum Associates, 1979.
- Phares, E. J. Locus of control of reinforcement. In G. Hazda & R. Corsini (Eds.), Theories of learning. Itiasca, Ill.: Peacock, 1980.
- Revlis, R. Syllogistic reasoning, logical decisions from a complex data base. In R. J. Falmagne (Ed.), Reasoning: Representation and process. New Jersey: Lawrence Erlbaum Associates, 1975.
- Roberge, J. T. A study of children's abilities to reason with basic principles of deductive reasoning. American Educational Research Journal, 1970, 7, 583-596.
- Roberge, J. T. A re-examination of the interpretation of errors in syllogistic reasoning. Psychometric Science, 1970, 19, 331.
- Roberge, J. T., & Paulus, D. Developmental patterns for children's class and conditional reasoning abilities. Developmental Psychology, 1971, 4, 191-200.
- Rotter, J. B. Social learning and clinical psychology. New Jersey: Prentice-Hall, 1954.
- Rotter, J. B. Generalized expectancies for internal-external control of reinforcement. Psychological Monographs: General and Applied, 1966, 80, No. 609.
- Rotter, J. B. Some problems and misconceptions related to the construct of internal vs external control of reinforcement. Journal of Consulting and Clinical Psychology, 1975, 43, 56-67.
- Rotter, J. B. Generalized expectancies for problem-solving and psychotherapy. Cognitive Therapy and Research, 1978, 2, 1-10.
- Rotter, J. B., Liverant, S., & Crowne, D. P. The growth and extinction of expectancies in chance controlled and skilled tasks. Journal of Psychology, 1961, 52, 161-177.

- Ryckman, R. Perceived locus of control and task performance. In L. Perlmutter & R. Monty (Eds.), Choice and perceived control. New Jersey: Lawrence Erlbaum Associates, 1979.
- Sawrey, J., & Telford, C. Educational psychology. Boston: Allyn and Bacon, 1968.
- Seeman, M. Alienation and social learning in a reformatory. American Journal of Sociology, 1963, 69, 270-289.
- Seeman, M., & Evans, J. W. Alienation and learning in a hospital setting. American Sociological Review, 1962, 27, 772-783.
- Shipman, J. R. Structural and linguistic variables that contribute to difficulty in the judgement of deductive arguments of the conditional type. A paper presented at the annual meeting of American Educational Research Association, Washington, D.C., March 30-April 3, 1975.
- Staudenmayer, H. Understanding conditional reasoning with meaningful proposition. In R. J. Falmagne (Ed.), Reasoning: Representation and process. New Jersey: Lawrence Erlbaum Associates, 1975.
- Sutherland, A. E. The effects of internal-external locus of control and level of information upon group problem-solving. Doctoral Dissertation, University of North Carolina, 1972.
- Taplin, J. E. Reasoning with conditional sentences. Journal of Verbal Learning and Verbal Behavior, 1971, 10, 218-225.
- Taplin, J. E., & Staudenmayer, H. Interpretation of abstract conditional sentences in deductive reasoning. Journal of Verbal Learning and Verbal Behavior, 1973, 12, 530-542.
- Thistlewaite, D. L. Attitude and structure as factors in the distortion of reasoning. Journal of Abnormal Social Psychology, 1950, 45, 442.
- Wason, P. C., & Johnson-Laird, P. N. Psychology of reasoning. London, England: B. J. Batsford, 1972.
- Watson, D., & Bauml, E. Effects of locus of control and expectation of future control upon present performances. Journal of Personality and Social Psychology, 1967, 6, 212-215.
- Winer, B. Statistical principles in experimental design. Toronto: McGraw-Hill, 1971.

Wohlwill, J. F. From perception to inference: A dimension of cognitive development. In I. Sigel & F. Hooper (Eds.), Logical thinking in children, 1968.

APPENDIX A

CHILDREN'S NOWICKI-STRICKLAND INTERNAL-EXTERNAL SCALE  
AND THE CONDITIONAL REASONING TASK

The booklet in front of you is made up of two parts. Part I is a questionnaire about your beliefs and opinions on things and events that you are bound to have thought about or experienced at some time or other. There are no right or wrong answers. The only right answers to the questions asked are the ones that are right for you.

The second part of this booklet is a test of a special kind of ability. It is a test of reasoning ability.

It is required from you, in answering the questions of this booklet, to follow the instructions carefully and to answer all the questions to the best of your knowledge. Please, do not write on the booklet and please start and stop when asked to do so. You are to write your answers on the answer sheet provided.

In the answer sheet provided, you will see that the question numbers are arranged in a vertical order (i.e. from up to down) and that each question has 10 digits starting from 0 to 9. To mark your answer to a question, first find the number of the question on the answer sheet, then blacken completely and neatly the space within the small bracket of the number that corresponds to that of your answer. If you wish to change your answer, erase your first mark completely and then blacken your new choice. Use only the pencil provided.

Now turn the page.

---

Please Do Not Open This Booklet Until  
You Are Told To Do So By The Examiner.

---

PART I

On the following pages you will find some questions which ask for your reactions to many things that you're bound to have thought about or experienced at some time or other. Each question should be answered either yes or no. Mark your answer on the answer sheet provided by first finding the appropriate question number and then blackening either the space numbered (1) or (2) corresponding to your selected answer of yes or no. If your answer to the question is YES, you blacken the space numbered (1) in the answer sheet provided. If you answer NO to the question, you blacken space numbered (2). In the answer sheet you will see 10 digits to each question. Only (1) and (2) are of concern here; the rest of the digits will be ignored throughout this section.

Example:

0. Do you like baseball? . . . YES (1)  
NO (2)

If you answer YES, you blacken in the answer sheet space number (1), as illustrated.

0. (0) (1) (2) (3) (4) (5) (6) (7) (8) (9)

If you answer NO, you blacken space numbered (2), as illustrated:

0. (0) (1) (2) (3) (4) (5) (6) (7) (8) (9)

Your answer to the questions should be what you more strongly believe to be true as far as you're concerned, rather than what you think should be or would like to be true. Since the questions ask for your beliefs and opinions, obviously there are no right or wrong answers. THE ONLY RIGHT ANSWERS TO THE QUESTIONS ARE THE ONES THAT ARE RIGHT FOR YOU. If you are not sure of an answer, mark whichever that comes closest to being right for you. Answer the questions carefully, and PLEASE DO NOT OMIT ANY QUESTIONS..

If you have any questions, ask them now.

---

Please Do Not Open This Booklet Until  
You Are Told To Do So By The Examiner.

---

1. Do you believe that most problems will solve themselves if you just don't fool with them?.. YES (1)  
NO (2)
2. Do you believe that you can stop yourself from catching a cold?..... YES (1)  
NO (2)
3. Are some kids just born lucky?..... YES (1)  
NO (2)
4. Most of the time do you feel that getting good grades means a great deal to you?..... YES (1)  
NO (2)
5. Are you often blamed for things that just aren't your fault?..... YES (1)  
NO (2)
6. Do you believe that if somebody studies hãrd enough he or she can pass any subject?.. YES (1)  
NO (2)
7. Do you feel that if things start out well in the morning that it's going to be a good day no matter what you do?..... YES (1)  
NO (2)
8. Do you feel that most of the time it doesn't pay to try hard because things never turn out right anyway?..... YES (1)  
NO (2)
9. Do you feel that most of the time parents listen to what their children have to say? YES (1)  
NO (2)
10. Do you believe that wishing can make good things happen?..... YES (1)  
NO (2)
11. When you get punished does it usually seem it's for no good reason at all?..... YES (1)  
NO (2)
12. Most of the time do you find it hard to change a friend's (mind) opinion?..... YES (1)  
NO (2)

13. Do you think that cheering more than luck helps a team to win?..... YES (1)  
NO (2)
14. Do you feel that it's nearly impossible to change your parents' mind about anything?.. YES (1)  
NO (2)
15. Do you believe that your parents should allow you to make most of your own decisions? YES (1)  
NO (2)
16. Do you feel that when you do something wrong there's very little you can do to make it right?..... YES (1)  
NO (2)
17. Do you believe that most kids are just born good at sports?..... YES (1)  
NO (2)
18. Are most of the other kids your age stronger than you? ..... YES (1)  
NO (2)
19. Do you feel that one of the best ways to handle most problems is just not to think about them? ..... YES (1)  
NO (2)
20. Do you feel that you have a lot of choice in deciding who your friends are? ..... YES (1)  
NO (2)
21. If you find a four-leaf clover do you believe that it might bring you good luck? YES (1)  
NO (2)
22. Do you often feel that whether you do your homework has much to do with what kind of grades you get? ..... YES (1)  
NO (2)
23. Do you feel that when a kid your age decides to hit you, there's little you can do to stop him or her? ..... YES (1)  
NO (2)

24. Have you ever had a good luck charm?..... YES (1)  
NO (2)
25. Do you believe that whether or not people like you depends on how you act?.... YES (1)  
NO (2)
26. Will your parents usually help you if you ask them to ? ..... YES (1)  
NO (2)
27. Have you felt that when people were mean to you it was usually for no reason at all? YES (1)  
NO (2)
28. Most of the time, do you feel that you can change what might happen tomorrow by what you do today?..... YES (1)  
NO (2)
29. Do you believe that when things are going to happen they just are going to happen no matter what you try to do to stop them? ..... YES (1)  
NO (2)
30. Do you think that kids can get their own way if they keep trying? ..... YES (1)  
NO (2)
31. Most of the time do you find it useless to try to get your own way at home? ..... YES (1)  
NO (2)
32. Do you feel that when good things happen they happen because of hard work?..... YES (1)  
NO (2)
33. Do you feel that when somebody your age wants to be your enemy there's little you can do to change matters? ..... YES (1)  
NO (2)
34. Do you feel that it's easy to get friends to do what you want them to? ..... YES (1)  
NO (2)

35. Do you usually feel that you have little to say about what you get to eat at home? YES (1)  
NO (2)
36. Do you feel that when someone doesn't like you there's little you can do about it? ..... YES (1)  
NO (2)
37. Do you usually feel that it's almost useless to try in school because most other children are just plain smarter than you are? .... YES (1)  
NO (2)
38. Are you the kind of person who believes that planning ahead makes things turn out better? ..... YES (1)  
NO (2)
39. Most of the time, do you feel that you have little to say about what your family decides to do? ..... YES (1)  
NO (2)
40. Do you think it's better to be smart than to be lucky? ..... YES (1)  
NO (2)

STOP

---

Please Do Not Turn The Page Until  
You Are Told To Do So By The Examiner.

---

PART II

On the following pages of this test of reasoning ability, you will be presented with problems in logic. The items which you will be presented with are presented in verbal and in symbolic form. Each problem will have two statements above a line. Below that line, you will find three possible answers from which you will select the answer you think follows logically from the statements given above the line. In every problem you must accept the statements above the line as being true. That is, whether the statements are true or not in real life does not matter in these problems, since you are required to pretend they are true. Sometimes the statements will contradict what you know and believe to be true. Having accepted, for the purpose of this test, the statements above the line as ALWAYS TRUE, your next task is to choose from the statements found below the line the one which you think follows logically from the statements above the line.

Here is an example of a logic problem in verbal form :

BILL IS SMART.  
TED IS NOT SILLY.

- 1) Bill is not smart and Ted is not silly.
- 2) Bill is smart and Ted is not silly.
- 3) Neither 1 nor 2 necessarily follows.

In the example, you must first accept the statements "Bill is smart" and "Ted is not silly" as true. Having accepted the statements as true, your task is to reason in your mind which statement below the line is a logical conclusion to the statements above the line.

Here is an example of a logic problem in symbolic form:

P.  
NOT Q

- 1) Not P and not Q.
- 2) P and not Q.
- 3) Neither 1 nor 2 necessarily follows.

In this example, "P" and "Q" stand for any statements. Other letters of the alphabet may also be used. A period is placed at the end of the line to remind you that "P" and "Q" are statements. Again in this type of problem, you must accept that "P" and "not Q" are statements and they are true. Below the line are three possible answers from which you are to select the statements you think follows logically from the true statements above the line.

DIRECTIONS FOR MARKING YOUR ANSWERS ON THE ANSWER SHEET PROVIDED:

EXAMPLE:

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.

To answer this problem, you must first accept the statements "John Doe is a glub" and "The earth is round", which are above the line, as true. Next, your task is to reason which of the statements below the line you think follows logically from the two statements above the line.

If you reason that the statement "John Doe is a glub and the earth is round" follows logically from the statements above the line, which must be accepted as true, then blacken completely and neatly the space numbered (1) in the answer sheet. Make sure you have the correct question number. If you reason that statement number 2 is the correct answer, blacken space numbered (2) in the answer sheet. If you reason that neither statement 1 nor statement 2 follows logically, from the two statements above the line, blacken space numbered (3). IN NO CASE ARE YOU TO MARK MORE THAN ONE ANSWER TO THE SAME QUESTION. On the answer sheet you will see 10 digits to each question. Only (1), (2), and (3) are of concern in this test; the rest of the digits will be ignored.

If you are in doubt about the answers, mark the answer that seems most logical to you. And if you wish to change your answer, erase your first mark completely and then blacken your new choice.

Each question should be answered. Do NOT OMIT ANY QUESTIONS. Unanswered questions will be considered the same as if answered incorrectly.

DO NOT FORGET: All statements above the line must be accepted as true. For example, the statements "John Doe is a glub" and "the earth is round" must be accepted as true statements. Next, decide on one and only one of the three concluding statements below the line, as being the statement which logically follows from the statements above the line. 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.

---

Please Do Not Open This Booklet Until  
You Are Told To Do So By The Examiner

---

59. 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.
- 

60. 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.
- 

61. IF DOGS PURR, THEN CATS BARK.  
DOGS PURR.

---

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

62. 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.
- 

63. IF THE CONTRACT IS LEGAL, THEN LANE 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.
- 

64. 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.
- 

65. 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.

41. 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.
- 

42. 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.
- 

43. 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.
- 

44. 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.
- 

45. 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.
- 

46. 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.

47. IF X, THEN Z.  
NOT X.

---

- 1) Not Z.
  - 2) Z.
  - 3) Neither 1 nor 2 necessarily follows.
- 

48. 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.
- 

49. IF A, THEN B.  
B.

---

- 1) A.
  - 2) Not A.
  - 3) Neither 1 nor 2 necessarily follows.
- 

50. 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.
- 

51. 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.
- 

52. IF A, THEN B.  
NOT B.

---

- 1) Not A.
- 2) A.
- 3) Neither 1 nor 2 necessarily follows.

53. 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.
- 

54. 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.
- 

55. 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.
- 

56. IF X, THEN R.

---

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

57. 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.
- 

58. IF R, THEN S.  
NOT R.

---

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

66. IF X, THEN R.  
X.

---

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

67. 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.
- 

68. 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.
- 

69. 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.
- 

70. 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.
- 

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

72. IF P, THEN Q.  
NOT Q.

---

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

73. 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.
- 

74. IF M, THEN N.  
M.

---

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

75. 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.
- 

76. 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.
- 

77. IF IT SNOWED YESTERDAY, THEN THE SCHOOLS WERE CLOSED YESTERDAY.  
SCHOOLS WERE CLOSED YESTERDAY.

---

- 1) It snowed yesterday.
  - 2) The weather was clear.
  - 3) Neither 1 nor 2 necessarily follows.
- 

78. 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.

79. 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.
- 

80. 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.
- 

81. 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.
- 

82. 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.
- 

83. IF P. THEN R.  
NOT R.

---

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

84. 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.
- 

85. IF P. THEN Q.  
Q.

---

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

86. 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.
- 

87. 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.
- 

88. IF P, THEN R.  
NOT P.

---

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

89. 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.
- 

90. IF CORNWALL IS A PROVINCE, THEN 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.
- 

91. IF X, THEN Z.  
NOT Z.

---

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

92. 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.

93. IF A, THEN B.  
NOT A.

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

94. IF S, THEN P.  
S.

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

95. 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.
- 

96. IF M, THEN N.  
N.

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

97. 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.
- 

98. 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.
- 

99. IF A, THEN B.  
A.

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

100. 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.
- 

The following questions ask for your sex. Answer either YES OR NO, and mark your answer in the answer sheet by blackening either (1) or (2) corresponding to your answer.

101. I am a female .....YES (1)  
NO (2)

102. I am a male .....YES (1)  
NO (2)

APPENDIX B

ABSTRACT OF

A study of the relationship between locus of control  
of reinforcement and performance on deductive  
conditional reasoning tasks

ABSTRACT OF

A study of the relationship between locus of control  
of reinforcement and performance on deductive  
conditional reasoning tasks

The purpose of the present study was to test the hypothesis that an individual's standing on the locus of control of reinforcement personality dimension is related to that individual's performance of deductive conditional reasoning tasks.

The sample used was 312 grade 8 students of both sexes. The measuring instruments were the Children's Nowicki-Strickland Internal-External Scale (CNS-IE) and the Conditional Reasoning Test (CRT). Internals were operationally defined as those who scored 10 or less on the CNS-IE scale ( $n = 142$ ,  $\bar{x} = 8.16$ ,  $s.d. = 1.67$ ), and externals were operationally defined as those who scored 18 or more on the CNS-IE scale ( $n = 170$ ,  $\bar{x} = 20.13$   $s.d. = 2.19$ ).

To test the hypotheses, two two-way multi- and univariate analyses of variance were computed with locus of control of reinforcement and sex as independent variables and concrete-familiar content, suggestive content, and symbolic content as dependent variables, respectively for valid and invalid patterns of argumentation. The level of significance was set at .05.

The results obtained offered partial support for the hypotheses. Different performance trends were found for

internals and externals on the valid and invalid patterns of argumentation. Internals, as hypothesized, outperformed externals on the valid patterns of argumentation; whereas externals performed better than internals on the invalid patterns of argumentation. An interpretation was advanced to explain the latter trend.