THE EFFECTS OF LOCUS OF CONTROL AND INCENTIVES ON BINARY-CHOICE PROBABILITY LEARNING TASK PERFORMANCE

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VITAE

John Ronald Swaine was born in 1942 and educated in Yarmouth, Nova Scotia. He received his Bachelor of Arts degree in Psychology and English from Mount Allison University, Sackville, New Brunswick, in 1965. His Master of Arts degree in Developmental Psychology was granted by Teacher's College, Columbia University, New York, in 1969. His Interim Report for the University of Ottawa was completed in 1974 and was entitled Contingency Management in a Family Setting.

ABSTRACT

This study examined the effects of non-specific material and social incentives on the problem-solving behaviour of grade six boys and girls who were classified by way of their locus of control. A binary-choice probability learning task with contingent feedback was selected as the dependent measure, and consisted of one hundred trials of anticipating the occurence of two colours from an audio tape recording in which one of the colours appeared randomly with a .70 probability per ten trial block. The data was subjected to a 2(locus of control) x 2 (sex of subject) x 3(incentive condition) x 10(trial blocks) analysis of variance with repeated measures. Analyses of variance were also performed over the first five and last five trial blocks, and on each of the first five trial blocks. Cognitive strategies used in problem-solving were tabulated for non-parametric and descriptive analyses.

Overall, there were no significant incentives, sex or locus of control effects on performance. While subjects entered the task with generalized expectancy for outcome based on their locus of control set, the task itself created a situation in which the partial random reinforcement schedule generated diminished specific expectancies, thus neutralizing differences between groups. However, all subject groups showed a continuous learning effect across trial blocks. When examined more closely, differential effects were seen on the initial trials. On each of the first two trial blocks externals significantly outperformed the internals; across these blocks there was a significant locus of control x incentives effect; externals responded at a higher rate of performance than the internals under all incentives, but especially under non-incen-

tive conditions. Internals scored higher under social conditions; both groups did poorest under material incentives. A moderately significant locus of control x sex of subject interaction over the first five trial blocks added to indications in the descriptive data that the external boys were performing at a superior level to all other groups. No significant differences were seen over the last five trial blocks. It seemed that as trials progressed the incentives effects quickly dimished while the more powerful locus of control and sex effects continued to differentially influence performance until mid-task, after which there were no significant differences between groups. This was interpreted in terms of a transient novelty effect of the non-specific incentives, Rotter's social learning theory and causal attribution theory.

As a group, all subjects began using alternating strategies, but modified them with each subsequent trial block. Over all trials there was a steady increase in the matching strategy and a decline in the use of alternating strategies. This was especially evident with the external boys under control conditions while the reverse was so for the internal girls under control conditions. Maximizing strategies were rarely used by subjects at this age level. These findings were interpreted as corroborating the strategy and locus of control literatures, and as demonstrating the flexibility and responsiveness of these subjects to the probability learning task.

Further investigations into initial learning differences using a series of short tasks over a broader age range was seen as a logical extension of this study.

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INTRODUCTION

For many years learning theories have emphasized the importance of reinforcement contingencies as prime considerations in the understanding of human behaviour. Out of the increased sophistication of these theories, and with new research into a subject's prior experiences with reinforcement, the notion developed that people come to associate kinds of reinforcements with specific types of behaviours. Julian Rotter refined these concepts in his Social Learning Theory, and with his colleagues, coined the term locus of control to refer to an individual's perceived control over the reinforcement he receives. As a result of research in psychology over the past decade, locus of control of reinforcement was found to be a fruitful area of study. General findings have revealed that internal locus of control children utilize a more cognitive and confident approach to problem-solving, originating in their history of successful experiences over which they have gained control; on the other hand, external children tend to view events as being under the control of luck, chance, fate or powerful others.

In learning situations, differences in locus of control have been used to predict children's academic achievement with some success; internality is generally considered to be a better predictor of academic success with older children. With maturity and experience, children progress towards internality, but the gradual transition from the dependent, external young child to the more cognitive and independent internal

adolescent has been difficult to study. Part of the difficulty would appear to be in the changes in the value of reinforcing events which seem to occur during the developmental process. Studies relating to the perceived value of various reinforcers, and the use of these reinforcers as incentives to alter behaviour have been examined, although somewhat myopically; that is, research has seemingly attempted to determine relative values of reinforcers while, until quite recently, overlooking the experiential and personality variables which infuse reinforcers and incentives with greater or lesser value to a given individual in a given context. Incentives are widely used in a variety of situations with children in order to facilitate maximal usage of their learning potential. In spite of this, the area involving the application of incentives to children with differing experiential and personality variables has not been systematically researched.

This study was prompted by the question of whether incentives could differentially influence the problem-solving behaviour of internal and external locus of control children. It was felt that an investigation in this area would be both original and relevant, with possible practical application to children in school learning situations and with theoretical implications for social learning theory.

This thesis is divided into five chapters, beginning with a review of the literature, a description of the subject selection, design and methodology, presentation of the results, and discussion including the summary and conclusions.

REVIEW OF THE LITERATURE

The purpose of this study is to examine the problem-solving behaviours of internal and external locus of control children under various incentive conditions, within a social learning theory frame of reference. This chapter will review Rotter's Social Learning Theory, reporting relevant studies on locus of control and its developmental antecedents, incentives and a description of the probability learning task to be used. A brief summary and methodological rationale ends the chapter.

Rotter's Social Learning Theory

In the understanding of human behaviour, increasing emphasis is being placed on research dealing with subjective differences between people rather than on quantitative observational data alone. Stemming from the long history of learning theory going back to the turn of the century, and incorporating this research into human social behaviour, Rotter's Social Learning Theory (SLT) attempts to understand human behaviour as a process of learning, in which subjective and motivational aspects are included. It states generally that behaviour is goal-directed, and occurs within an environmental context which may have reinforcing consequences for the individual. As a result of his research, Rotter (1966) concluded that human social behaviour is a function of the interaction between expectancy of this reinforcement, reinforcement value and the psychological situation. Furthermore, his theory posits

that behaviour has its common origins in the physiological needs of the infant (Rotter, Chance and Phares, 1972). These needs produce observable behaviours which signal their presence to an environment which deals with them. If the environment is able to meet the need and satisfy it, these observable behaviours will be reinforced, and, in the future, will have a stronger probability of recurrence whenever the original need is felt; moreover, the reinforcement itself will become associated with a complex of behaviours and situations which themselves may eventually acquire reinforcing characteristics; thus, the environment selectively reinforces some behaviours. Although any behaviour has the potential of occuring within a given context, it is more likely that one which has a history of being positively reinforced by a valued reinforcing event will occur. With repeated exposure, the reinforcing event becomes the goal for purposive behaviour; if positive, behaviour will be directed towards it; if negative, it will be avoided (Rotter, 1954).

Repeated experience with reinforcing events causes an expectation to develop that a particular reinforcer will occur in some given context or situation; that is, the individual comes to expect that certain kinds of reinforcing events will occur as a function of his behaviour. Although this specific expectation is internal and subjective, it is learned through experience. As the individual accumulates experience in a given situation, he begins to generalize it to new situations which are perceived as similar; thus, his contact with them is coloured by previous learning and these generalized expectancies and experiences further influence his reception to future experiences. In this complex manner,

a stable accumulation of experience and expectations builds up within the individual which increases the probability that he will behave in a consistent and predictable way in specific situations.

Rotter, Chance and Phares (1972) summarized the relationship between reinforcement value, expectancy and situation as follows:

$$BP_x, s_1, R_a = f\ (E_x, R_a, s_1\ \&\ RV_a, s_1)$$

"The potential for behaviour $\underline{x}$ to occur, in situation 1 in relation to reinforcement $\underline{a}$, is a function of the expectancy of the occurence of reinforcement $\underline{a}$, following behaviour $\underline{x}$ in situation 1, and the value of reinforcement $\underline{a}$ in situation 1"; that is, behaviour has the strongest potential for occurence when the subjective expectancy of a reward is high and when the context or situation is such that a reward is possible. For example, if he was sucoessfully decisive in the past, the person may perceive an on-going situation as one in which decisiveness could also lead to success; his potential for decisive behaviour would therefore, be high and may generalize to the new situation.

Rotter (1966) elaborated the concept of generalized expectancy to include the concept of perceived personal control over reinforcement, based on whether or not the person perceives a causal relationship between his own behaviour and the reward. When the person perceives the reward as being contingent on his own behaviour, this is seen as a belief in internal control; when the reward is perceived as contingent on luck, chance, fate or the control of powerful others, it reflects a belief in external control. Rotter hypothesized that consistent differences existed between individuals with respect to control of

reinforcement, and that these were of significance to an understanding of the nature of the social learning process. His research indicates that individuals vary along a continuum from extreme externality to extreme internality, with most people clustering in the middle range. Subsequent research (Hersh and Scheibe, 1967; Schneider, 1971; Nowicki and Strickland, 1973) has shown that there does not appear to be any "average" I-E score, since the mean scores vary from study to study and seem to change as a function of maturity and experience. The term, therefore, refers to a relative rather than an absolute position on the locus of control continuum; subjects scoring towards the extremes are considered to hold progressively stronger beliefs in internal or external locus of control.

The degree to which people perceive personal control over reinforcement can be measured by administering any of a variety of scales which have been developed. Phares (1955, 1957) constructed a 26-item, Likert-type scale in his study of chance and skill effects on reinforcement expectancy; thirteen items measured internal locus of control, and thirteen items measured external locus of control. The scale was revised by James (1957) who added filler items, and found low but significant correlations between perceived control as measured by the test and task behaviour. In 1962, Rotter, Seeman and Liverant expanded the James-Phares scale into a 29-item, forced-choice format and included questions into such areas as achievement, affection and social and political attitudes; social desirability was controlled by eliminating items which correlated highly with the Marlowe-Crowne Social Desirability Scale. The final scale, still somewhat biased towards

achievement and showing low but positive correlation with intelligence (Hersch and Scheibe, 1967), was published by Rotter (1966) and is used extensively in locus of control research with adult and college populations.

Several locus of control scales for children have also been developed. Bialer (1961) developed the Children's Locus of Control Scale for use with both normal and mentally retarded populations. The twenty-three item scale was designed to be administered orally to the individual child. The Intellectual Achievement Responsibility Questionnaire (IAR Scale) was developed by Crandall, Katkovsky and Preston (1962) and measured the child's perception of control over intellectual achievement. Standardization data was based on a school population ranging from grades three to twelve. Battle and Rotter (1963) used a projective test format based on the Rosenzweig Picture Frustration Technique which asked a child to respond to a series of cartoons; while standardized on school populations, this test proved difficult to administer to groups and consequently is not frequently used in research. Finally, Nowicki and Strickland (1973) developed a 40-item forced-choice questionnaire for children in which subjects indicate agreement or disagreement with statements describing internal or external reinforcement situations. Means and standard deviations are given for grades three through to twelve since children's scores become more internal with age. The scale is controlled for intelligence and is not significantly correlated with socioeconomic status or social desirability; Hisama (1976) found little correlation with learning disability or behaviour disorder. Split-half reliabilities range between $r = .63$ for

grades three to five, r = .68 for grades six to eight, r = .74 for grades nine to eleven and r = .81 for grade twelve. Test-retest reliabilities at six-week intervals are .63 for third grade, .66 for the seventh grade, and .71 for the tenth grade. This global test was designed to be readable at the fifth grade level, and yet be appropriate at the twelfth-grade level; it is widely used for research purposes with children. Nowicki, in collaboration with others, has developed a series of other scales which can be used to measure locus of control longitudinally from pre-school to old age (Nowicki and Duke, 1974).

In summary, locus of control is a construct based on Rotter's elaboration of social learning theory, and reflects the individual's generalized beliefs about control of reinforcement as a function of expectancy, reinforcement value and situation. Rotter (1966) posits that locus of control affects a variety of behavioural choices in a broad range of situations. It can be reliably measured using a variety of scales which have been developed for this purpose. Research articles and books on the concept have proliferated; a bibliography prepared by Throop and MacDonald (1971) contains over 300 references. Since then, the research has been even more prodigious. Numerous reviews have been published (Lefcourt, 1966; Joe, 1971; Lefcourt, 1972) along with several books (Rotter, Chance and Phares, 1972; Lefcourt, 1976; Phares, 1976). The entire literature attests to the validity of the I-E variable along a broad spectrum of psychological and behavioural dimensions. The following section will review these studies with specific reference for the problem-solving behaviours of internals and externals which is the focus of this thesis. Of particular interest will be the

manner in which internals and externals perceive novel situations, attend to available information and utilize this information in decision making and problem-solving.

Research on the Construct of Locus of Control

Studies into the characteristics and behaviour of groups which demonstrate internal or external control of reinforcement have been extensive, particularly over the last decade. The literature is diverse, often dealing with complex behaviours far removed from the laboratory setting; as such it has been open to criticism about lack of methodological "tightness" and the inferences which are made from the results (Weiner, Heckhausen, Meyer and Cook, 1972; Rest, 1976). In spite of this, studies report consistent findings regarding the behaviour of internals and externals.

One finding frequently observed in the literature has been that internals tend to be more cognitively alert and curious when seeking information. Seeman and Evans (1962) investigated the behaviour of hospitalized tuberculosis patients, their knowledge of their disease, their questioning for more information and their satisfaction with the information they were given. The results showed that internal patients were more curious and knowledgeable about tuberculosis and its treatment and were less satisfied with the information they were given, than were externals. Using a social influence situation in which attempts were made to influence subject attitudes towards the Viet Nam war, Davis and Phares (1967) found that internals tended to seek out and

gather more preliminary data about people whose attitudes they were trying to change, than did externals. Implied in these studies is the suggestion that the information-gathering process is somewhat more time consuming for internals and that in the use of this information, internals may tend to appear more deliberate and conservative in their approach to problems. Interestingly, studies by Thomas (1970), MacDonald (1972), and Hjelle and Finck (1976) found that when examined, both as individuals and as families, internals tended towards more conservative and traditional ideologies while externals were more liberal; this suggested that locus of control may also be reflected in the broader aspects of lifestyle and political attitudes.

Perhaps because of this greater effort at information-collection, internals show more accurate perceptions and effective use of information in a variety of problem-solving tasks. Phares (1968) examined locus of control as a function of decision-making in a task which involved memorizing bits of information about four men for later recall. After a week, subjects were asked to match these men to ten occupations and eight women, and to state the reasons for their choices. Results showed that internals made more effective use of the information, which had been equally available to externals; internals also gave more reasons and more correct matches than did the externals. Using the rod and frame apparatus, block design, and embedded figures tests, Deever (1968) found internals to be less field dependent, more accurate, self-reliant, and assertive in their perceptions than were the externals. The author suggested that internals tend to rely more on their own reinforcement history and are more autonomous than externals. Similar

conclusions were drawn from a study by Lefcourt and Wine (1969) in which the subjects interviewed two target persons. One person behaved normally, while the other avoided eye contact and behaved in a "puzzling" manner. The results showed that the internals looked more closely at the unusual person than at the conventional one but also made more observations of individuals than did the externals. The authors concluded that internals are more vigilant and attentive to essential, information-providing cues which help with problem-solving.

In a second study, Lefcourt and Wine (1969) examined subject attentiveness under two conditions. Subjects were placed in an experimental room where a number of objects (poetry on a blackboard, television set, advertising, etc.) were situated, and asked to complete an irrelevant task. Half of the subjects were told that the experiment was studying attentiveness, while the other group were told nothing about the purpose of the experiment; while internals showed little variation between conditions, the externals exceeded the internals in their recall of items under the instructional set than when it was undefined. It was concluded that the behaviour of externals is more easily influenced by expectations and instructions, while internals tend to be more consistent in their responding.

Kneavel (1978), in a motivational study using a digit-cancelling task under skill and chance conditions, found that while externals under chance conditions outperformed the internals during the first trial block, by the third trial the internals under all conditions were significantly outperforming them. Kneavel interpreted this as the

internal's resistance to the manipulative influence of the experimenter, while the externals were more susceptible to it. Both the Kneavel and the Lefcourt and Wine studies also demonstrated a significant difference in initial responding to tasks, with externals being initially somewhat better than the internals, although the internals' deliberate, cognitive approach resulted in an overall superior success rate.

Lefcourt, Gronnerud and MacDonald (1973) and Lefcourt, Antrobus and Hogg (1974), using verbal humour and sexual double entendre procedures in a word association test, reported that internals were not only more perceptive to essential cues, but they also more readily deduced meanings, accepted them and turned situations into humourous ones. They seemed to be more cognitively alert than other subjects, were more quickly aware of the nature of the task and indicated this awareness to the researchers. Externals were significantly less alert to verbal details and potentially productive cues; moreover, once their decisions are made, internals tend to show more autonomy and confidence in their judgements and in this process are less easily influenced by outside pressures. Crowne and Liverant (1963) examined the confidence of statements made by students during two Asch-type conformity tasks in which subjects were asked to make bets concerning the accuracy of their statements. The authors found that while externals tended to conform to peer expectations, internals were quite confident in their own judgements. These characteristics were also noted in studies on verbal conditioning by Strickland (1970) and by Johnson, Ackerman, Frank and Fionda (1968), who found that internals were more resistant to peer pressure, more

aware of the influences placed upon them and more likely to follow their own judgements.

Internals have consistently been found to be more achievement-oriented and persistent in complex problem-solving. James (1965), in a report to the Society for Research in Child Development, described how, in a complex puzzle-solving task, internals were more consistently persistent in their efforts. Franklin (1963) sampled 1,000 high school students and found that internals showed greater achievement motivation in such things as intention of going to college, amount of time spent on homework and investigation of prospective colleges. This was interpreted as a reflection of the internal's acceptance of personal responsibility for, and persistence in, school achievement. Lessing (1969) examined the grade point averages of high school students and found that a sense of personal control (i.e., internal locus of control) was related to higher grades, even when intelligence was controlled. Nowicki and Walker (1974) found that fifth and sixth grade students who perceived themselves as being internally controlled were able to achieve more in school. Moreover, Crandall, Katkovsky and Preston (1962) noted that children with high intellectual achievement were more likely to believe that they, rather than others, were responsible for the reinforcements they received. Strickland (1973) compared the degree to which internal and external elementary school children could delay the delivery of rewards, and found that internals were able to choose rewards that were more valuable over time, whereas externals chose immediate but less valuable rewards. In reviewing these findings, Phares (1976) concluded that

internals tend to show superior academic achievement and persistence in pursuing long-term goals. He attributed part of their success to their ability to delay gratification in order to attain greater rewards later, while externals seem to rely more on immediate goals.

Differences in performance as a function of locus of control have also been found attributable to the subject's perception of, and attention to, the task at hand. In an early study by Rotter and Mulry (1965), the motivational value of skill and chance instructions were examined in terms of locus of control. Undergraduate students were given a difficult angle-matching task under skill or chance instructions; their decision times were used as the dependent variable which for internals under skill instructions was found to be longer than for chance; there was no significant difference for the externals. The authors concluded that perception of a task requiring skill is more highly motivating for internals than for externals. Similar findings were also obtained in a more detailed study by Lefcourt, Lewis and Silverman (1968) using a simple motor task with decision time as the dependent variable. Internals spent more time deliberating their decisions in the perceived skill condition than in the perceived chance condition; externals were found to have longer decision times in the perceived chance conditions compared to the perceived skill condition. Further analysis revealed that internals were more cognitively engaged and attentive in the perceived skill condition than the perceived chance condition. The authors concluded that internals are more dubious about accepting the examiner's description of a task as skill or chance determined than are the externals.

Other authors (Lefcourt and Wine, 1969; Kneavel, 1978) have also found that externals are more easily influenced by an instructional set or experimenter expectations than are internals.

Julian and Katz (1968) found that as the difficulty of the task increased, internals under skill conditions seemed to require longer decision times, while the externals did not differ as extensively and behaved as though there were no differences between simple and difficult chores. This finding was expanded by a set of experiments by Ryckman, Stone and Elam (1971) and Ryckman and Rodda (1971) in which groups of internals and externals were strongly criticized while participating in a dart-throwing task. Under skill conditions, the internals showed greater concern and anxiety about the outcome; under chance conditions, externals were found to be more anxious. The authors interpreted their concern and anxiety as being indicative of higher motivation.

In summary, studies on the characteristics and behaviour of people who maintain internal or external orientations have generally provided consistent findings. If they perceive a situation as requiring some degree of skill, internals seem to be observant, careful and cognitively involved before making decisions and as a result, initially somewhat slower in the problem-solving process. They are more curious, persistent and less easily influenced than the externals and are more confident once their decisions are made. Externals seem less discriminating but somewhat more initially successful on some tasks, although the internal's deliberate, cognitive style eventually results in superior overall performance. This is reflected in higher achievement in school where skill, persistence and high expectations for success are a definite asset.

Studies into the growth from external to internal locus of control have been few in number, since most work has concentrated on populations of late adolescents and adults. However, it would appear that developmental and experiential considerations are the basis for these differences. The following section will review some of these factors as they are related to the development of locus of control.

Developmental Antecedents of Locus of Control

In spite of the expanding literature on locus of control, very little work has been done specifically on either the conditions which facilitate locus of control or on its developmental course. One reason is that there have been relatively few studies of child populations with whom research is made more difficult by the complexities of the developmental process, and by a dearth of techniques and instruments available for this purpose. There is, however, agreement on the general parameters of child growth. Developmentally, the individual moves towards increasing differentiation and independence from the environment on which he is initially totally dependent. This natural progression is seen in all spheres—biological, behavioural and social; it is reflected in the individual's increasing ability to function independently and gain a sense of mastery over many of the events and conditions which impinge on his life (Singer and Singer, 1969). This implies not only facilitative conditions for growth but also a series of successful experiences throughout childhood from which the person gradually learns to depend on himself rather than on others. The progression from external to internal locus of control seems to occur synonymously with this

growth and development in other areas yet studies indicating the nature of this relationship have been relatively few in number.

Bialer was the first to hypothesize the growth from external to increasingly internal control of reinforcement. Using mentally retarded and normal youngsters matched both for age and intelligence, Bialer (1961) found that internality was related to mental age and the ability to delay gratification. No significant relationship was found between locus of control and intelligence. Bialer's findings suggested that internality was related to experiential factors and maturity, rather than chronological age alone.

In developing the Intelligence Achievement Responsibility Questionnaire, Crandall, Katkovsky and Crandall (1965) administered their test to children of both sexes in grades three through twelve, thus obtaining developmental data on locus of control. The authors noted increasing internality with age; moreover, they reported that internality seemed to be established by the third grade after which there was very little change noted.

Penk (1969) used Bialer's scale with groups of children at five different age levels and again confirmed that internality increased with age as did concomitant feelings that events were under personal control rather than due to luck or chance. Beebe (1971) examined locus of control and self-concept, and found that not only did internality increase with age but there was a levelling off at adolescence for both sexes; he also found a significant relationship between internality and positive self-concept at all ages.

Corroborative evidence for increasing internality throughout childhood was found in Nowicki and Strickland's (1973) and Nowicki's (1976) work on their Locus of Control Scale for Children. They administered the scale to children from grades three to twelve and found that the mean scores were more external in the early grades, with a gradual change towards internal scores at the higher grade levels.

The growth of internality seems well substantiated but the factors which facilitate it have been only examined retrospectively and remain, therefore, questionable. Chance (1965) used the IAR and the Parental Attitude Research Instrument to inquire about parental expectations and behaviours. She found that permissive and flexible maternal attitudes and expectations for early independence were associated with internality. Katkovsky, Crandall and Good (1967), using similar interviews and questionnaires, reported that protective, nurturing, approving and non-rejecting parental behaviour is associated with the child's belief in internal control. These studies parallel the work of other researchers in child development (Bowlby, 1953; Erikson, 1963; Piaget and Inhelder, 1969; Singer and Singer, 1969) who note an increasing assumption of responsibility for personal behaviour with increasing age provided a facilitative and loving familial environment is provided.

Studies inquiring about the child's perception of the parent's attitudes and child-rearing practices done by Shore (1967), Davis and Phares (1969) and Loeb (1975) found that internal children rated their parents as having more positive involvements with them, associated with less rejection, direction, inconsistency and hostile control than externals.

Studies indicate that on-going experience with the environment can also influence locus of control. Harvey (1971) examined business administrators and found that the longer a person holds an administrative position, the more internal he scores on Rotter's scale. Even short-term but significant events can have some impact; for example, Nowicki and Barnes (1973) found that deprived inner-city adolescents in an instructive and co-operation-reinforcing summer camp shifted towards internality after only one week of camp. Similar phenomena have been reported with college students by Gorman (1968) and McArthur (1970) following political events which contrasted with their expectations. Also significant is Smith's (1970) finding that clients at a crisis intervention centre gradually shifted towards an internal position as their life situation improved following therapy in which they were taught more effective coping techniques. Moreover, the mean I-E score for some specific population have been observed to change over a period of years. Schneider (1971), for example, has reported a shift of 2.96 points towards externality over a four-period in college males. The author interpreted this shift as being the result of increasing alienation and cultural change during a period of political unrest and high drug usage.

The previously mentioned studies point to locus of control as a construct which seems to shift towards internality with increasing maturity provided positive expectations for independence in combination with perceived corroborative experiences are present. Mean I-E scores may vary between populations and as a function of time or significant events, although they are relatively stable at any point along the developmental

continuum. LOC scores seem to reflect individual maturity or assimilated experience rather than intelligence or chronological age. Moreover, measurable short-term changes can be seen following significant environmental events, although the permanence of this shift has not yet been determined.

In our culture, much emphasis has been laid on the child's incorporation of traditional, stereotyped sex-role behaviours. Since the expectancy for these behaviours is different for boys and girls, they should be instrumental in the development of differing perceptions of control over reinforcement, reinforcement value and behaviours. These variables, as they relate to locus of control, have not been extensively examined; the relevant studies are reviewed in the following section.

Sex-Role Variables Related to Locus of Control

Sex differences have been found in adult studies on locus of control generally reflecting cultural stereotypes of sex roles. With North American cultures, men have been traditionally encouraged to be more assertive, physically active and competitive while women have had greater emphasis laid on emotional and interpersonal areas in addition to relatively greater socialization pressures than have men (Platt, Pomeranz, Eisenman & DeLisser, 1970). It is not surprising, therefore, that on a measure of expectancy of personal control which includes a bias towards achievement, males frequently score more internal on a greater variety of characteristics than do women.

Schneider (1968, 1972), using a forced-choice questionnaire, had internals and externals select their preference for skill or chance-directed activities. He found that, for males, there was a positive correlation between skill activity preference and internal locus of control, while externals preferred chance activities; no correlation was found for females. Similar findings were determined in a study by Brown and Strickland (1972). Internal and external college students who were listed in their yearbooks served as subjects and their activity summaries were the dependant variables. Brown and Strickland found that internal males were more frequently office-holders and had significantly higher grade-point averages than externals; similar evidence was inconclusive for females. The authors note that cultural values associated with sex role and achievement may be responsible for these differences. Klemp (1969) used a measure of hypnotic suggestibility in a study of interpersonal trust and hypothesized that the higher the trust, the more susceptible the person would be to hypnosis. He found that this was true for internal females but not for males. This again suggests sex differences, with the skepticism of the internal males and the more trusting females meeting cultural role expectations.

With children, sex differences are rather less predictable. On the Intellectual Achievement Responsibility Questionnaire, Crandall, Katkovsky and Preston (1962) found sex differences in the first three grades, but not afterwards, with internal girls showing greater self-responsibility for academic achievement than boys. A later study by Crandall, Katkovsky and Crandall (1965) found that IAR scores predicted achievement scores

for younger girls and older boys, with girls proving to be more internal between grades one and six and boys more internal after grade eight. Studies of the middle elementary grades (grades six to eight) fail to show clear sex differences (Lessing, 1969) although McGhee and Crandall (1968) found that self-responsibility for failure on the IAR was a better predictor for boys while self-responsibility for success was a predictor for girls.

While sex variables in adult behaviour in relation to locus of control have been found to conform with cultural expectations, the issues have not been sufficiently clarified to make statements with any degree of certainty. Moreover, since the completion of many of these studies, the role of women has rapidly started to change implying the need for fresh studies in which sex variables are examined more systematically. With children, the literature is even less clear with fewer studies being reported and, of these, only one variable (prediction of school grades) demonstrates clear sex differences.

The aforementioned sections describe the background of the concept of locus of control, measures used to determine it, general characteristics of internals and externals, developmental antecedents, and sex-role differences. The volume of the literature attests to the growing interest in locus of control as a personality variable and as a predictor of behaviour. Studies suggest that there are differences in how internals and externals perceive and approach problem-solving situations, given a variety of alternatives from which to choose. The problem-solving process is a conscious one (Weir, 1964) and can be influenced

by many things—expectancies, reinforcement value, the situation, etc. It would seem that a controlled manipulation of these variables would shed some light into how decisions are made. This study will examine changes in reinforcement value in order to determine what effects these may have on the problem-solving behaviours of internal and external male and female children. The following section will review the research findings on rewards and reinforcers with respect to their value and use as incentives with children at various age levels, and summarize the trends which have been observed.

Incentives

The use of incentives in psychological research is based on the assumption that the incentive in question will have motivating impetus for the subject. This can occur as a result of previous exposure to rewards or reinforcers under favourable conditions, or through observation of them and their effect on others (Bandura, 1969). Used as incentives, rewards and reinforcers have been widely used in psychological research to provide reliable data supporting the view that subject behaviour can be altered in response to them (Swingle, Coady and Moors, 1966; Morris and Coady, 1974; Coady and Brown, 1978). Moreover, incentives are commonly observed in parent-child interactions and seem to be an effective means of influencing child behaviour.

The literature often interchanges the terms "reward," "reinforcement" and "incentive" so that their meanings become blurred in interpretation. A reinforcer is any event that increases the likelihood of strengthening

the response it follows, while a reward is a more general kind of reinforcer which operates in more varied situations (Logan and Wagner, 1965). Incentives can be viewed as a particular application of rewards or reinforcers; they operate on the social learning theory assumption that the child has prior experience with a specific reinforcing event in a given context so that it comes to be valued by the child and anticipated following a behaviour. Incentives, therefore, refer to the anticipation of specific, consequential events which are perceived as being valued and potential reinforcers, and thus serve to increase the potential of certain behaviours. Expectancy of reinforcement refers to a broad, generalized construct which includes the anticipation of rewards of both positive and negative reinforcing value under certain conditions based on prior experience and, as such, can be seen as a close correlate of Rotter's concept of locus of control.

While it has generally been found that some incentives can improve performance, their specific nature, delivery and relationship to personality variables such as locus of control has yet to be established. Witryol (1971) underscores the complexity in this area by pointing out that research must attempt to understand some of the broad learning experiences leading to the preference for a particular incentive in subject groups and whether it fits the experimental task to which it is applied. In spite of Dmitruk's (1973) criticism that research has tended to focus on specific incentives, usually categorized as material (such as edibles,tokens, money, or small toys) or social (comments from the experimenter such as "very good," "fine," etc.) in nature, without

precise definition of either the incentive or its appeal value to children at differing age levels, some general trends have been reported.

Witryol and Ormsby (1961) presented forty subjects in each of three grades (kindergarten, third, and sixth) with a variety of both material and social rewards. They found that with kindergarten children, material rewards were preferred over verbal rewards. With the third and sixth grade children, verbal rewards were preferred over material rewards. The authors conclude that there is a gradual shift in preference from material to verbal rewards with age.

Lewis, Wall and Aronfreed (1963) investigated positive and negative social reinforcers and found that while grade one students were more responsive to the positive social reinforcers, there were no differences between groups at the grade six level. Similarly, McCullers and Stevenson (1960) found that verbal reinforcement was more effective with three to four year olds, but not for eight to nine year olds on a probability learning task. These data suggest that in early to mid-childhood, social reinforcers may have less incentive value to children with increasing age.

Witryol, Tyrell, and Lowden (1965) selected 20 boys and 20 girls from each of grades one, three and five. Each subject ranked a penny, a charm, bubble gum, "very good boy (girl)," and nothing for reward preference value. There were small but reliable differences between reward value when compared to the "nothing" control condition. With increased age, boys preferred the penny, and by the fifth grade both boys and girls showed a preference for social rewards.

Witryol's (1971) review of the incentive literature examined reward preferences over a wide range in children. He found that children in early elementary school (grades one to five) more frequently chose material kinds of incentives, but that preferences for both material and social incentives increased with age. Sex differences were seen at the grade five level with boys preferring monetary rewards while girls preferred social rewards. This difference was attributed to the increased social awareness in girls at that age level and suggests that heightened social awareness in the pre-adolescent may increase the effectiveness of social reinforcers during that period.

Not only is there a differential subject preference for various kinds of incentives, but the incentives themselves can differentially influence the performance of subjects on learning tasks. For example, Terell and Kennedy (1957) used a discrimination learning task with groups of children at two age levels (four to five years and eight to nine years). Praise, reproof, candy, a token, or no reward (control) were used as the independent variables, with candy proving to be the most effective incentive for both age groups.

Jeffrey and Skager (1962) wanted to determine if material incentives for correct responses would improve performance on a spatial generalization gradient task. They found that for seven-year-old males the material incentive of a poker chip, which could be cashed later for a movie, improved performance over a control condition. For the ten-year-old group, the added material incentive did not affect performance over the control condition.

Siegel and Andrews (1962) used small toys, and Stevenson and Hoving (1964) used nickels as material incentives on probability learning tasks. They found higher terminal performances and faster asymptotic levels of response than under no incentive, or low incentive conditions. A study by Benowitz and Busse (1970) found that a material incentive (crayons) applied by the classroom teacher to a group of low SES black grade four students could increase their spelling performance. Wilson, Witryol and Hust (1975) used grade five students in a study in which various monetary incentives were associated with specific words on a word recall test. The authors found that the words with the highest monetary value were more frequently recalled.

The possibility that material incentives may also contain important "social" qualities is one which must be addressed. It is true, especially with children, that material reinforcers are not given in social isolation and that they may be subsequently used to enhance social recognition or position. However, these social aspects appear to be secondary to the preference for the material incentive itself. A factor here may be the egocentricity and concreteness of young children (Piaget and Inhelder, 1969) who tend to focus primarily on the immediate reinforcing qualities of any incentive (Strickland, 1973; Phares, 1976). Another factor could be the perceived reward value of a material incentive in children for whom the incentive may be novel or important because of inexperience or a felt need for it. Additionally, the incentives literature attests to general preferences for either material or social kinds of incentives, and both have been found to differentially influence subject behaviour on a variety of tasks (Witryol, 1971).

In addition to specific types of incentives within the general categories of "material" or "social," the effects of non-specific or ambiguous incentives have also been examined. These include the anticipation of broader social (peer recognition, pressure, competition) or material ("prizes") reinforcers, and have been found to differentially influence performance. More recently, this has introduced an exploration of the complex interaction between personality variables and incentives on various learning tasks.

Witryol and Alonzo (1962) had pre-school children rank the reward value of bubble gum, a balloon, a charm, a marble and a paper clip. In addition, they attempted to influence the scaling by later telling the subjects that the paper clip was preferred by one of their friends prior to a second presentation. The rank order of the paper clip rose from last place during the first presentation to first place during the second presentation indicating that peer pressure can influence reward choice.

Swingle, Coady and Moors (1966) compared the effectiveness of five incentive conditions with performance feedback in maintaining the lever-pressing behaviour of college males. They found that some subjects were highly responsive to self-competition, while for others, self-competition was less motivating than monetary or social incentives. The authors concluded that incentive value may be based on some other cognitive mediating variable such as need for social approval or need for achievement.

In another study, Morris and Coady (1974) administered a two-choice probability learning task to one hundred and eighty children who had

been divided into high and low need for social approval groups. Non-specific social ("most of your friends do very well in this game and you will be liked and praised if you do well") and material incentive conditions ("if you do well you have a chance to win a very good prize"), in addition to control (no incentive) conditions were used. Subjects with a high need for social approval scored higher under all incentive conditions but particularly under social incentive conditions; moreover, this group tended to use strategies which maximized their number of correct responses more frequently than the low need for social approval group. The authors concluded that social reinforcement has a high value for the high need for social approval group and related this to a reinforcement history in which social kinds of reinforcement have predominated and are, therefore, expected and valued. They also suggested that this expectancy can be altered through the use of incentives.

Coady and Brown (1978) divided one hundred and twenty children ranging in age from eight to ten years of age into high and low need for social approval groups using the Children's Social Desirability Questionnaire. They were then administered a digit cancelling task under three non-specific incentive conditions--normative ("most children your age do well on this task"), competitive ("you have a chance to win a prize") and control (no incentive). The authors found that high need for social approval subjects responded better under normative incentive conditions in which they perceived that their performance would be compared to group norms. The more independent, low need for social approval group responded better to the competitive incentive.

The application of these studies to an examination of locus of control is based on the apparent similarities between the high need for social approval group and the external locus of control group. Both are dependent on other factors rather than themselves for reinforcement and seem to behave in similar ways on learning tasks. Young children, external locus of control children and high need for social approval groups tend to use maximizing strategies. The Morris and Coady (1974) and Coady and Brown (1978) studies suggest further that incentives can have an impact on the performance on these groups; however, research into the interaction between locus of control and incentives have been rare.

Baron and Ganz (1972) used a simple form discrimination task with ten and eleven-year old black subjects in order to determine the relationship between locus of control orientation and the value of intrinsic (visual feedback) and extrinsic (verbal feedback from the examiner) reinforcers. Findings showed that internals performed better with intrinsic reinforcement than did the externals who performed better with extrinsic reinforcement. When both intrinsic and extrinsic reinforcers were combined, the internals did less well than with intrinsic reinforcement alone. These findings suggest that the more independent internals rely more on their own direct feedback than do the externals who perform best when given external verbal support through a social reinforcer.

Taub and Dollinger (1975) examined the differential effects of material incentives and purpose as an incentive in relation to locus of control. Using a coding task, subjects were tested under four combined incentive conditions: reward, purpose, no reward and no purpose. Their

findings indicated that internals were unaffected by the various incentive conditions while the externals were motivated by both reward and purpose.

Wortman (1975) examined perceived control over task outcome and found that subjects who caused their own outcome and knew beforehand what they hoped to obtain, perceived themselves as having more choice over the outcome and assumed more responsibility for it. These findings suggest that perceived personal control (internal locus of control) over outcome may in itself be more highly motivating than external reinforcements or incentives for some subjects while the more dependent subjects (external locus of control) perform better when external recognition is given.

Bastien (1976) examined the effects of non-specific social and material incentives with three levels of locus of control orientation on a digit cancelling task using male and female subjects ranging in age from eight to eleven years. As expected, she found that the internal locus of control subjects performed significantly better than the external locus of control subjects while a middle group did not significantly differ from the extreme locus of control groups. No differences between incentive conditions were found. The author pointed out that McCullers and Stevenson (1960) and Lewis, Wall, and Aronfreed (1963) also did not find differential incentive effects with similar age children as used in her study, although differential incentive effects have been obtained with younger children.

The above studies are far from conclusive, but suggest that as with locus of control, the value of rewards are learned within an experiential context and when offered as incentives, can differentially influence individual performance on experimental tasks. There seems to be an increase in the motivational value of all incentives and a general shift from material to social kinds of incentive preference with age, but specific trends have yet to be delineated. One study reports that mid-elementary school boys are more responsive to material incentives while girls at the same level are more responsive to social incentives; moreover, recent studies suggest that incentives may have more value for younger and externally dependent subjects whereas for those internal subjects who perceive themselves as having control over a task and its outcome, incentives may provide little additional motivational value. It would seem, therefore, that these personality and experiential variables should have some impact on the motivational properties of various kinds of reinforcing events and thus on their potential to differentially influence behaviour when offered as incentives. The apparent parallel shifts of locus of control and reinforcement value with age is an intriguing one, since both directly influence the behaviour potential of children through changes in expectancy for reinforcement. However, the area has not yet been explored.

A major problem in this kind of study would be to find experimental tasks which are simple, interesting, ego-involving and yet applicable to subjects of all ages so that these developmental changes can be observed and valid conclusions drawn. Probability learning tasks meet these criteria and are now widely used in research over all age ranges. The

following section will outline the findings of research using probability learning tasks with particular reference to studies with children.

The Probability Learning Task

The study of children's performance on probability learning tasks arise from the view that these tasks can demonstrate developmental changes in problem-solving strategies, and in the child's understanding of the nature of probability events. The tasks themselves were first used in the 1930's as verbal variations of classical conditioning paradigms (Goulet and Goodwin, 1970) and have been widely used in contemporary research with children.

Probability learning tasks ask the subject to predict which of several alternatives will occur in a series of trials. The actual occurence of these events is regulated by the experimenter in a predetermined but random sequence known as the partial reinforcement schedule. While the subject may be convinced that he is capable of making successful choices 100% of the time, it is virtually impossible for him to do so (Weir, 1962). As the task proceeds, the subject can learn several things: to obtain information about the occurence of each event over trial blocks, to deduce optimum strategies for maximizing correct predictions, and to inhibit strategies which do not result in correct predictions (Goulet and Goodwin, 1970). The nature of the tasks permits a wide range of possible independent variables which do not alter the basic task and which yields minimal expected basal or ceiling levels of responding. Correct choices serve both as information feedback as

well as reinforcers for the choices themselves. A number of types of probability learning tasks have been developed, including two, three, or more available choices, contingent and non-contingent feedback, different modes of presentation and a range of reinforcement schedules.

In the two-choice or binary-choice probability learning task, subjects are instructed to predict which of two events will occur in a series of trials. These events are presented in fixed proportions (e.g. 70:30) over the total number of trials but occur in random sequence. As a performance measure, the two-choice task provides immediate information feedback regarding the success of choices, thus reinforcing the choice and the strategy which underlies it. Each such strategy, if it continues to occur for a sufficiently long sequence of trials can be identified by the experimenter by examining the actual choices made by the subject (Restle, 1962). Strategies are considered to be a function of cognitive maturity and/or experiental factors, and are reflected both in the early stages of practice and following asymptote (Lewis, 1966). Subjects will gradually eliminate less successful strategies and adopt new ones in response to the partial reinforcement schedule until asymptote is reached, at which point responding becomes more stable.

Three strategies which have been found to occur in probability learning tasks are maximizing, alternating and probability matching. If a subject uses a maximizing strategy, he chooses the most frequently reinforced event on every trial (e.g. ten out of ten trials) which thus provides a high proportion of successful choices. In the probability matching strategy the subject learns to choose alternatives at the rate

each one occurs per block of trials. For example, if the events occur in 70:30 proportions, the subject will learn to make choices at the same rate; that is, in a block of ten trials he will choose the most frequently occuring event seven times. With the alternating strategy (also known as "gamblers' fallacy" or trial and error), subjects tend to increase expectancy following failure and to decrease it following success. This is reflected in the subject's alternation of responses following success or failure on each trial, and results in a low level of successful choices per trial block. These strategies have been well documented (Phares, 1976; Goulet and Goodwin, 1970; James, 1965; Weir, 1964) and are used to describe various kinds of solutions to probability learning tasks in the following review.

An early study by Messick and Solley (1957) used pre-school and elementary school children to explore a number of general problems in using a two-choice probability learning task. Although the number of subjects was small (n = 13), children were tested under all combinations of procedures, schedules, incentive conditions, etc. Their results suggested that children at these age levels were able to discriminate between various schedules of reinforcement and demonstrated differences in strategy formation between older and younger subjects although the reliability of their findings was questionable because of sample size.

The relationship between strategy formation and cognitive maturity, intelligence and chronological age was not clear in the early studies, since maximizing had been observed in both young children and adults. Stevenson and Zigler (1958) used a three-choice probability learning task with a larger sample of retarded and normal youngsters. They found that

the maximizing strategy was used more often and more successfully by young and retarded subjects than by normals. Extending the study, Stevenson and Weir (1959) compared the performance of children ranging in age from three to nine years on a three-choice task. They also found age differences between strategies used, with maximizing being seen most frequently in the youngest subjects but decreasingly so in the older subjects. The authors concluded that the use of strategies seemed to depend on experiential rather than maturational factors with the older children having had more experience in problem-solving situations and therefore having more strategies available with which to work. While the younger children tended to perseverate to a single response strategy, the older ones seemed to develop, test and reject a series of strategies.

Maximizing was also noted in nursery school children in studies by Jones and Liverant (1960), Kessen and Kessen (1961) and Lewis (1966), using two-choice probability learning tasks. Their nursery school children seemed to select a single response and stick with it permitting response maximization more frequently so that their rate of success was higher than the elementary school children. The authors concluded that maximization in younger children is the result of some type of non-cognitive process such as instrumental conditioning, while in the older children the conscious problem-solving reflects a cognitive process and results in a lowering of the children's performance.

Although seemingly discrepant, a study by Crandall, Solomon and Kellaway (1961) found no differences between the performance of adolescents and younger children on a two-choice task. Lewis, Wall, and

Aronfreed (1963) found similar results in comparing the performance of first and sixth graders. Extrapolation from the earlier studies would have led to the hypothesis that increasingly complex strategies should occur in the adolescent group but instead the authors found the same maximizing strategies as seen in the younger subjects. Weir (1964) consolidated the data from a series of similar studies in which subjects ranging in age from three to twenty years had performed the same task. He pointed out that the strategies used by young children are very simple, in which the maximizing strategy can be viewed as perservation or conditioning to a specific choice and is strengthened by partial reinforcement whenever the response is correct. As the child matures, however, there is a transition to an increasingly cognitive approach through middle childhood which by early teens and adulthood becomes quite complex. These more complex alternating strategies are reinforced less frequently and cause a lowering of the success rate. They are rejected, in turn, with the eventual solution approaching the maximizing of the pre-schoolers even though the strategy is learned through a completely different process and reflects a more mature cognitive style.

Weir also found that asymptote was reached more rapidly with the pre-schoolers and adults (within the first trial block) than with older children indicating that the cognitive style of the older children tended to interfere with a more rapid solution to the task. Lewis (1966) also found that increases in age or intelligence did not result in superior binary-choice performance, and actually resulted in poorer performance. He explained that conscious decision-making is a disadvantage

in solving the task since the child's attempts at problem-solving reduces his problem-solving success rate on the task. Lewis concluded that maximization is often best achieved by a minimum of cognitive capacity. Goodwin (1969) further explains this by hypothesizing that although older children are gradually developing the capacity to generate complex hypotheses, they are still too immature to shift to new and more abstract ones when they fail, or do not meet expected levels of success. Thus, their performance would contain a high proportion of alternating responses and a low proportion of maximizing or probability matching responses, reflected in a reduced success rate and longer period of time to reach asymptote.

Instructional set may also play a role in determining task performance. Weir (1962) provided differential instructions concerning possible task outcome with children ranging in age from five to thirteen years on a three-choice probability learning task. The results showed that older children who entered the task with the expectancy that there was a solution which would lead to a high rate of reinforcement showed more variable search behaviours (alternating strategies) than the younger subjects. Younger subjects generally had lower expectancies to succeed and seemed more willing to settle for a lower frequency of reinforcement. The younger subjects also showed a definite tendency to enter the task with a set to respond in a fixed pattern, while for older subjects this was less apparent.

These data have been consistently supported in subsequent studies with subjects across a wide range. Derks and Paclisanu (1967) used a two-choice probability learning task with subjects ranging from four

years to college adult and found that there was a shift from maximizing in the nursery schoolers to alternating strategies in the elementary grades and to maximizing again with the adults. Goodwin's (1969) study used a three-choice task over the same age range with similar results although she found somewhat more variability in the adult group.

A few studies have specifically examined probability learning task behaviour under material and social incentive conditions and found that incentives can generally generate higher asymptote response levels than under control or information feedback conditions. For example, Brackbill, Kappy and Starr (1962), Singer and Andrews (1962), Bisett and Rieber (1966) and Stevenson and Hoving (1964) used scaled material incentives with six to thirteen year olds on two-choice tasks, and found that higher valued incentives were able to produce higher levels of responding, particularly if contingent feedback was also provided.. Social reinforcers (praise, etc. for correct responding) have also been effective in improving the performance of grade one students, but not grade six students (Lewis, Wall and Aaronfreed, 1963), over information feedback conditions alone. Other researchers, (Goulet and Goodwin, 1970), have suggested that this effect may have been the result of a negative interaction between the experimenter and the older children. However, in the previous review on incentives, social incentives seemed to be of increasing value with age and able to affect performance on a variety of tasks. It is possible, therefore, that for older children the probability learning task itself is sufficiently interesting and rewarding that social reinforcements may not be able to differentially

affect performance. Clarification of this issue will be of considerable interest to this study.

In reviewing the developmental trends in both probability learning and locus of control, one is struck by the child's expanding ability to rely on his own experience in order to formulate hypotheses and assume response control in increasingly personal and complex ways when presented with problem-solving tasks. It may be that the complex hypothesis-testing of the elementary school and early adolescent children relies heavily on their perception of being free to deal with these tasks on their own, having had corroborative experiences independent of adults or powerful others and thus internalizing their own sense of autonomy and differentiation. This corresponds with the individual's increasing sense of personal control over reinforcement with age and experience. It is also consistent with Piaget's description of childhood logic through the concrete operational period and later into the formal operations period when complex abstract reasoning begins to develop (Inhelder and Piaget, 1958). The incentives literature too suggests that there may be an increase in the reinforcement value of all incentives, and a general shift from material to social kinds of incentive preference with age, but specific trends have yet to be delineated. Moreover, incentives effects may be different with internals and externals since studies indicate that incentives may have more value for younger and externally dependant subjects whereas for those who perceive themselves as having control over a task and its outcome, incentives may provide little additional motivational value, particularly on probability learning tasks.

The following section will summarize the review of the literature and outline the rationale for the present study.

Rationale for the Present Study

Social learning theory research indicates that if a person develops in a nurturing and independence-supporting environment, he comes to perceive and experience himself as being increasingly able to control the outcomes in his environment. Locus of control refers to the person's perceived control over reinforcements as being under his own control (internal locus of control) or contingent on luck, chance, fate or powerful others (external locus of control). This position on the locus of control continuum can be reliably measured using a variety of tests. Various research has demonstrated that internals and externals react differently in many situations, including problem-solving situations. In general, internals are more alert, cognitive, curious, persistent and yet initially cautious and conservative in their approach to problem-solving. Their judgements tend to be more independent and are less easily influenced than the externals who tend to conform to the expectations of others. Externals also tend to prefer chance rather than skill activities, are less persistent and curious, and are more dependent on (but less alert to) environmental cues. Internal children are, therefore, generally more active, academically successful and independent, although initially somewhat slower in decision-making than are externals.

An area which has not yet been adequately explored is the behaviour of internals and externals in relation to differential reinforcement values. Since social learning theory views behaviour as being a function

of reinforcement value, expectancy and situation, one might suspect that if expectancy and situation were kept constant while reinforcement value was manipulated, variations in performance would result. This study proposes to examine this area by offering two types of non-specific incentives to internal and external elementary school children in order to determine if differential performance on a simple learning task will occur. Moreover, the cognitive strategies which underlie their performance may demonstrate variation as a function of locus of control and incentive value.

Late childhood is a period when children are increasingly sensitive to social and interpersonal issues. They are also on the threshold of adolescence, during which they will move towards greater autonomy and independence, and their intellectual processes will be increasingly able to handle conceptualizations in an abstract way. Here too, shifts occur in the value children seem to place on material and social kinds of incentives. Children at this age are generally lively, enthusiastic and responsive to games and challenges; they would, therefore, be a particularly interesting group to study.

A binary-choice probability learning task was chosen to study the relationship between locus of control and incentives. These tasks are simple and ego-involving with no right or wrong answers. They are widely used with children so that comparisons can be made with other studies in order to examine cognitive changes over various age ranges. By providing contingent feedback with a partial random reinforcement schedule, subjects learn to note the occurence of the events and to

devise or reject strategies in order to maximize response accuracy. As the dependent measure, the subject's actual responses can be used to infer these strategies and compare performance across subject groups. Since locus of control helps the internal child to enter novel tasks with high expectancy for success based on his own personal skill, and the external child to enter with a lower expectancy for success believing that external factors are controlling his outcome, variations in performance reflecting this expectancy would be predicted. Since the literature has shown that the internals are more cognitively alert and intrinsically motivated when they perceive the task outcome as being skill determined, it is expected that they will explore more alternatives in the search for successful response patterns, thus lowering their number of successful choices in the initial trial blocks. The externals, who are less cognitively involved and more extrinsically motivated, may be faster at noting the repetitive frequency of the stimuli and perseverate to it, thus initially picking up on the task more rapidly than the internals. Over all trials, however, internals should show superior performance. Interestingly, this introduces the possibility of examining dynamic processes across a temporal dimension rather than static relationships alone.

Research studies have not yet been able to scale the absolute values of specific reinforcers, nor is it likely that this can be done since each child's experiences with them are so varied, and reinforcement values change as the child matures. Therefore, non-specific material and social incentives were chosen for this study. It is presumed that

each child has had previous experience with prizes and with peer recognition (either directly or through observation) so that these are viewed by all children as being both positive and desirable. Non-specific incentives also allow for uniform anticipation of the reinforcement across subjects as subjects translate their own values concerning material or social reinforcers into behaviour.

As discussed previously, both perceived control of reinforcement and incentive value are based on similar kinds of learning experiences, yet the interaction between them has not yet been fully explored, particularly with children. It would seem, for example, that if externals tend to be more dependant on others for reinforcement, then their perceived value of material or social incentives may be somewhat heightened in comparison with an internal group; moreover, there may also be sex differences in perceived reinforcement value, reflected in differential responding on the probability learning task.

It would also seem that differences should be seen in the choice of strategies used by internals and externals at this age level, with internals tending to use the more complex alternating and matching strategies as a result of their initial set for success based on their own skill; externals should more quickly adopt maximizing strategies reflecting their belief that the task will be insolvable because luck rather than their own skills will determine outcome. It was felt that a study of these variables would be both original and relevant, with possible practical application for children in school learning situations and with theoretical implications for social learning theory.

The next section will present the subject selection and design of the study, followed by the specific hypotheses to be tested.

EXPERIMENTAL PROCEDURE

This section will present a description of the subjects, experimental procedures, definition of the variables and the hypotheses to be tested.

The Sample

One hundred and eighty grade six students ranging in age from 131 months to 159 months served as subjects. They were selected from a population of 457 students in nine regular classrooms within five elementary schools in the Fredericton, New Brunswick School system. All students were required to have parental permission before participating in the study (See Appendix A). Return rate for the permission slips was more than 90% in all schools and only two parents refused permission. In one school, several students who had forgotten their slips insisted on telephoning their parents for permission under the supervision of the principal; subject participation within each class was, therefore, very high.

Screening and Selection of Subjects

During the screening session, all children were first administered Form A of the Peabody Picture Vocabulary Test and then the Nowicki-Strickland I-E Scale for Children. Testing was done during regular school hours in groups of between 18 to 30 students in any given session. All data was collected between November 14 and November 23, 1977.

The Peabody Picture Vocabulary Test (PPVT) plates were professionally photographed and shown as slides to the students in their own darkened classrooms. Students were told that they were to be given a vocabulary test. Oral instructions complied with the standardized requirements for the test, and were as follows: "On the screen, you will see a series of numbered slides, each one having four numbered pictures on it. I will say a word, then you try to identify the picture which goes with the word I say. When you have decided, put an X through one of the four numbers beside the slide number on the answer sheet. Here are some practice ones" (See Appendix B). Three practice slides were shown, any questions answered and the test slides were then administered. Sixty slides (Numbers 50 to 110) were shown to the students, this having previously been determined as being well beyond the dull-normal to high-average ranges for this age group. Subjects reported no difficulty following this task and completed all test items.

When the Peabody Test was completed, the Nowicki-Strickland Scale (See Appendix C) was administered, using the following oral instructions: "Below you will find a series of statements. Mark an X through yes (Y) if you agree with it, or no (N) if you disagree with it. Please mark only one to every statement. There are no right or wrong answers: I am interested in what you think and not what you feel others might think." Any questions were answered and instructions were clarified as indicated. Although there were occasional complaints about difficulty in making individual choices, all items were answered by all students.

The total screening procedure took approximately 35 to 40 minutes. Children who were then identified by the teacher or principal as having learning problem were excluded from the sample. Protocols were hand scored and checked by the examiner and an assistant. Subjects with PPVT I.Q.'s of <80 and >120 were eliminated from the sample so that a possible variance in cognitive maturity would not effect strategy formation on the probability learning task. This was also done since the possibility of attentional deficits in the retarded group, and the existence of relatively few very bright subjects, would have meant an unequal distribution across intelligence and undesired heterogeneity among the sample group.

Mean and median I-E scores for the group were identical:

$$(\bar{X} = 16.00, \text{ s.d.} = 4.78)$$

A median split was performed on the I-E scores and subjects scoring above it and below it were defined as externals and internals, respectively. Means scores for boys and girls groups

$$(\bar{X} \text{ boys} = 15.89, \text{ s.d.} = 4.80; \bar{X} \text{ girls} = 16.10, \text{ s.d.} = 4.79)$$

were found to be similar to the Grade Six norms of Nowicki and Strickland (1973) and Nowicki (1976):

$$(\bar{X} \text{ boys} = 13.73, \text{ s.d.} = 5.16; \bar{X} \text{ girls} = 13.32, \text{ s.d.} = 4.58)$$

A t test performed on the internal

$$(\bar{X} = 11.91, \text{ s.d.} = 2.12)$$

and external

$$(\bar{X} = 20.09, \text{ s.d.} = 2.71)$$

scores found these groups to be significantly different:

$$(t = 22.1836, \text{ df} = 2,178; p > .001).$$

Subjects were then randomly assigned to one of three incentive conditions (See Figure 1) until each cell had the required fifteen subjects. A description of the sample group is presented in Table I and Figure 2. Remaining subjects were also randomly assigned to groups as spares.

Administration of the Probability Learning Task

Several days after the initial testing, groups of between three to fifteen subjects were accompanied by the examiner from their classroom to a large, quiet room which had been especially set up for the probability learning task. Fifteen individual places were set up for the subjects on desks or tables separated by 61 cm x 61 cm masonite partitions. Each place was angled towards the examiner so that subjects were in visual contact with him but not with one another.

At each place was an answer sheet (See Appendix D), a pencil, a pile of blue and yellow plastic chips[1] (100 blue and 100 yellow) and two clear plastic 40 dram containers. These containers had lock-up caps which were coloured to match the chips and were slotted so that the chips could be easily passed through them. This simple binary-choice task follows that used by Yost, Siegel and Andrews (1962) and was selected in order to maintain active interest by subjects and to provide contingent feedback on performance. The number of chips in each container could also be checked against the responses on the answer sheet in order to ensure response accuracy. At the front of the room was a cassette tape recorder sitting on a table.

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[1]Blue and yellow were chosen since they are easily differentiated; no subject reported or demonstrated difficulty in color discrimination.

Table I

Mean Age and Locus of Control Score

for Each Subject Sample Group

Sample Group	N	AGE Mean (in months)	AGE S.D.	LOC Score Mean	LOC Score S.D.
abc					
MEB	15	137.80	6.19	20.33	4.03
SEB	15	138.20	5.62	19.80	1.70
CEB	15	136.80	4.34	19.80	2.18
MEG	15	137.47	3.83	19.27	2.63
SEG	15	139.20	4.77	21.00	2.85
CEG	15	138.33	7.42	20.33	2.87
MIB	15	138.60	4.44	12.33	2.44
SIB	15	137.20	5.20	11.60	1.59
CIB	15	139.67	5.35	11.53	2.56
MIG	15	136.40	3.52	12.27	2.60
SIG	15	139.73	3.94	12.00	1.85
CIG	15	136.46	3.83	11.73	1.67
Total sample	180	138	5.03	16.00	4.78

[a]Condition

M - Material
S - Social
C - Control

[b]Locus

E - External
I - Internal

[c]Sex

B - Boys
G - Girls

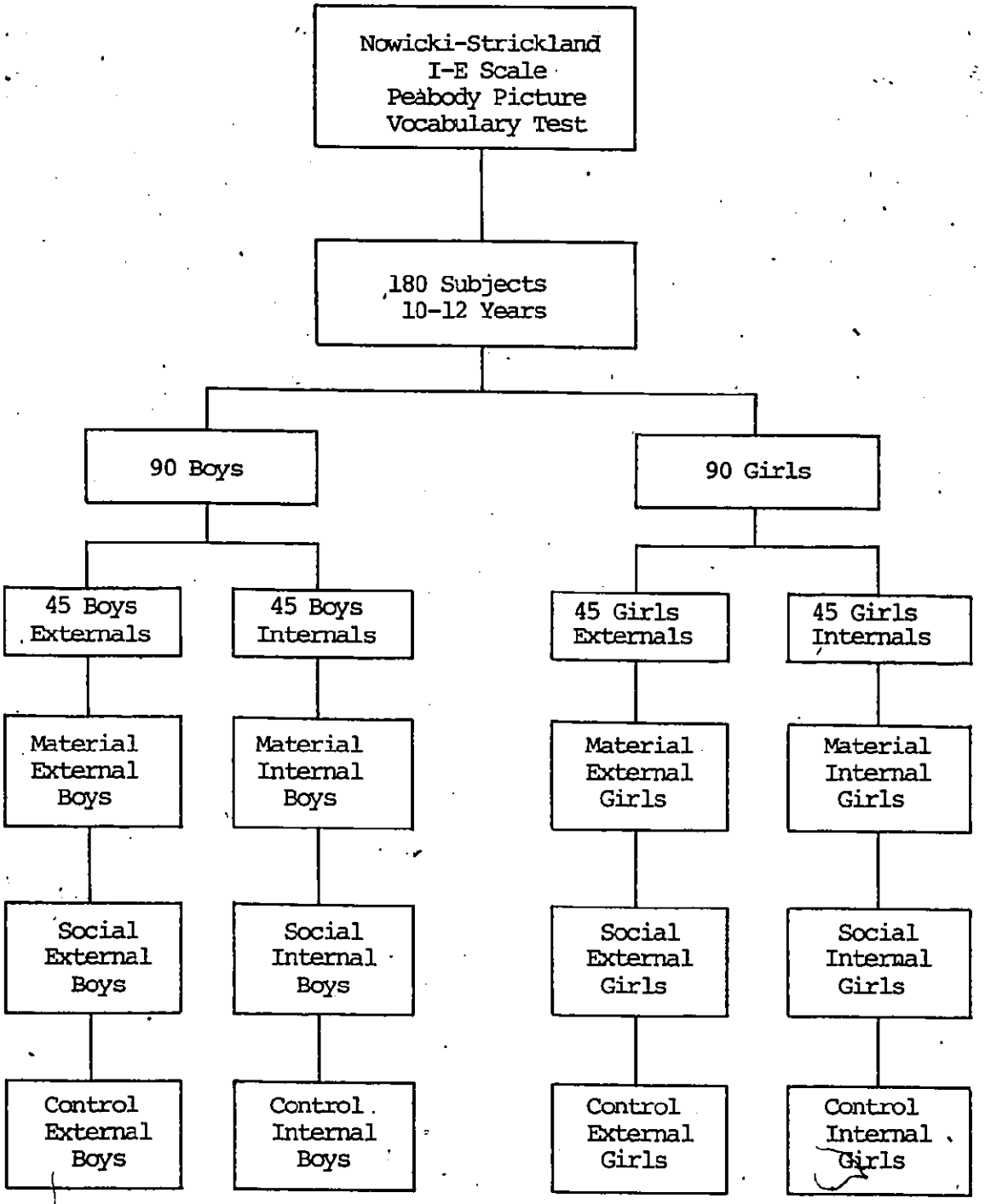

Figure 1 - Flow chart showing experimental design of study

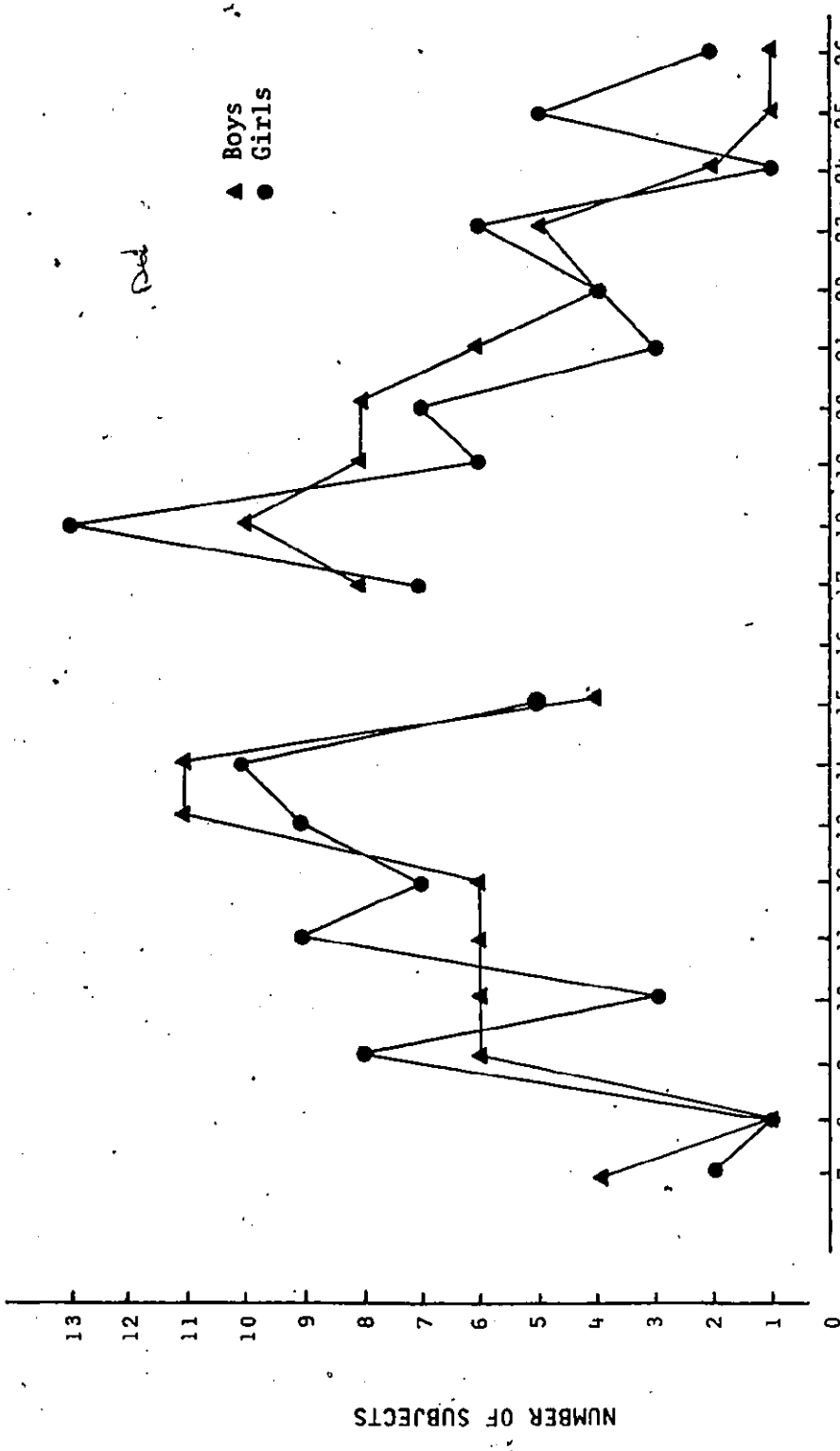

Figure 2 - Frequency Distribution of Locus of Control Scores by Sex in Sample Group

All instructions and choices for the probability learning task were recorded on tape by a professional actor in order to eliminate possible verbal instruction bias. Four tapes were used: one for each of the three incentive conditions and one for the probability learning task itself. Each group, therefore, heard two tapes (instructions and probability learning task) under identical conditions.

First, the sound level of the tape was checked and adjusted as necessary. Then instructions were played to the subjects, the tape stopped and any questions answered. Instructions were phrased in a neutral way in order to avoid any possible set towards skill/chance expectancy, achievement or outcome. They were as follows:

Control condition: "Today we will play a game of choices. In front of you are two plastic containers with coloured caps and between them is a pile of plastic chips which are also coloured. Try to guess what colour I say before I say it. If you choose blue, then put a blue chip in the blue container and circle blue on your answer sheet. If you choose yellow, then put a yellow chip in the yellow container and circle yellow on your answer sheet. Are there any questions?"

Social condition: Instructions were the same as for the control condition but with the following addition which was designed in order to generate the expectancy for a social reward: "Most young people do very well in this game and if you do well, I'm sure that people will find out about it and appreciate you for it. Are there any questions?"

Material condition: Instructions were the same as for the control condition but with the following addition which was designed to generate the expectancy for a material reward: "If you do well on this game, you

stand a good chance of winning a prize. Are there any questions?" Incentives were thus defined in non-specific terms in order to allow the subjects to translate their own expectancies concerning locus of control and incentive value into behaviour.

Finally, the probability learning task tape was played and the subjects given assistance as required during the first few trials. The tape went as follows:

> "Now, guess the colour I say before I say it. You will hear a number, then choose a colour by putting a coloured chip in the container with the same colour cap and then circling your choice on the answer sheet. Make sure you have made your choice before the bell sounds. Ready? Number one... (pause) ... (bell). The colour was yellow. Number two ..." etc.

Subjects were given eight seconds to make and record their responses before the bell signalled the end of each trial. There were five practice trials followed by one hundred trials divided into 10 x 10 blocks. All subjects had learned the task by the third practice trial. On each block of ten trials, the colour blue appeared randomly with a .70 probability (See Appendix E); that is, blue appeared seven times and yellow appeared three times per ten trial block; blue was not allowed to occur more than four times in succession.

Random reinforcement of subject responses was provided by the tape recording; the visibility of their choices on the answer sheet and in the transparent containers served as feedback, offering subjects information on their previous choices. The possibility of some subjects

changing their responses post hoc had been observed during the pilot study and anticipated during this procedure. Therefore, subjects were closely supervised by the examiner and an assistant so that correction of responses to fit the response schedule was virtually impossible. A check of all protocols showed that no subjects marked their choices as correct or incorrect; a later check comparing protocol responses to the reinforcement schedule found no consistency. The number of chips in each container was counted and compared with responses on the answer sheet; no errors were found.

The probability learning task was such that successful responding depended upon the subject's attention, cognitive involvement and judgement. Put simply, the problem which confronted the subjects was how to successfully figure out which colour was coming next. Learning depended on the subject's attention to the frequency of occurence of the two colours, cognitive involvement in order to perceive and develop search strategies to maximize successful trials, and judgement in making the actual choices. As such, the task draws on cognitive problem-solving rather than concept acquisition skills. It was employed to see if there would be differential responding by subject groups under the various incentive conditions and whether they could learn appropriate strategies for maximizing response outcome.

The task was administered to groups of subjects on the basis of incentive condition; each group was randomly composed of subjects of both sexes and locus of control as determined prior to the probability learning phase of the experiment. All three conditions were run at each of the

schools at least once, depending on the size of the sample. Three spares (one each in MIB, CEG and CIB groups) had to be used when assigned subjects were absent on the day of testing; these substitutes were closely matched for sex and locus of control score with the absent subject. The time required to complete the task was approximately 35 minutes. Subject participation was enthusiastic; afterwards, subjects frequently commented spontaneously that the task was enjoyable indicating a high level of co-operation.

Analysis of the Probability Learning Task

It had initially been anticipated that the number of blue chips in the blue container would be used as the dependant variable, since a pilot study had demonstrated that children at this age were able to perform this task easily and accurately. However, in two schools, a few subjects accidentally put a yellow chip in the blue container, or vice versa. Moreover, because of the lock-top nature of the container, it was impossible for them to easily correct this response. Subjects reported their error, and were instructed to continue with the task. A later check found that the number of chips in their containers matched the number of blue responses on their answer sheets. However, because this presented a possible source of error, the responses on the answer sheet were used as the dependant variable. These were tabulated into 10 x 10 blocks for analysis.

Statistical Design

Analyses of variance were performed on the data using 2 (Locus of Control) x 2 (Sex of Subject) x 3 (Incentive Condition) x 10 (Trial Blocks) as factors. The level of significance was selected as $p < .05$. Aggregate procedures from the S.P.S.S. manual were used for the tabulation of strategies over all factors and crosstabulation for the distribution of strategies across the different groups (See Appendix F).

Hypotheses

Based on the review of the literature, it is expected that:

(a) Internal locus of control children make more blue choices than external locus of control children on the probability learning task.

(b) Internal locus of control children make fewer blue choices than external locus of control children during the initial trials.

(c) Social incentives improve the performance of both locus of control groups more than material incentives.

(d) External locus of control children make more blue choices under incentive conditions than internal locus of control children under incentive conditions.

(e) The matching strategy (seven blue choices per trial block) will be used more frequently by the internal locus of control children than by the external locus of control children.

(f) The maximizing strategy (nine or ten blue choices per trial block) will be used most frequently by the external locus of control children than by the internal locus of control children.

The following section will present the data analysis and results of the experiment.

PRESENTATION OF RESULTS

This section will present the statistical analyses of the study including explanatory tables and figures, as well as a presentation of the strategies used by subjects to solve the probability learning task.

Data Analyses

Total data analysis. A 2(Locus of Control) x 2(Sex of Subject) x 3(Incentive Condition) x 10(Trial Block) analysis of variance (repeated measures) was performed on the data (See Table II). This revealed a significant main effect of BLOCKS ($F = 45.3601$; $df = 9,152$; $p < .001$) with a lack of statistical significance in the remaining main effects and interactions. This indicated that, irrespective of incentive condition, sex or locus of control, all subjects learned to select the most highly reinforced choice more frequently as the trial blocks progressed. An examination of the graphic presentation (See Figure 3) showed that the external boys were performing at a higher rate than internal boys in nine out of ten trial blocks and higher than all other groups in five out of the initial six blocks. Moreover, the boys group was performing at the extremes in relation to the girls groups over the initial two trials.

Analysis of sample extremes. Because of the possibility of sampling error which might have accounted for the lack of significant difference between groups, locus of control was more narrowly defined by

Table II

Analysis of Variance of Total Data

Source	df	Sums of Squares	Mean Squares	F	p
Between:					
LOC	1	5.7800	5.7800	.9142	n.s.
SEX	1	.6422	.6422	.1016	n.s.
LOC x SEX	1	15.6800	15.6800	2.4801	n.s.
COND	2	2.3433	1.1717	.1853	n.s.
LOC x COND	2	31.9900	15.9950	2.5299	n.s.
SEX x COND	2	19.2678	9.6339	1.5238	n.s.
LOC x SEX x COND	2	1.0300	.5150	.0815	n.s.
ERROR 1	168	1062.1467	6.3223		
Within:					
BLOCK	9	645.8022	71.7558	45.3601	<.001
LOC x BLOCK	9	12.9200	1.4356	.9075	n.s.
SEX x BLOCK	9	11.1911	1.2435	.7860	n.s.
LOC x SEX x BLOCK	9	10.5533	1.1726	.7412	n.s.
COND x BLOCK	18	34.7678	1.9315	1.2210	n.s.
LOC x COND x BLOCK	18	32.1433	1.7857	1.1288	n.s.
SEX x COND x BLOCK	18	12.3989	.6888	.4354	n.s.
LOC x SEX x COND x BLOCK	18	24.7700	1.3761	.8699	n.s.
ERROR 2	1512	2391.8533	1.5819		

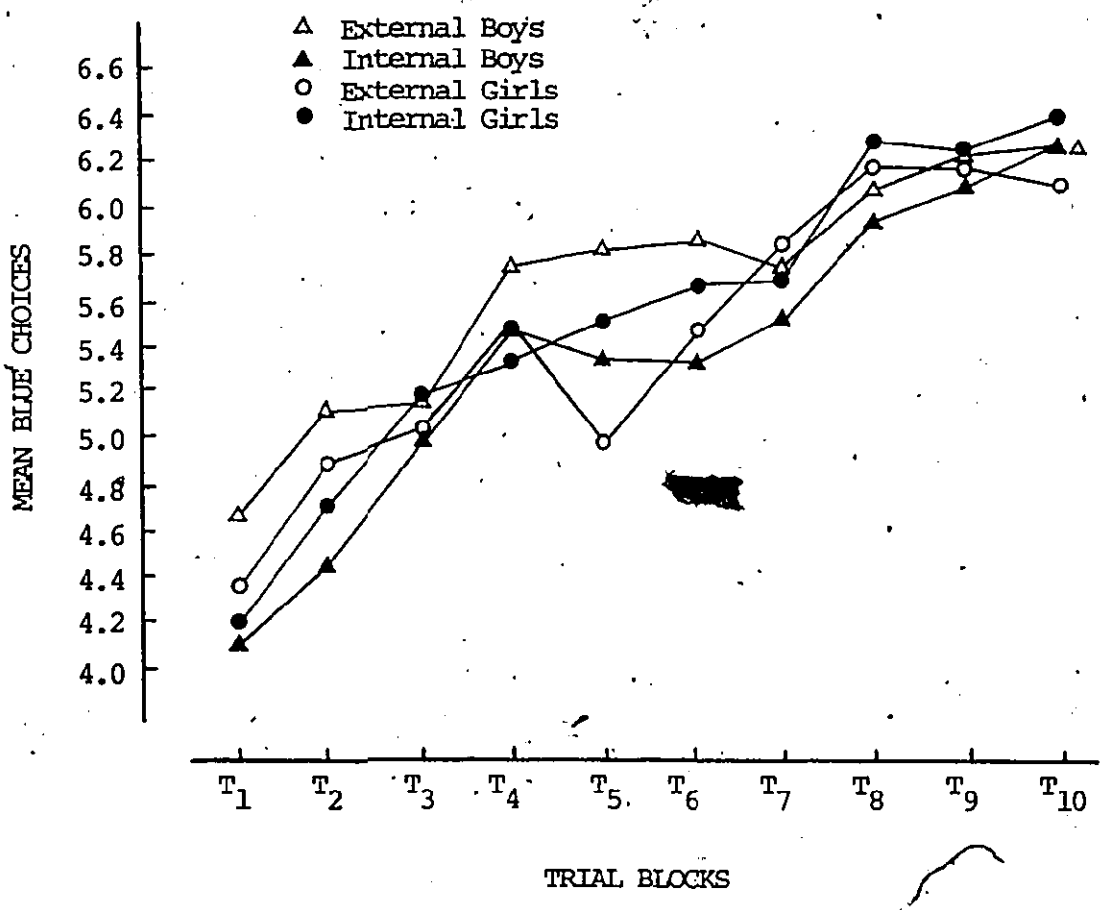

Figure 3. Mean Frequency of Blue Choices of Subjects, Showing the LOC x SEX Interaction over Ten Trial Blocks

widening the median split to ± one standard deviation of the median score following Nowicki (1976), and reanalyzing the data. In this way, it was hoped that differences between the internal and external groups would be more sharply contrasted. Again, there were no statistically significant differences between groups ($p < .10$).

Analysis of the last five trial blocks. Since previous research had shown that initial differences can be concealed within an overall analysis and an examination of these present data suggested this possibility, it was felt that there was sufficient conceptual justification for doing a multiple comparison among means. The trial blocks were then broken down into two groups consisting of the first five and last five trial blocks, and subjected to a 2(LOC) x 2 (SEX) x 3 (COND) x 5(BLOCK) analysis of variance. Over the last five trial blocks, there was again a significant main effect of BLOCKS ($p < .001$), but no statistical significance in the remaining main effects and interactions (See Appendix G).

Analysis of the first five trial blocks. Over the first five trial blocks, the significant main effect of BLOCKS was again observed ($p < .001$). In addition, there was a significant LOC x SEX interaction ($F = 4.1488$; $df = 1,168$; $p < .01$) confirming the previous observation of the external boys' high rate of responding in relation to other groups, and also the variability in the boys group. External boys ($\bar{X} = 5.33$) selected blue more frequently than all other groups ($\bar{X} = 4.95$) during these five trials (See Table III and Figure 3). Because of these results and the suggestions in the graphic presentation that other differences between groups may have existed, analyses of variance were performed on each of these trial blocks.

Table III

Analysis of Variance Over the First Five Trial Blocks

Source	df	Sums of Squares	Mean Squares	F	p
Between:					
LOC	1	7.4711	7.4711	2.3917	n.s.
SEX	1	4.5511	4.5511	1.4569	n.s.
LOC x SEX	1	12.9600	12.9600	4.1488	<.01
COND	2	2.6600	1.3300	0.4258	n.s.
LOC x COND	2	15.6956	7.8478	2.5122	n.s.
SEX x COND	2	3.6822	1.8411	0.5894	n.s.
LOC x SEX X COND	2	3.4200	1.7100	0.5474	n.s.
ERROR 1	168	524.8000	3.1238		
Within:					
BLOCK	4	171.1067	42.7767	27.3458	<.001
LOC x BLOCK	4	7.7511	1.9378	1.2388	n.s.
SEX x BLOCK	4	4.5378	1.1344	0.2520	n.s.
LOC x SEX x BLOCK	4	5.7511	1.4378	0.9191	n.s.
COND x BLOCK	8	8.5067	1.0633	0.6798	n.s.
LOC x COND x BLOCK	8	17.7822	2.2228	1.4210	n.s.
SEX x COND x BLOCK	8	2.9289	0.3661	0.2340	n.s.
LOC x SEX x COND x BLOCK	8	13.2356	1.6544	1.0576	n.s.
ERROR 2	672	1051.2000	1.5643		

The first trial block showed a significant main LOC effect ($F = 4.5133$; $df = 1,168$; $p < .05$) indicating that externals ($\bar{X} = 4.50$) chose blue more frequently than internals ($\bar{X} = 4.133$; See Appendix G). This main LOC effect was maintained on the second block ($F = 3.8818$; $df = 1,168$; $p < .05$) with externals ($\bar{X} = 5.02$) again outperforming the internals ($\bar{X} = 4.63$). The second trial block also showed a slight LOC x COND interaction which failed to reach statistical significance ($F = 2.9027$, $df = 2.168$; $p < .10$), but which hinted at a differential incentives effect on performance (See Appendix G). Across both trial blocks, the F score of the main LOC effect increased ($F = 8.3833$; $df = 1,168$; $p < .01$) and a significant LOC x COND x BLOCK interaction was also found ($F = 3.0010$; $df = 2,168$; $p < .05$). The BLOCKS main effect was again significant ($p < .001$). These data are presented in Table IV and Figures 4 and 5. Based on these findings, it would appear that on the probability learning task used in this study, subjects were initially responsive to incentive conditions. Externals scored higher than internals under all incentives, but were most responsive under control conditions; internals were most responsive under social incentive conditions. There was no statistical significance between the performance of boys and girls groups.

There were no statistically significant differences on trial blocks three or four ($p < .10$; See Appendix G).

On the fifth trial block, there was a significant LOC x SEX interaction ($F = 5.1229$; $df = 1,168$; $p < .05$), and a slight main SEX effect

Table IV

Analysis of Variance Over First Two Trial Blocks

Source	df	Sums of Squares	Mean Squares	F	p
Between:					
LOC	1	12.8444	12.8444	8.3833	<.01
SEX	1	.4000	.4000	.2611	n.s.
LOC x SEX	1	4.9000	4.9000	3.1981	<.10
COND	2	2.7056	1.3528	.8829	n.s.
LOC x COND	2	2.1056	1.0528	.6871	n.s.
SEX x COND	2	.1167	.0583	.0381	n.s.
LOC x SEX x COND	2	6.6500	3.3250	2.1702	n.s.
ERROR 1	168	257.4000	1.5321		
Within:					
BLOCK	1	23.5111	23.5111	15.0567	<.001
LOC x BLOCK	1	.0111	.0111	.0071	n.s.
SEX x BLOCK	1	.2778	.2778	.1779	n.s.
LOC x SEX x BLOCK	1	.4000	.4000	.2562	n.s.
COND x BLOCK	2	.2389	.1149	.0765	n.s.
LOC x COND x BLOCK	2	9.3722	4.6861	3.0010	<.05
SEX x COND x BLOCK	2	.1389	.0694	.0445	n.s.
LOC x SEX x COND x BLOCK	2	2.7169	1.3583	.8699	n.s.
ERROR 2	168	262.3333	1.5615		

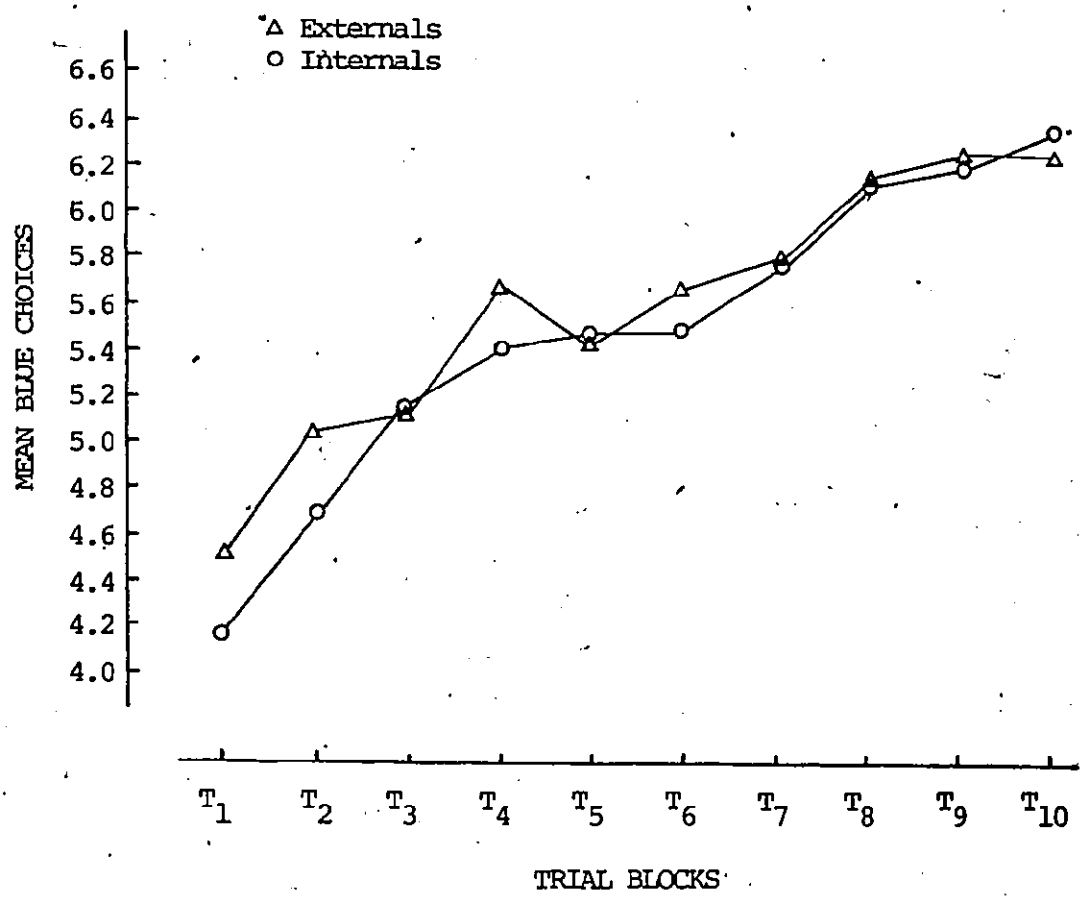

Figure 4. Mean Frequency of Blue Choices by Internal and External Subjects over Ten Trial Blocks.

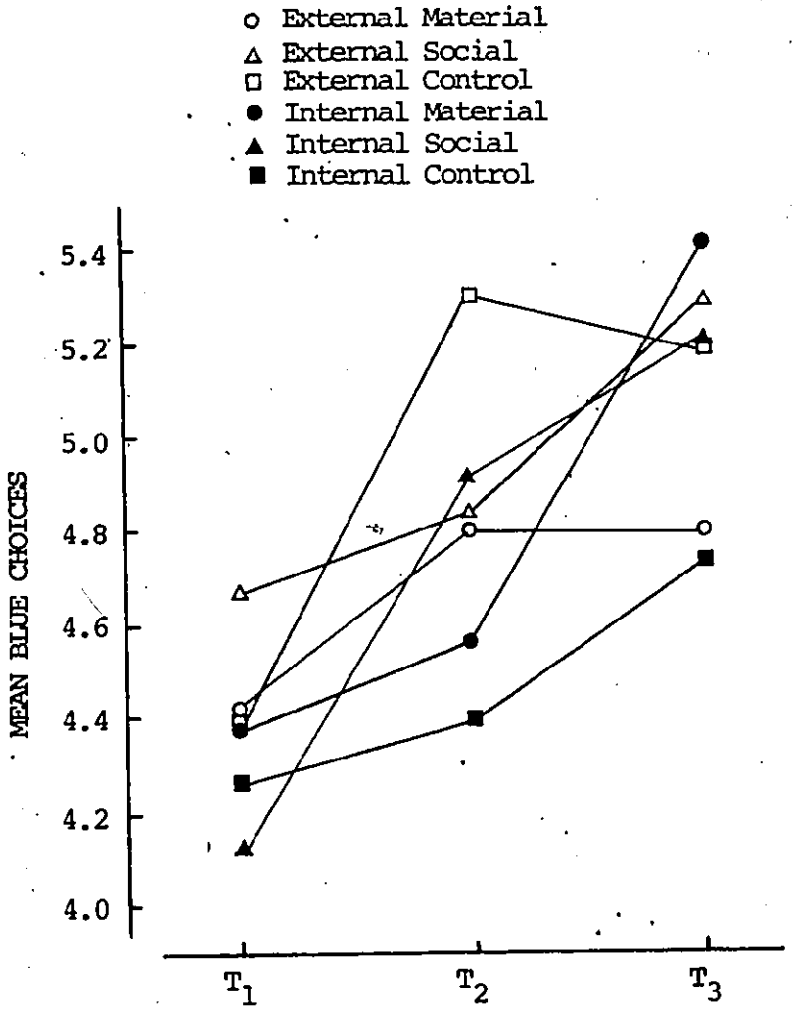

Figure 5. Mean Frequency of Blue Choices by Subjects showing the LOC x COND Interaction over $T_1 - T_3$

which failed to reach statistical significance ($F = 2.7550$; $df = 1,168$; $p < .10$). During this trial, external boys ($\bar{X} = 5.84$) chose blue more frequently than other groups ($\bar{X} = 5.30$), continuing the trend suggested by Figure 3 and the ANOVA over the first two trial blocks (See Table V).

On the probability learning task used in this study, all subjects learned to increase their choice of the most frequently occuring event. There were significant differences between locus of control subjects on each of the first two trials, with externals outperforming internals. Across these two trials, there was also a differential incentives effect with externals showing a higher rate of performance under all incentives than internals, but especially under control (no incentive) conditions, while internals performed best under social incentive conditions. Across the first five trial blocks, external boys significantly outperformed other subject groups; there were no significant differences over the last five trial blocks.

Strategies

Strategies used by each sample group across trial blocks were then examined. Operational definitions for each strategy were as follows: probability matching (MAT) was defined as any trial block score of seven, which exactly matched the occurence of blue per trial block; maximizing (MAX) was defined as any trial block score of nine or ten, since this was well above the probability of occurence of blue and thus indicated a consistent use of that choice within any trial block; the

Table V

Analysis of Variance of the Fifth Trial Block

Source	df	Sums of Squares	Mean Squares	F	p
Between:					
LOC	1	.1389	.1389	.0632	n.s.
SEX	1	6.0500	6.0500	2.7550	<.10
LOC x SEX	1	11.2500	11.2500	5.1229	<.05
COND	2	4.7444	2.3722	1.0802	n.s.
LOC x COND	2	8.3444	4.1722	1.8999	n.s.
SEX x COND	2	.4333	.2167	.0987	n.s.
LOC x SEX x COND	2	2.4333	1.2167	.5540	n.s.
ERROR 1	168	368.9333	2.1960		

alternating strategy (ALT) was defined as any trial block score from one to five, since this was well below the probability of occurence of blue and indicated an alternation of choice between blue and yellow within any trial block. Any trial block score of six or eight was not included in order to eliminate categorization of borderline strategies so that the defined categories would remain discrete. Aggregate and cross tabulation procedures were then used to tabulate strategies over all factors and to show the distribution of strategies across groups. Data was subjected to the chi square test using a log-linear transformation model developed by Biomedical Computer Programs (1978) and was graphed for descriptive analysis. Descriptive and non-parametric analyses were used since the data did not meet the requirements for univariate analysis because of the small number of subjects in each cell.

The chi square test showed a significant BLOCK effect ($X^2 = 615.17$; $df = 10$; $p < .001$) indicating that as a group, subjects changed their use of strategies over trial blocks. Moreover, there was a significant BLOCK x STRATEGY interaction ($X^2 = 111.97$; $df = 37$, $p < .001$) showing that the ALT strategies were used more frequently than MAT or MAX strategies (See Figure 6). All higher order interactions failed to reach the required level of significance.

During the first trial blocks virtually all subjects (86.11%) utilized alternating strategies, but with each subsequent trial used them less, while increasing the use of the MAT and MAX strategies. Over all trials the mean use of ALT strategies was 49.78%, the mean use of the

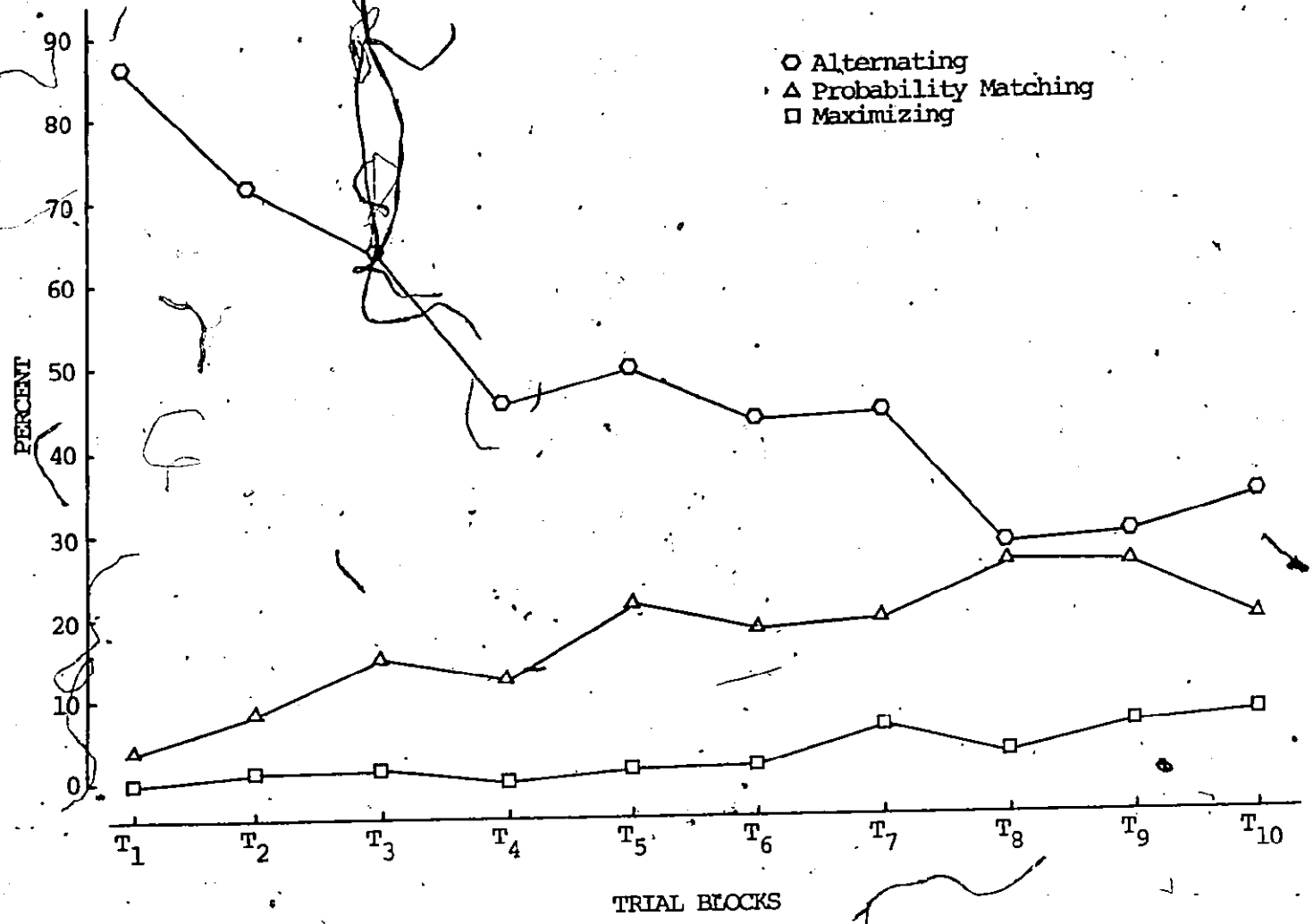

Figure 6. Percent of Subjects using Scorable Alternating, Probability Matching and Maximizing Strategies over all Trial Blocks.

MAT strategy was 17.17%, while the mean use of the MAX strategy was 2.89%. External boys more quickly dropped the ALT strategies and began to use the more successful MAT strategies than did other subjects (See Figure 7) which seems to corroborate the previously reported LOC and SEX differences in performance. Although there were no consistent differences between choice of strategy while under the various incentive conditions, the external boys under control conditions used the ALT strategy less frequently (35.33%) than all other groups while the internal girls under control conditions used it more frequently (58.00%) than all other groups (See Figure 8).

This section has presented the results of the statistical and descriptive data of the study and the implications of these findings will be discussed in more detail in the section which follows.

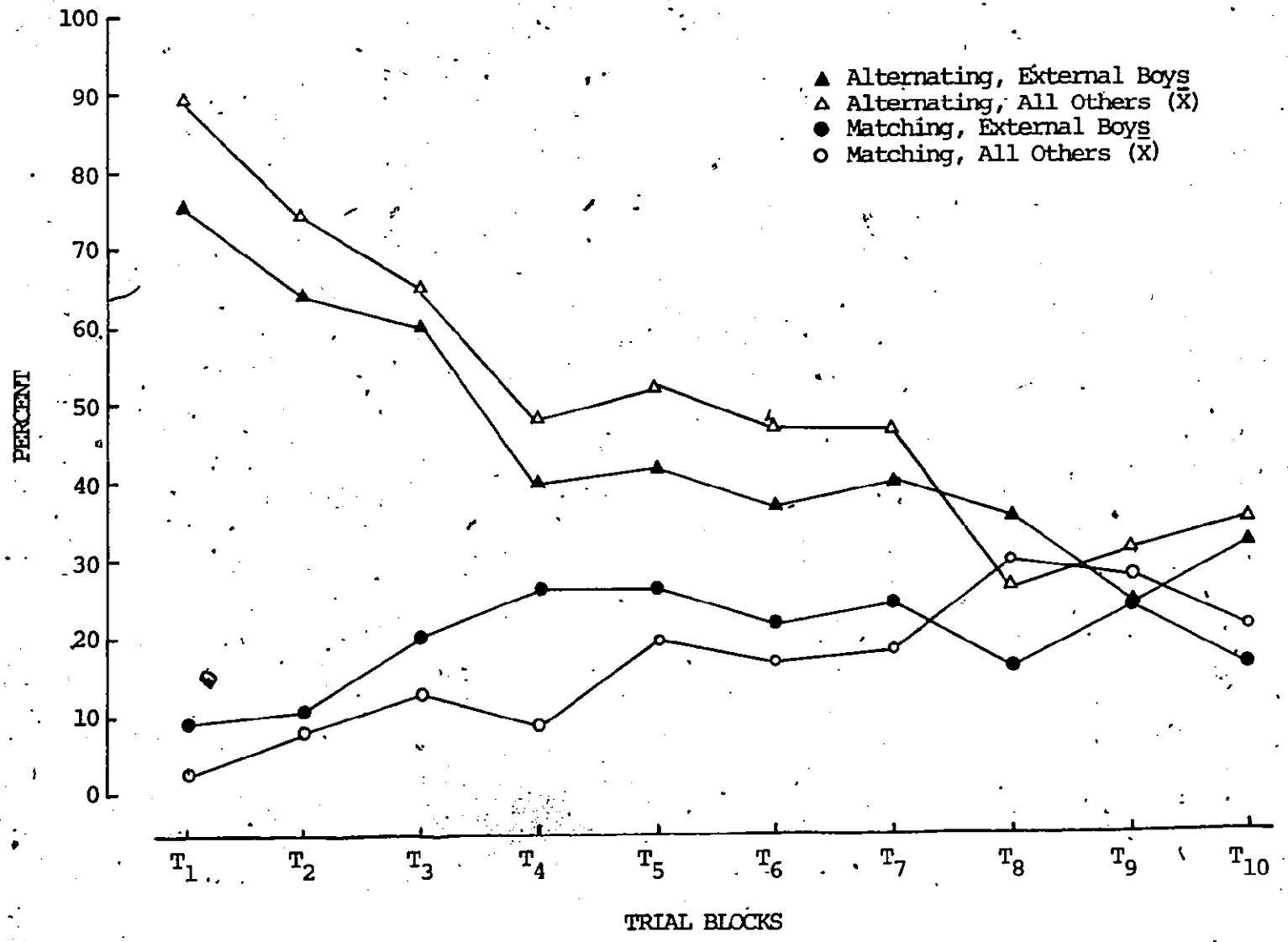

Figure 7. Percent Use of Scorable Alternating and Matching Strategies by External Boys Compared with All Others.

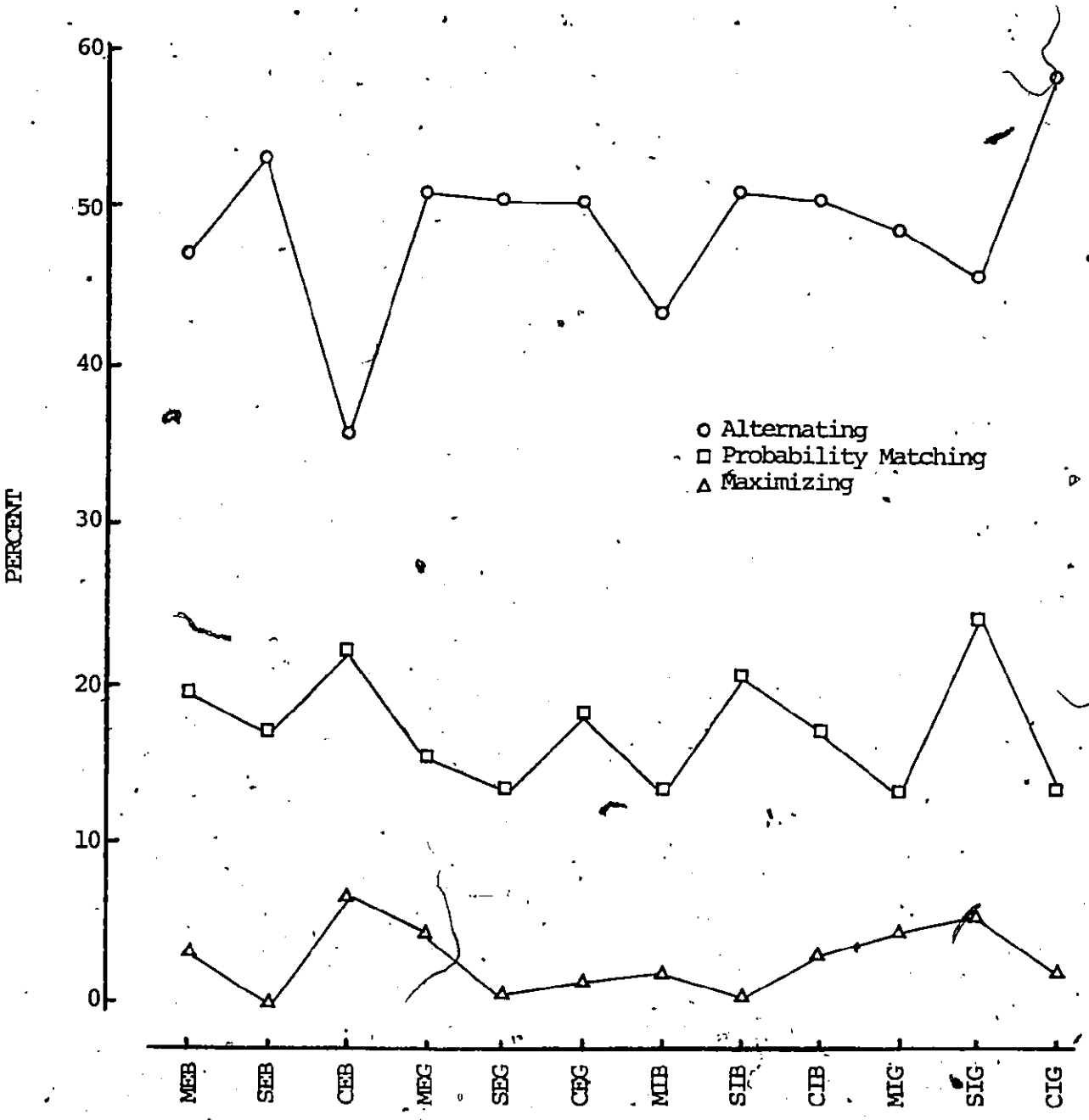

Figure 8. Percent of Subject Groups using Scorable Strategies over All Trials.

DISCUSSION

This section will present a discussion and interpretation of the findings and relate them to the hypotheses as outlined earlier in the thesis.

Main Effects

Main effect of locus of control. A significant ($p < .05$) main effect of locus of control was present on each of the first two trials blocks, with externals performing at a higher level than internals on the probability learning task. Following these trials, there were no significant main LOC effects on subject performance, indicating that after the first twenty trials, the differences between the performance of internals and externals became non-significant. Internals did not show overall superiority as predicted by the literature and during the initial phases of the task, the externals outperformed them. This would seem to be in contradiction with the body of literature which has outlined how internals are better able to attend to information - giving cues and are more persistent in problem-solving, and should therefore be more successful than externals (Phares, 1976; Lefcourt, 1976). However, these findings are not without precedent and will be examined in two steps: first, the differential initial learning response, and second, the lack of differences between groups over all trials.

Differential initial responses have been found between internals and externals on a variety of tasks. Baron and Ganz (1972) found that internals did less well than externals on a form discrimination task when given both verbal and visual feedback. Studies by Rotter and Mulry (1965), Lefcourt and Wine (1968), Julian and Katz (1968), and Kneavel (1978) found differences in initial approaches to tasks which involved such skills as observation, attention to detail, judgement and decision making. These studies also found the externals initially somewhat better than the internals, but the internal's slower, deliberate approach resulted in greater improvement and variation in performance in relation to the externals. Similar skills are also required for successful responding on probability learning tasks which demand attention and cognitive involvement on the part of the subject in order to develop solutions which will maximize response outcome.

Studies have shown that preadolescent children tend to alternate in their choice of solutions during problem-solving (Weir, 1964). A parallel cognitive style is also typical of the internal locus of control child, whose approach is not only curious and inventive, but also more attentive and conservative than the external child (Phares, 1976). These internal children seem to generate a variety of inventive solutions which are occasionally reinforced, but the testing of these hypotheses with each trial initially leads to many errors and a lower success rate. Moreover, internals are more likely to enter the probability learning task believing that the solution will be skill-determined and under these circumstances tend to show more concern and

anxiety about successful outcome (Ryckman and Rodda, 1971; Lefcourt, Lewis and Silverman, 1968; Rotter and Mulry, 1965). In these ways, the internal child at this age level seems to be at an initial disadvantage, reflected in an initial lower rate of successful responding.

The external child, who is less cognitive in his approach, seems to be able to follow the cues without the interference of excessive strategy-formation. He is also freer to note the repetitive frequency of blue and is reinforced for its choice more frequently. It is as though the externals at this age level become conditioned to the more frequent occurence of blue and search no further as described by Lewis (1966) and Weir (1964), while the internals persist in their hypothesis-testing and are more resistant to conditioning (Kneavel, 1978; Strickland, 1970; Johnson, Ackerman, Frank and Fionda, 1968; Lefcourt and Wine, 1968). Externals are also more likely to perceive the solution to the task as being chance-determined and, therefore, experience less anxiety-interference (Ryckman and Rodda, 1971; Lefcourt, Lewis and Silverman, 1968); thus, externals seem to learn faster and are initially more successful at the task.

The higher initial success rate of the externals tends to reinforce their choices more frequently and to maintain them at a moderately successful level. Meanwhile, the more self-motivated internals continue to search for and eventually find successful solutions which reflect more complex cognitive processes and also lead to a more precise understanding of the task itself. In this way, both the internals and externals are reinforced for their own particular cognitive

styles: externals for their "lucky guessing" and internals for their thoughtful searching. Therefore, susceptibility to conditioning and dependency on external cues, plus the minimal utilization of cognitive hypothesis-testing would appear to provide higher initial levels of reinforcement and successful problem-solving for external subjects at this age level. In school achievement situations, where the thoughtful, cognitive and self-motivated approach is fostered, internal children would clearly be at an advantage. On the other hand, tasks involving immediate or snap judgements based on external cues, such as sorting or classifying, might be best handled by externals.

This finding is consistent with the literature dealing with the qualitative aspects of the problem-solving skills of both internals and externals. It suggests that with this type of task, locus of control set can differentially affect initial performance; however, it does not account for the reasons why differences in the predicted direction failed to materialize over all trials. An understanding of this phenomenon may involve theoretical frameworks other than Rotter's social learning theory and is discussed in the following section.

Learning theorists have commonly observed that under neutral instructions and partial reinforcement schedules (as used in this study), subjects on probability learning tasks seem to persist in choosing the less frequently reinforced event, even after several hundred trials (Anderson, 1960). Consequently the number of successful responses is

much less than if subjects had consistently chosen the most frequently reinforced event. This reflects the continued use of alternating strategies with these subjects in spite of the fact that maximizing would result in a higher level of success; this has already been observed in the present study and in the literature on problem solving in children (Weir, 1964). The explanation for this is of some controversy among learning theorists.

Social learning theorists such as Rotter (1966; Rotter, Chance and Phares, 1972) would posit that locus of control would play a major part in the maintenance of alternating behaviours. According to this viewpoint, internals should persist longer at exploring for a successful solution to a probability learning task, especially if they view the task as requiring some degree of skill, before shifting to maximizing; the reverse would be true for externals. Lawrence and Festinger (1962) deal with this issue in terms of cognitive dissonance; partial reinforcement leads to cognitive dissonance during unreinforced trials, but task behaviour continues because the subject is reinforced part of the time and giving up would result in dissonance with this reality. Others (Sheffield, 1949; Capaldi, 1966) hypothesize the effect as being due to the persistence of a response which has been reinforced for a long period of time after the reinforcement has taken place.

Causal attribution theory (Rest, 1976; Weiner, 1972; Weiner, Heckhausen, Meyer and Cook, 1972) proposes that the subject's behaviour on any reinforcement schedule will determine his beliefs about the causes

of the reinforcements or non-reinforcements. Studies into subject behaviour under various reinforcement schedules has shown that different schedules of reinforcement lead the subject to make different kinds of causal explanations for task outcome. For example, causality may be attributed to the reinforcement schedule itself, to luck, personal ability or individual effort. Weiner (1972) argues that the skill-chance dimension (Rotter's locus of control dimension) is actually confounded by a stable -- unstable dimension so that changes in expectancy are not caused by locus of control factors alone, but also by beliefs about stability (i.e., degree of task difficulty, personal ability) and instability (i.e., amount of effort, luck). The stability or instability and internality or externality of these attributions will determine task persistence.

Moreover, random partial reinforcement schedules have been found to lead to unstable luck attributions which result in relatively small expectancies for change in task outcome and a greater resistance to response extinction. Therefore, subjects under this kind of schedule will tend to persist longer in the use of a least frequently reinforced event, which results in a low level of successful responding. It is important to note too that many trials of a random schedule must occur before the subject perceives the task outcome as due to unstable luck factors (Rest, 1976).

If, after a number of trials, subjects would begin to attribute their failures or successes to luck rather than skill factors, attribution theory would predict that they would persist longer at the

task without "giving up" their complex hypothesis-testing to maximizing. This effect would apply to all subjects if all received identical reinforcement schedules, and would result in similar levels of expectancy for reinforcement and outcome. It should also result in similar levels of performance across subjects.

It may be, therefore, that subjects in the present study were affected by at least two kinds of factors. First, they entered the task with their locus of control set, in which their general expectancy for successful outcome in this novel situation depended on their own skill or on chance factors as described previously (Phares, 1976; Rotter and Mulry, 1965). Their initial responses would be based on this set, and on any additional factors such as instructions or the anticipation of a valued reinforcer following the task. This study confirmed that differential responding was apparent in trial blocks one and two, as expected by social learning theory. Secondly, once subjects began to realize that the trials provided only partial reinforcement of their choices, their expectancy for successful outcome in this specific context would diminish. Attribution theory suggests that subjects would then begin to alter their attribution for success or failure to that in which unstable luck factors predominated, thus neutralizing their initial general expectancies, especially for the internals. If this is so, then similar levels of performance should be seen following the initial trials, irrespective of locus of control or incentive condition. The lack of differential performance was observed during this study. Additionally, since the subjects' expectancy for potentially receiving a reward would be diminished in proportion

to their success rate, the motivational effects of the incentives (if any) would become very low, and possibly secondary to the more immediate reinforcement of correct choices. This diminished incentives effect was observed during this study and has also been documented by Witryol (1971); it will be discussed in a later section.

Main effect of trial blocks. A significant ($p < .001$) main effect of blocks was present throughout the ten blocks of ten trials, regardless of sex, incentive condition or locus of control. This indicates a continuous learning effect for all groups over all trials at a fairly uniform rate and is a phenomena commonly observed in human learning.

While there is some evidence to suggest that late elementary school children prefer blue over other colours (Staples, 1932) it is unlikely that this would have resulted in a low initial choice of blue and a uniform increase in the choice of this colour across all groups. Rather, subjects seemed to be responding to the frequency of occurence of blue in conjunction with partial reinforcement for its selection; in fact, many subjects were able to exactly match their responses to this frequency per trial block.

However, the previous analyses and descriptive data shows that the rate of learning for each group was not identical. First, an examination of Figure 4 demonstrates that over the first two trial blocks the externals initially learned at a significantly faster rate than internals, although their performance was erratic; while it appears that asymptote was reached by T_2, this group showed a second burst of learning after T_3, with what appears to be a second asymptote at T_4. This

suggests that although initially faster, the externals seemed to be behaving in a reactive, almost impulsive way causing them to miss essential cues which then lowered their rate of success. Meanwhile, the more deliberate and cognitive internals continued to learn at a slower but more even rate, which eventually met that of the externals by T_5, after which their rates of learning were approximately the same.

Secondly, Figure 3 shows that within the external boys there was more variation in performance than within the internals. It was the external boys who initially performed at a higher level than all other groups during five of the initial six trials. They also scored higher than the internal boys over all but the last trial block. It would appear that the combination of being both external and male at this age level may place a child at a slight advantage on simple problem-solving tasks. While not fully explained, it may be that the cultural expectations for boys to be less inhibited and more adventuresome plays in synchrony with the less cognitive orientation of the externals and results in subjects who are more easily conditioned to making blue choices.

Thirdly, the performance of the boy and girl externals was more erratic and variable than internals as a group. Figure 3 shows that learning for the internals proceeded at a steady pace, with an even and gradual slope showing little variation between boys and girls. However, the externals' curves are jerky and uneven, showing several wide variations between the boys and girls. This observation is supportive of the locus of control literature which describes the internals as being

more careful and cognitively involved before making decisions (Julian and Katz, 1968; Lefcourt, Lewis and Silverman, 1968; Rotter and Mulry, 1965) while the externals seem more easily influenced by the reinforcement schedule and their dependency on external cues (Deever, 1968). These data also suggest slight sex differences within the external group.

Thus, while the main effect of BLOCKS shows steady learning across groups, the descriptive data and the previous analyses indicate differential sex and locus of control effects which result in different learning curves during the early trial blocks.

Interaction Effects

Interaction of locus of control x condition x block. A significant three way interaction effect ($p < .05$) between locus of control and incentive condition was found over the first two trial blocks. This interaction is a complex one which requires some elucidation. It confirms the main locus of control effects described above, and consolidates the argument for differences in performance over the initial trial blocks on factors other than locus of control alone. That is, subjects on this task clearly responded differently to the various incentive conditions and this affected their performance on the probability learning task. At the same time, since the F score is marginal, and these effects were not present following the initial trials or in the descriptive data, it is possible that their overall validity is questionable.

Any interpretation of this interaction should be done with caution, bearing in mind that the findings may not be as strong as they appear. Nevertheless, a manipulation of the reinforcement value of incentives was the focus of this study, and the findings may still be important in the study of initial learning.

According to social learning theory, if expectancy for reinforcement and situation remain constant, then changes in reinforcement value should result in changes in behaviour potential (Rotter, 1966). During this study, non-specific material and social incentives were offered to subjects under standard conditions; since differential initial performance resulted, these incentives must have had reinforcement value for subjects and were motivating for them at the onset of the task.

Externals were more sensitive to all incentives than were the internals. This is in keeping with Phares (1976), Taub and Dollinger (1975) and Lefcourt, Lewis and Silverman (1968) who have reported that externals are more dependent on extrinsic reinforcers in order to do well. It is also consistent with the Kneavel (1978), Strickland (1970) and Deever (1968) studies which indicate that internals are more self-reliant and resistant to experimenter influence. Similarly, Taub and Dollinger (1975) found that internals were less affected by incentives, while the performance of externals was improved by the use of rewards.

Internals seemed most influenced by social incentive conditions, and for this group the anticipation of positive social responses seems to be more highly motivating than material incentives or no incentive.

This is in keeping with the developmental studies on the decreasing value of material incentives with increasing age as described by Witryol, Tyrrel and Lowden (1965) and with a broad body of literature on the social development of children at this age level (Hurlock, 1972). In spite of the previously described intrinsic motivation and autonomy of the adult internals (Deever, 1968), internal children seem to function somewhat better if they anticipate some kind of social recognition for their successes.

Externals, although sensitive to social and material incentives, tended to give more responses when under control (non-incentive) conditions. This indicates that control externals somehow "caught on" to the task faster than other groups; it was also this group which used a higher proportion of MAT strategies which provided them with a higher level of success. This finding is especially interesting since externals are usually considered to be more dependent on external cues and reinforcements in order to do well (Taub and Dollinger, 1975; Lefcourt, Lewis and Silverman, 1968) and under control conditions these would appear to be absent. It may be that in the absence of stated directions, anticipated experimenter or teacher approval was perceived and acted upon by the externals and this may have served as a more powerful incentive for this group than either material or social conditions. That is, left with no particular stated reason for doing the task and based on prior experience, the control externals would have presumed that there would be some form of extrinsic reinforcement; in this context, the most logical place from which this might be delivered would be some authoritative person such as the experimenter, his assistant or

the teacher. This is consistent with Phares (1976) who explains that the lack of explicit instructions allows subjects to react in their own characteristic fashion as externals or internals. This might also tend to compound the motivational effects of the other incentive conditions and account for some of the differences in performance between internal and external groups.

Incentive conditions did not differentially affect subject performance following the initial trials, and this issue deserves further discussion. Since incentives did have an impact on the subjects' early performance and not later on, it is possible that the value of the incentives did not remain constant as the task proceeded. The non-specific nature of the incentives, for example, may not have been powerful enough to sustain differences between groups following the initial trials. The literature in this regard is inconclusive, with studies reporting that non-specific incentives both are (Coady and Brown, 1978; Morris and Coady, 1974) and are not (Bastien, 1976) effective incentives. These same incentives were able to differentially influence the problem-solving behaviour of fifty subjects in a pilot study prior to this research. The general literature on incentives has found incentives to be effective in influencing behaviour (Witryol, 1971) but not with all age groups. Lewis, Wall and Aronfreed (1963) and McCullers and Stevenson (1960) found no incentives effects with late elementary school children. These studies did not, however, predict or more closely examine initial learning effects which might have occurred since experimental methodology has generally focussed on static statis-

tical relationships rather than on sequential effects along a temporal dimension. As mentioned previously, Witryol's (1971) review of the incentives literature noted that incentives effects often diminish following the initial few trial blocks.

A further explanation might be that the expectancy for actually receiving the incentives diminished in response to the perceived outcome, and thus had a less immediate impact on behaviour. As the probability task proceeded, subjects would be increasingly confronted with the fact that their choices were not correct 100% of the time, nor was a solution easy to find. Therefore it may have seemed increasingly unlikely that they would be able to obtain the reward, thus diminishing generalized expectancy for success and also incentives effectiveness.

The probability learning task itself, with its occasional reinforcement of correct responses served to sustain high interest and enthusiasm by subjects. During this study no subject exhibited boredom; in fact, most were highly enthusiastic about continuing the task beyond the one hundred trials and many wanted to return on another occasion. It is possible, even likely, that the reinforcement value of finding a solution to the task began to exceed that of the incentives so that it became the task itself and not the anticipation of the incentive which was of greater reinforcement value to subjects.

In addition to these possibilities, attribution theory offers a plausible alternative. While the novelty of possibly receiving a reward may have helped to influence initial enthusiasm and motivation

(Witryol, 1971), subjects quickly become aware that success or failure on a trial was not a function of their own skill, but rather due to luck, or chance or the reinforcement schedules which were beyond their control. Weiner, Heckhausen, Meyer and Cook (1972) describe how, after the initial trials, subjects come to attribute their outcomes as due to unstable luck factors. Roughly translated into Rotter's social learning theory framework, this would suggest that increased experience with a task leads to lessening impact of reinforcement and reinforcement value, and would thus result in similar levels of performance for all subjects. If this view holds, it would be expected that more constant personality characteristics such as locus of control and sex-role behaviour should persist longer across trials than the transient anticipation of a non-specific reinforcer. In fact, that seems to be what took place during this study; as trials progressed the incentives effects quickly diminished while locus of control and sex effects continued to differentially influence performance until mid-task, after which there were no significant differences between groups.

This area is one which requires further study through empirical research into initial learning, possibly by using a series of short tasks (e.g. concept acquisition, perceptual discrimination, probability learning, digit cancelling, etc.) under various incentive conditions in order to clarify the issue. Replication of this study using a neutral task which is less intrinsically reinforcing (such as digit cancelling) would also help to verify these findings.

Interaction of locus of control x sex. Moderate levels of significance were found in the locus of control x sex interactions over the first two trial blocks ($p < .10$) and the first five trial blocks ($p < .01$). While these failed to reach the required levels of statistical significance, their persistence throughout the first half of the probability learning task and the superiority of the performance of the external boys (Figure 3) as described previously, merits cautious consideration. Moreover the ANOVA of the fifth trial block shows a significant ($p < .05$) locus of control x sex interaction and slight main sex effect ($p < .10$), adding strength to the suggestion that sex differences may be important in the problem-solving performance of internal and external children at this age level.

Strategies

In the discussion thus far the statistical and descriptive presentations have indicated that in spite of the overall lack of results, there may be initial differences in learning as a function of locus of control, incentive condition and possibly sex role variables. An advantage of selecting a probability learning task for this type of research is that it also offers a closer examination of the cognitive strategies used by subject groups to solve the task (Weir, 1962). That is, by looking at the trial block performance, it can be seen how subjects respond to the reinforcement schedule -- if they are maximizing, probability matching or alternating in their approach to the task (Goulet and Goodwin, 1970; Lewis, 1966; Restle, 1962). Studies have shown

that age is a factor in the choice of strategy, with younger children tending to maximize (Jones and Liverant, 1960; Stevenson and Weir, 1964). Adolescents and adults seem to begin a task with alternating strategies, but eventually return to the maximizing responses seen in young children since it provides a higher level of successful responses (Weir, 1964; Lewis, Wall and Aaronfreed, 1963; Crandall, Solomon and Kellaway, 1961). Most studies focus on the strategies used by subjects over the last several trial blocks, or following asymptote (Goulet and Goodwin, 1970; Weir, 1964) rather than across trials. The present study will examine these strategies as they emerged across trial blocks in order to demonstrate that at this age level, subjects are flexible and responsive to the reinforcement schedule.

An analysis of the strategies used by the 180 grade six subjects in this study showed that, as a group, they initially used ALT strategies in attempting to solve the probability learning task. They also modified their strategies with each subsequent trial block in response to both the demands of the task and the rates of reinforcement which each strategy provided. Although the MAX strategy would have provided the highest success rate, most of the subjects were still too cognitively immature to use it; instead, subjects tended to guess and to change strategies in response to the random pattern of reinforcement. This is supportive of Weir's (1964) finding of developmental changes in the use of strategies with increasing age, with the alternating strategies being most common at this age level. It is also in keeping with Piaget's description of children at the late concrete operational period (Inhelder

and Piaget, 1958).

There were no clear indications of consistent use of one particular strategy over all trial blocks; rather, the subjects in this study seemed to be in a transition stage between the ALT approach described by Weir (1964) in late childhood and the more complex MAT and MAX strategies seen in teenagers and adults. Within each trial block there was a steady increase in the use of the MAT strategies, and later, a slight increase in the MAX strategy across blocks with a continuous decline in the use of ALT strategies. Maximizing strategies were rarely used by subjects in this study. Clearly, subjects at this age level are sensitive, flexible and responsive to the demands of the probability learning task. Differences in strategy in relation to locus of control, sex and incentive condition were suggested by the descriptive data, but impossible to determine through the use of inferential statistics because of the small number of subjects in each cell.

The previously reported initial differences in responding between subject groups was facilitated by a decreasing use of the ALT strategies in conjunction with an increased use of the MAT strategy. As a group, externals more quickly dropped the ALT strategies over the first two trials than did the internals. This was especially so for the CEB group, whose ability to focus concretely on the task provided them with superior performance over all other subjects in five of the six initial trials. Over all trials, this group had the lowest percentage of ALT strategies (35.33%), the highest percentage of MAX strategies (7.33%)

and the second highest percentage of MAT strategies (22.00%). This suggests that this group were less explorative and cognitive in their search for strategies, while being more responsive and more easily conditioned to the occurence of blue than were other groups. The CIG group seemed more cognitively involved with the task; over all trials this group had the highest percentage of ALT strategies (58.00%). Their relative preoccupation with finding a correct solution to the task, however, resulted in a lower responsivity to the occurence of blue as demonstrated in their low percentage of MAT (12.67%) and MAX (2.00%) strategies.

In spite of the cultural expectations for boys to be more adventurous and active, and girls to be more inhibited, very few studies with children report sex differences in problem-solving performance at this age level. One possible exception is McGhee and Crandall (1968) who found that self-responsibility for academic failure was a better predictor for boys, while self-responsibility for success was a better predictor for girls on the Intellectual Achievement Questionnaire. Others (Lessing, 1969; Crandall, Katkovsky and Preston, 1962) found no sex differences at this age. Similarly, when viewed as isolated variables during the present study, no differences are discernable in choice of strategy by boys and girls, internals and externals. However, the interaction between them seems to generate a potentiating effect, especially under non-incentive conditions when subjects tend to react in their own characteristic fashion (Phares, 1976), and this seems most apparent in the external boys and internal girls. That is, in the ab-

sence of any instructional or motivational set, internal girls tended to persist at developing and rejecting a variety of hypotheses, while external boys tended to notice the repetitive frequency of blue and responded to it without the same degree of exploration or alternate solutions.

The following section will present the summary and conclusions of the study; in addition, suggestions will be made for future exploration.

Summary and Conclusions

This study examined the effects of locus of control and non-specific material and social incentives on a probability learning task using grade six pupils as subjects. The review of the literature indicated that locus of control was a learned, generalized expectancy for control of reinforcement and develops towards increasing internality with maturity provided that positive and facilitative environmental experiences are present. External subjects perceive rewards as contingent on luck, chance, fate or powerful others; internals perceive rewards as being under their own control. A number of scales have been developed to measure locus of control in both children and adults.

The literature on incentives suggested that incentives can influence child behaviour on experimental tasks but that the value of the incentive itself depends on prior experience with the reward, as well as the context in which it is offered. While material incentives have

been found to be of value to preschoolers and young children, social kinds of incentives seem to assume more value by the late elementary years.

A two-choice probability learning task was chosen as the dependent variable since they have been widely used as a method of studying problem-solving behaviour in children and adults. The tasks are simple, ego-involving and responsive to a wide latitude of possible independent variables from which inferences about developmental changes can be made across age. They also offer an opportunity to examine the subject's awareness of the response schedule and the strategies used to maximize successful outcome.

Subjects were first screened using the Peabody Picture Vocabulary Test and the Nowicki-Strickland I-E Scale, and then randomly assigned to one of twelve cells. The probability learning task consisted of 100 trials of anticipating the occurence of two colours and was administered to groups of up to fifteen students on the basis of treatment condition. Their responses were recorded on an answer sheet and were analyzed in 10 x 10 trial blocks.

The study was unable to demonstrate that incentives can have a significant impact on the problem-solving behaviour of internal and external grade six boys and girls. The inherent methodological difficulties of using a probability learning task, which itself seemed to be intrinsically reinforcing for the subject group, made it difficult to draw clear conclusions concerning the impact of incentives or locus of control on behaviour. While subjects entered the unfamiliar task with a generalized expectancy for outcome based on their locus of control set, experience

with the task gradually created a situation in which they realized that success was impossible. Within this context, their specific expectancies for outcome seemed to diminish over trials, thus neutralizing the differences between groups and resulting in overall lack of significant results. However, it does seem to support Rotter's notion of the efficacy of generalized expectancies in novel situations, with limited predictability for expectancy following experience within a specific situation.

When examined more closely, differential effects on initial performance were found. Significant locus of control effects were seen in trial blocks one and two, with externals outperforming the internals. This was interpreted as a difference in initial learning of the task, with the less cognitive orientation of the externals enabling them to more readily note the occurence of the events, while the internal's attempts at finding a correct solution to the task lowered their rate of successful outcome.

Across the first two trial blocks there was a significant incentives and locus of control effect, with externals learning faster than internals under all incentive conditions, but especially under non-incentive conditions. This was interpreted in terms of the external's dependency on extrinsic reinforcers, and as the result of an anticipated reinforcer from the examiner or a teacher arising from the projected expectations of the more dependent externals under non-incentive conditions. Internals scored higher under social incentive conditions; both groups did poorest under material incentives, which is in keeping with the decreasing value of material incentives in combination with the surge of interpersonal awareness, at this age level.

A moderately significant locus of control x sex of subject interaction was found over the first five trial blocks, with the external boys

outperforming all other groups. This was seen as a possible potentiating effect between the non-cognitive approach of the externals and the adventuresome nature of the boys which resulted in a greater susceptibility to noticing and conditioning to the occurrence of the most frequently occurring event.

Viewed sequentially along a temporal dimension, this study suggests that various effects may occur throughout the course of a research study which may be overlooked in the overall analysis. During this study it seemed that as trials progressed the incentives effects quickly diminished while locus of control and sex effects continued to differentially influence performance until mid-task, after which there were no significant differences between groups. This was explained in terms of the transient novelty effect of the non-specific incentives, Rotter's social learning theory and causal attribution theory.

In their use of strategies, all sample groups began by predominantly using alternating strategies but gradually introduced probability matching with each subsequent trial block. Maximizing strategies were rarely used by subjects in this study. This was seen as indicating subject sensitivity and flexibility with respect to the task and is typical of children who are in the pre-adolescent transition period between concrete and formal, abstract logic. Internal girls and external boys showed wide variability in their choice of strategies under non-incentive conditions, with the CEB group showing a very low proportion of complex, search strategies (alternating) and CIG showing the reverse. This added to the suggestion of a potentiating effect between locus of

control and sex of subject under neutral conditions within these two groups.

Recommendations for Future Research

This study illustrates that late-elementary schoolchildren appear to be in a transition period with respect to sex-role expectations, incentives value and problem-solving strategy formations. Many studies have reported differences in these areas, both above and below this age level; it may be that these children are in a period of psychological change which is preceeded and followed by more stable periods during which research findings can be more clearly differentiated. If this is so, then a developmental study examining the interaction between locus of control and incentives could be a valuable one.

In the course of such developmental research, attention might focus on aspects relating to initial learning responses. This could be done using a variety of short tasks tapping a broader range of behaviours under various incentive conditions in order to more fully understand this potentially important aspect of human learning. An examination of the subject's choice of response as a function of the reinforcement schedule itself may also reveal differential locus of control, sex or incentive effects. The use of a two-choice probability learning task appeared to be of some intrinsic reinforcement value to subjects during this study and may have contributed to the lack of significant differential effects; therefore, this task may not be the most appropriate

task to use in future studies of this kind. These investigations will necessitate larger numbers of subjects and more complex analyses than were within the scope of this study, but might discover significant findings which could be both theoretically and practically relevant to the study of learning.

The use of incentives in child research has yet to be systematically explored. Studies have tended to focus on the minute reward values of specific rewards, while overlooking the impact of personality variables, experience with the rewards, delivery of rewards and context in which they are offered. In spite of general trends, very little is actually known about the developmental changes in incentive value with increasing age; moreover, incentives have yet to be carefully defined and applied in ways so that the interpretation of the results of various studies can be compared. The differential effects of non-specific and concrete incentives on performance must also be investigated.

The examination of the problem-solving strategies generated during probability learning and other tasks is one which should be exploited by developmentalists. It has the potential of providing valid, transferable data which can be collected using a variety of independent variables, and is intriguing to both subject and researcher alike. Here too, cognitive strategies have not been clearly defined, differentiated, and adequately integrated with psychological theory. The use of a larger sample population would allow a more detailed analysis of the use of strategies and the changes in the use of strategies in response

to various independent variables. Consideration must also be given to the literature on contingent and non-contingent feedback, reinforcement schedules and other such task variables as they relate to incentive and personality effects on performance. For example, a non-random reinforcement schedule might result in different patterns of strategy use than was seen in the present study.

Finally, the results of this study reinforce the view that any examination of cognitive problem-solving must consider that solutions develop within a sequential, temporal dimension. By focussing exclusively on static statistical relationships, important qualitative or descriptive data which may amplify the quantitative data, may be overlooked. This area is expecially relevant in studies with children and should be incorporated into future designs.

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APPENDIX A

LETTER TO PARENTS AND PERMISSION SLIP

Dear Parent of Guardian,

Your child's class is being invited to become part of a research study investigating how children learn. It will take about 30 minutes of class time in each of two sessions over a period of a week so that regular schoolwork will not be disrupted.

The first session will consist of a questionnaire which will help to determine some of the children's attitudes and does not inquire about personal or family matters. The second session will be a simple learning game which children everywhere seem to enjoy.

Please sign the permission slip below and return it to the teacher in order that your child may be included in the study group.

Thank you for your co-operation.

Sincerely yours,

John R. Swaine, M.A.
Research Director

My child _____, (Date of birth)

_____ has my permission to participate in Mr. Swaine's study on how children learn.

_____
Signature

PLEASE RETURN BY WEDNESDAY, NOVEMBER 9th, 1977

APPENDIX B

RECORD FORM FOR GROUP ADMINISTRATION OF
THE PEABODY PICTURE VOCABULARY TEST

Name: _____ Grade: _____

School: _____

Teacher's name: _____

Circle one: boy girl

Today's date: Year: _____ Month: _____ Day _____

Birthdate: Year: _____ Month: _____ Day _____

Instructions:

On the screen you will see a series of number slides, each one having four numbered pictures on it. You will hear a word, then try to identify the picture which goes with the word you hear. When you have decided, put an X through one of the four numbers beside the slide number on the answer sheet. Here are some practice ones:

Slide Number	Answer
A.	1 2 3 4
B.	1 2 3 4
C.	1 2 3 4

Raise your hand if you have any questions.

Slide Number	Answer	Slide Number	Answer	Slide Number	Answer
50	1 2 3 4	71	1 2 3 4	92	1 2 3 4
51	1 2 3 4	72	1 2 3 4	93	1 2 3 4
52	1 2 3 4	73	1 2 3 4	94	1 2 3 4
53	1 2 3 4	74	1 2 3 4	95	1 2 3 4
54	1 2 3 4	75	1 2 3 4	96	1 2 3 4
55	1 2 3 4	76	1 2 3 4	97	1 2 3 4
56	1 2 3 4	77	1 2 3 4	98	1 2 3 4
57	1 2 3 4	78	1 2 3 4	99	1 2 3 4
58	1 2 3 4	79	1 2 3 4	100	1 2 3 4
59	1 2 3 4	80	1 2 3 4	101	1 2 3 4
60	1 2 3 4	81	1 2 3 4	102	1 2 3 4
61	1 2 3 4	82	1 2 3 4	103	1 2 3 4
62	1 2 3 4	83	1 2 3 4	104	1 2 3 4
63	1 2 3 4	84	1 2 3 4	105	1 2 3 4
64	1 2 3 4	85	1 2 3 4	106	1 2 3 4
65	1 2 3 4	86	1 2 3 4	107	1 2 3 4
66	1 2 3 4	87	1 2 3 4	108	1 2 3 4
67	1 2 3 4	88	1 2 3 4	109	1 2 3 4
68	1 2 3 4	89	1 2 3 4	110	1 2 3 4
69	1 2 3 4	90	1 2 3 4		
70	1 2 3 4	91	1 2 3 4		

Now, put down your pencil and wait for further instructions.

APPENDIX C

THE NOWICKI-STRICKLAND INTERNAL-EXTERNAL SCALE FOR CHILDREN, WITH EXTERNAL RESPONSES UNDERLINED

PREVIOUSLY COPYRIGHTED MATERIAL

IN APPENDIX C, LEAVES 120 to 122,

NOT MICROFILMED

120 - 122 - The Nowicki-Strickland Internal-External Scale for Children.

APPENDIX D

ANSWER SHEET FOR PROBABILITY LEARNING TASK

Name: _____ Date: _____

Teacher's name: _____ Grade: _____

School: _____

	Choice			Choice			Choice			Choice	
1	B	Y	27	B	Y	53	B	Y	79	B	Y
2	B	Y	28	B	Y	54	B	Y	80	B	Y
3	B	Y	29	B	Y	55	B	Y	81	B	Y
4	B	Y	30	B	Y	56	B	Y	82	B	Y
5	B	Y	31	B	Y	57	B	Y	83	B	Y
6	B	Y	32	B	Y	58	B	Y	84	B	Y
7	B	Y	33	B	Y	59	B	Y	85	B	Y
8	B	Y	34	B	Y	60	B	Y	86	B	Y
9	B	Y	35	B	Y	61	B	Y	87	B	Y
10	B	Y	36	B	Y	62	B	Y	88	B	Y
11	B	Y	37	B	Y	63	B	Y	89	B	Y
12	B	Y	38	B	Y	64	B	Y	90	B	Y
13	B	Y	39	B	Y	65	B	Y	91	B	Y
14	B	Y	40	B	Y	66	B	Y	92	B	Y
15	B	Y	41	B	Y	67	B	Y	93	B	Y
16	B	Y	42	B	Y	68	B	Y	94	B	Y
17	B	Y	43	B	Y	69	B	Y	95	B	Y
18	B	Y	44	B	Y	70	B	Y	96	B	Y
19	B	Y	45	B	Y	71	B	Y	97	B	Y
20	B	Y	46	B	Y	72	B	Y	98	B	Y
21	B	Y	47	B	Y	73	B	Y	99	B	Y
22	B	Y	48	B	Y	74	B	Y	100	B	Y
23	B	Y	49	B	Y	75	B	Y	101	B	Y
24	B	Y	50	B	Y	76	B	Y	102	B	Y
25	B	Y	51	B	Y	77	B	Y	103	B	Y
26	B	Y	52	B	Y	78	B	Y	104	B	Y
									105	B	Y

APPENDIX E

PROBABILITY LEARNING TASK RESPONSE SCHEDULE,
SHOWING TEN TRIAL BLOCKS AND THE RANDOM OCCURANCE
OF BLUE RESPONSES WITH .70 PROBABILITY

	Choice
1	B (Y)
2	(B) Y
3	B (Y)
4	(B) Y
5	(B) Y
6	B (Y)
7	(B) Y
8	B (Y)
9	(B) Y
10	(B) Y
11	B (Y)
12	(B) Y
13	(B) Y
14	(B) Y
15	(B) Y
16	B (Y)
17	(B) Y
18	(B) Y
19	(B) Y
20	B (Y)
21	B (Y)
22	(B) Y
23	(B) Y
24	(B) Y
25	(B) Y
26	B (Y)

	Choice
27	(B) Y
28	(B) Y
29	(B) Y
30	B (Y)
31	(B) Y
32	(B) Y
33	(B) Y
34	B (Y)
35	(B) Y
36	B (Y)
37	B (Y)
38	(B) Y
39	(B) Y
40	(B) Y
41	B (Y)
42	(B) Y
43	(B) Y
44	(B) Y
45	(B) Y
46	(B) Y
47	B (Y)
48	(B) Y
49	(B) Y
50	B (Y)
51	(B) Y
52	(B) Y

	Choice
53	(B) Y
54	B (Y)
55	(B) Y
56	(B) Y
57	(B) Y
58	(B) Y
59	(B) Y
60	B (Y)
61	B (Y)
62	(B) Y
63	B (Y)
64	(B) Y
65	(B) Y
66	(B) Y
67	(B) Y
68	(B) Y
69	(B) Y
70	B (Y)
71	(B) Y
72	(B) Y
73	(B) Y
74	B (Y)
75	B (Y)
76	(B) Y
77	(B) Y
78	B (Y)

	Choice
79	(B) Y
80	B (Y)
81	(B) Y
82	B (Y)
83	(B) Y
84	(B) Y
85	(B) Y
86	(B) Y
87	(B) Y
88	B (Y)
89	(B) Y
90	(B) Y
91	(B) Y
92	B (Y)
93	(B) Y
94	(B) Y
95	B (Y)
96	(B) Y
97	B (Y)
98	(B) Y
99	(B) Y
100	(B) Y
101	B (Y)
102	(B) Y
103	(B) Y
104	B (Y)
105	(B) Y

APPENDIX F

CROSSTABULATION ANALYSIS OF STRATEGY CHOICE BY SUBJECT GROUPS

CROSSTABULATION: TRIAL BLOCK ONE

Strategy		Group											
		MEB	SEB	CEB	MEG	SEG	CEG	MIB	SIB	CIB	MIG	SIB	CIG	Totals %
ALT	Row %	7.7	7.1	7.1	9.0	6.5	9.0	9.7	8.4	8.4	8.4	9.7	9.0	
	Total %	7.4	6.7	6.7	8.6	6.1	8.6	9.2	8.0	8.0	8.0	9.2	8.6	95.1
MAT	Row %	25.0	0.0	25.0	0.0	0.0	0.0	0.0	12.5	12.5	12.5	0.0	12.5	
	Total %	1.2	0.0	1.2	0.0	0.0	0.0	0.0	0.6	0.6	0.6	0.0	0.6	4.9
MAX	Row %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Total %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Column %	8.6	6.7	8.0	8.6	6.1	8.6	9.2	8.6	8.6	8.6	9.2	9.2	100.0

$X^2 = 10.3216$, df = 10; p = 0.5017

CROSSTABULATION: TRIAL BLOCK TWO

Strategy		Group											
		MEB	SEB	CEB	MEG	SEG	CEG	MIB	SIB	CIB	MIG	SIG	CIG	Totals %
ALT	Row %	6.9	9.2	6.2	9.2	8.5	7.7	10.0	7.7	10.0	8.5	6.9	9.2	
	Total %	6.1	8.2	5.4	8.2	7.5	6.8	8.8	6.8	8.8	7.5	6.1	8.2	88.4
MAT	Row %	0.0	0.0	33.3	0.0	13.3	13.3	0.0	20.0	0.0	0.0	20.0	0.0	
	Total %	0.0	0.0	3.4	0.0	1.4	1.4	0.0	2.0	0.0	0.0	2.0	0.0	10.2
MAX	Row %	0.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	
	Total %	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.4
	Column %	6.1	8.2	9.5	8.2	8.8	8.2	8.8	8.8	8.8	7.5	8.2	8.8	100.0

$X^2 = 34.94772$, df = 22; p = 0.0392

CROSSTABULATION: TRIAL BLOCK THREE

Strategy		Group												
		MEB	SEB	CEB	MEG	SEG	CEG	MIB	SIB	CIB	MIG	SIG	CIB	Totals %
ALT	Row %	9.6	7.8	6.1	10.4	7.8	8.7	8.7	7.8	9.6	7.7	6.1	10.4	
	Total %	7.6	6.3	7.9	8.3	6.3	6.9	6.9	6.3	7.6	5.6	4.9	8.3	79.9
MAT	Row %	3.7	18.5	11.1	3.7	3.7	11.1	7.4	7.4	11.1	7.4	14.8	0.0	
	Total %	0.7	3.5	2.1	0.7	0.7	2.1	1.4	1.4	2.1	1.4	2.8	0.0	18.8
MAX	Row %	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	50.0	0.0	0.0	
	Total %	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.7	0.0	0.0	1.4
	Column %	8.3	9.7	6.9	9.0	6.9	9.0	9.0	7.6	9.7	7.6	7.6	8.3	100.0

$X^2 = 21.40971$, df = 22; p = 0.4956

CROSSTABULATION: TRIAL BLOCK FOUR

Strategy		Group											
		MEB	SEB	CEB	MEG	SEG	CEG	MIB	SIB	CIB	MIG	SIG	CIG	Totals %
ALT	Row %	9.8	7.3	4.9	6.1	7.3	7.3	6.1	11.0	12.2	9.8	7.3	11.0	
	Total %	7.5	5.7	3.8	4.7	5.7	5.7	4.7	8.5	9.4	7.5	5.7	8.5	77.4
MAT	Row %	16.7	12.5	20.8	8.3	4.2	4.2	8.3	8.3	8.3	0.0	8.3	0.0	
	Total %	3.8	2.8	4.7	1.9	0.9	0.9	1.9	1.9	1.9	0.0	1.9	0.0	22.6
MAX	Row %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Total %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Column %	11.3	8.5	8.5	6.6	6.6	6.6	6.6	10.4	11.3	7.5	7.5	8.5	100.0

$X^2 = 13.14685$, df = 11; p = 0.2838

CROSSTABULATION: TRIAL BLOCK FIVE

Strategy		Group											
		MEB	SEB	CEB	MEG	SEG	CEG	MIB	SIB	CIB	MIG	SIG	CIG	Totals %
ALT	Row %	5.6	11.1	4.4	11.1	11.1	10.0	10.0	5.6	7.8	7.8	5.6	10.0	
	Total %	3.8	7.7	3.1	7.7	7.7	6.9	6.9	3.8	5.4	5.4	3.8	6.9	69.2
MAT	Row %	15.8	7.9	7.9	7.9	5.3	7.9	2.6	13.2	5.3	5.3	13.2	7.9	
	Total %	4.6	2.3	2.3	2.3	1.5	2.3	0.8	3.8	1.5	1.5	3.8	2.3	29.2
MAX	Row %	0.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0	
	Total %	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	1.5
	Column %	8.5	10.0	6.2	10.0	9.2	9.2	7.7	7.7	7.7	6.9	7.7	9.2	100.0

$X^2 = 24.80992$, df = 22; p = 0.3063

CROSSTABULATION: TRIAL BLOCK SIX

Strategy		Group												
		MEB	SEB	CEB	MEG	SEG	CEG	MIB	SIB	CIB	MIG	SIG	CIG	Totals %
ALT	Row %	6.3	8.9	6.3	7.6	8.9	8.9	10.1	11.4	10.1	5.1	5.1	11.4	
	Total %	4.3	6.1	4.3	5.2	6.1	6.1	7.0	7.8	7.0	3.5	3.5	7.8	68.7
MAT	Row %	9.4	15.6	6.3	6.3	6.3	3.1	9.4	9.4	6.3	9.4	12.5	6.3	
	Total %	2.6	4.3	1.7	1.7	1.7	0.9	2.6	2.6	1.7	2.6	3.5	1.7	27.8
MAX	Row %	0.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	
	Total %	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	3.5
	Column %	7.0	10.4	7.8	7.0	7.8	7.0	9.6	10.4	8.7	6.1	8.7	9.6	100.00

$X^2 = 26.91519$, df = 22; p = 0.2145

CROSSTABULATION: TRIAL BLOCK SEVEN

Strategy		Group											
		MEB	SEB	CEB	MEG	SEG	CEG	MIB	SIB	CIB	MIG	SIG	GIG	Totals %
ALT	Row %	8.8	7.5	6.3	10.0	6.3	8.8	6.3	7.5	12.5	10.0	5.0	11.5	
	Total %	5.6	4.8	4.0	6.3	4.0	5.6	4.0	4.8	7.9	6.3	3.2	7.1	63.5
MAT	Row %	14.3	5.7	11.4	5.7	14.3	8.6	5.7	8.6	0.0	8.6	8.6	8.6	
	Total %	4.0	1.6	3.2	1.6	4.0	2.4	1.6	2.4	0.0	2.4	2.4	2.4	27.8
MAX	Row %	0.0	0.0	18.2	27.3	0.0	0.0	0.0	0.0	18.2	9.1	27.3	0.0	
	Total %	0.0	0.0	1.6	2.4	0.0	0.0	0.0	0.0	1.6	0.8	2.4	0.0	8.7
	Column %	9.5	6.3	8.7	10.3	7.9	7.9	5.6	7.1	9.5	9.5	7.9	9.5	100.0

$X^2 = 26.46667$, df = 22; p = 0.2322

CROSSTABULATION: TRIAL BLOCK EIGHT

Strategy		Group												
		MEB	SEB	CEB	MEG	SEG	CEG	MIB	SIB	CIB	MIG	SIG	CIG	Totals %
ALT	Row %	10.0	14.0	8.0	6.0	8.0	10.0	8.0	10.0	10.0	6.0	6.0	4.0	
	Total %	4.9	6.9	3.9	2.9	3.9	4.9	3.9	4.9	4.9	2.9	2.9	2.0	49.0
MAT	Row %	4.3	6.4	4.3	10.6	4.3	8.5	10.6	6.4	10.6	10.6	12.8	10.6	
	Total %	2.0	2.9	2.0	4.9	2.0	3.9	4.9	2.9	4.9	4.9	5.9	4.9	46.1
MAX	Row %	40.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	10.0	0.0	
	Total %	2.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	4.9
	Column %	8.8	9.8	6.9	7.8	5.9	8.8	8.8	7.8	9.8	8.8	9.8	6.9	100.0

$X^2 = 19.89012$, df = 22; p = 0.5899

CROSSTABULATION: TRIAL BLOCK NINE

Strategy		Group												
		MEB	SEB	CEB	NEG	SEG	CEG	MIB	SIB	CIB	MIG	SIG	CIG	Totals %
ALT	Row %	7.5	9.4	3.8	5.7	13.2	3.8	7.5	11.3	9.4	9.4	5.7	13.2	
	Total %	3.5	4.4	1.8	2.7	6.2	1.8	3.5	5.3	4.4	4.4	2.7	6.2	46.9
MAT	Row %	6.3	6.3	10.4	6.3	6.3	12.5	6.3	10.4	12.5	4.2	12.5	6.3	
	Total %	2.7	2.7	4.4	2.7	2.7	5.3	2.7	4.4	5.3	1.8	5.3	2.7	42.5
MAX	Row %	8.3	0.0	25.0	25.0	0.0	8.3	8.3	0.0	0.0	8.3	8.3	8.3	
	Total %	0.9	0.0	2.7	2.7	0.0	0.9	0.9	0.0	0.0	0.9	0.9	0.9	10.6
	Column %	7.1	7.1	8.8	8.0	8.8	8.0	7.1	9.7	9.7	7.1	8.8	9.7	100.0

$X^2 = 23.09334$, df = 22; p = 0.3965

CROSSTABULATION: TRIAL BLOCK TEN

Strategy		Group												
		MEB	SEB	CEB	MEG	SEG	CEG	MIB	SIB	CIB	MIG	SIG	CIG	Totals %
ALT	Row %	8.1	11.3	4.8	6.5	11.3	9.7	11.3	8.1	4.8	9.7	8.1	6.5	
	Total %	5.4	6.3	2.7	3.6	6.3	5.4	6.3	4.5	2.7	5.4	4.5	3.6	55.9
MAT	Row %	8.6	5.7	5.7	14.3	5.7	11.4	5.7	11.4	14.3	2.9	8.6	5.7	
	Total %	2.7	1.8	1.8	4.5	1.8	3.6	1.8	3.6	4.5	0.9	2.7	1.8	31.5
MAX	Row %	14.3	0.0	7.1	7.1	7.1	7.1	7.1	7.1	7.1	14.3	14.3	7.1	
	Total %	1.8	0.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.8	1.8	0.9	12.6
	Column %	9.0	8.1	5.4	9.0	9.0	9.9	9.0	9.0	8.1	8.1	9.0	6.3	100.0

$X^2 = 11.62632$, df = 22; p = 0.9646

APPENDIX G

ANALYSIS OF VARIANCE TABLES

Analysis of Variance over Last Five Trial Blocks

SOURCE	df	Sums of Squares	Mean Squares	F	P
Between:					
LOC	1	.4444	.4444	.0824	n.s.
SEX	1	1.0000	1.0000	.1853	n.s.
LOC x SEX	1	4.0000	4.0000	.7414	n.s.
COND	2	12.2867	6.1433	1.1387	n.s.
LOC X COND	2	24.2822	12.1411	2.2503	n.s.
SEX x COND	2	18.5267	9.2633	1.7169	n.s.
LOC x SEX x COND	2	1.8200	.9100	.1687	n.s.
ERROR 1	168	906.4000	5.3952		
Within:					
BLOCK	4	71.4156	17.8539	12.3485	<.001
LOC x BLOCK	4	3.0333	.7583	.5245	n.s.
SEX x BLOCK	4	1.7444	.4361	.3016	n.s.
LOC x SEX x BLOCK	4	3.5222	.8806	.6090	n.s.
COND x BLOCK	8	13.6578	1.7072	1.1808	n.s.
LOC x COND x BLOCK	8	6.3733	.7967	.5510	n.s.
SEX x COND x BLOCK	8	6.5289	.8161	.5645	n.s.
LOC x SEX x COND x BLOCK	8	7.3244	.9156	.6332	n.s.
ERROR 1	672	971.6000	1.4458		

Analysis of Variance of the First Trial Block

SOURCE	df	Sums of Squares	Mean Squares	F	P
Between:					
LOC	1	6.0500	6.0500	4.5133	<.05
SEX	1	.6722	.6722	.5015	n.s.
LOC x SEX	1	1.2500	1.2500	.9325	n.s.
COND	2	1.0333	.5167	.3854	n.s.
LOC x COND	2	1.3000	.6500	.4849	n.s.
SEX x COND	2	.2111	.1056	.0787	n.s.
LOC x SEX x COND	2	5.2333	2.6167	1.9520	n.s.
ERROR 1	168	225.2000	1.3405		

Analysis of Variance of the Second Trial Block

SOURCE	df	Sums of Squares	Mean Squares	F	P
Between:					
LOC	1	6.8056	6.8056	3.8818	<.05
SEX	1	.0056	.0056	.0032	n.s.
LOC x SEX	1	4.0500	4.0500	2.3101	n.s.
COND	2	1.9111	.9556	.5450	n.s.
LOC x COND	2	10.1778	5.0889	2.9027	<.10
SEX x COND	2	.0444	.0222	.0127	n.s.
LOC x SEX x COND	2	4.1333	2.0667	1.1788	n.s.
ERROR 1	168	294.5333	1.7532		

Analysis of Variance of the Third Trial Block

SOURCE	df	Sums of Squares	Mean Squares	F	P
Between:					
LOC	1	.0500	.0500	.0225	n.s.
SEX	1	.0056	.0056	.0025	n.s.
LOC x SEX	1	1.2500	1.2500	.5629	n.s.
COND	2	2.7000	1.3500	.6079	n.s.
LOC x COND	2	9.3000	4.6500	2.0940	n.s.
SEX x COND	2	3.8778	1.9389	.8731	n.s.
LOC x SEX x COND	2	.3000	.1500	.0675	n.s.
ERROR 1	168	373.0667	2.2206		

Analysis of Variance of the Fourth Trial Block

SOURCE	df	Sums of Squares	Mean Squares	F	P
Between:					
LOC	1	2.9389	2.9389	1.5624	n.s.
SEX	1	2.9389	2.9389	1.5624	n.s.
LOC x SEX	1	.0500	.0500	.0266	n.s.
COND	2	.2111	.1056	.0561	n.s.
LOC x COND	2	5.2111	2.6056	1.3852	n.s.
SEX x COND	2	1.8778	.9389	.4992	n.s.
LOC x SEX x COND	2	5.6333	2.8167	1.4975	n.s.
ERROR 1	168	316.0000	1.8810		