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THE UNIVERSITY OF ALBERTA

INTRINSIC MOTIVATION, PLANNING AND PROBLEM SOLVING IN GOOD AND POOR READERS

by

(C) DEIRDRE MURPHY

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

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Abstract

The purpose of this study was to examine the relationship between intrinsic motivation and strategy learning. The literature indicates that poor school achievers are more extrinsically motivated than their average achieving peers. The question remains whether motivational orientation differentially influences learning on a task which does not involve reading. The theoretical model of intrinsic motivation, chosen for this investigation was that of Susan Harter (1978). The learning task used was based on the Hypothesis Testing Theory of Levine (1975). Performance on this strategy task, may, in addition to motivation, be influenced by the ability to plan. The strategic deficiencies shown by poor achievers when dealing with problem solving tasks, may reflect poor planning ability. A secondary purpose of this investigation was to examine the effect of planning on strategy learning. The theoretical model of planning chosen is that of Das et.al. (1975).

The subjects were 106 grade 5 students enrolled in the Edmonton Public School System. The subjects consisted of 43 poor readers and 63 average and above average readers. The former's reading attainment was at or below the 30th percentile on a system wide test of reading comprehension attainment; while the latter's reading attainment was at or above the 50th percentile on the same test. All subjects were administered (1) Scale of Intrinsic versus Extrinsic Motivation in the Classroom, (2) Visual Search Task, (3) Trail-making Task, and (4) Problem Solving Task.

The results of this study revealed that good readers were more intrinsically motivated than poor readers. Good readers used strategies more frequently than poor readers; they also tended to use more

efficient strategies. Extrinsically motivated children used fewer strategies than intrinsically motivated children, Poor planners used strategies less frequently than good planners. The results were discussed in terms of the process-product distinction in learning, and suggested the need to focus on how a problem is solved, rather than on just whether or not a solution is attained.

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I. INTRODUCTION

Many educators feel that the initial intrinsic interest in learning, evident when the child enters school, diminishes as the child progress through the system (Bruner 1968, Goodman 1962,). However, the accuracy of these observations has not been subjected to empirical testing. As Deci (1975) observed, very few studies have examined the comparative effectiveness of intrinsic versus extrinsic motivation in a learning situation. As will be seen from the literature review in Chapter 3, Deci's remarks are still true. Most of the studies in this regard have been in the area of Social Psychology, where the focus has been on factors which undermine intrinsic motivation, specifically the use of external rewards, and performance rather than learning. The distinction between performance and learning may seem artificial, since learning is of necessity inferred from performance. However, it is important to point out that the vast majority of studies on intrinsic motivation deal with performance on previously learned tasks, rather than performance on newly learned tasks. So, while intrinsic motivation is acknowledged as important for learning, little work has been under taken in this regard.

There is some evidence that the intrinsically motivated are more efficient learners than the extrinsically motivated (Haywood and Wachs 1966), and that individuals who are motivated by external reward use different problem solving strategies than individuals not so motivatied (Condry and Chambers 1978, Maer and Stallings 1972).

An examination of intrinsic motivation and learning would seem to have particular relevance for special disability groups (for example, the the learning disabled) who have experienced failure in a learning

situation, and where reward has been used to enhance learning. External reward may promote product learning but undermine intrinsic motivation, and thereby reduce interest in the process of learning. Research with learning disabled childen has shown that in a classroom situation, they are more extrinsically motivated than their average reading peers: they are less curious, less willing to perform challenging tasks, less willing to master problems independent of external assistance, more dependent on the judgement of others, and more dependent on external criteria to evaluate their performance (Lincon and Chizan 1970).

The purpose of the present study is to investigate possible differential effects of intrinsic and extrinsic motivational orientation on the strategy learning of average and below average readers. The task used in this study examines strategic behavior, using hypothesis testing theory, based on the work of Levine (1975). From previous albeit limited research, it is predicted that intrinsically motivated children will use more efficient strategies than the extrinsically motivated i.e. will be more logical in their problem solution. These predictions will also be more apparent for average readers than their low reading achieving peers.

These predictions will be investigated within the conceptual framework of White (1959) and Harter (1979). They conceptualize intrinsic motivation as consisting of mastery attempts, which, if successful, result in competent performance and feelings of efficacy, which in turn , provide the energy for further mastery attempts. White (1959) and Harter (1979) have labelled this effectance motivation. In the following chapter, this theoretical framework is discussed.

II. THEORETICAL FRAMEWORK

A. Intrinsic Motivation: White's Conceptualization of Effectance

The concept of effectance motivation was formulated by White (1959) who contended that drive theory was inadequate to account for certain aspects of human behavior namely curiosity, mastery, exploration, play and the need to deal competently with one's environment. This inadequacy has also been discussed by Hunt (1971).

White proposed the concept of effectance motivation to account for those behaviors (e.g., exploration, manipulation) which could not be explained by drive reduction theories. He considered that humans are in constant interaction with their environment, and develop the capacity to deal effectively with it. Competent behavior results in feelings of efficacy, which lead to a continuation of the activity. These behaviors are selective, directive, and persistent, and are motivated by the intrinsic pleasure or feeling of efficacy that results from competent performance, and not primarily from the learning that is it's consequence. Moreover, effectance motivation may lead to a continuation of the activity where there is no longer any gain in competence, purely for the pleasure derived in performing the task.

Energy for this intrinsically motivated behavior is not derived from tissue needs. Rather, it's source is the nervous system: satisfaction lies in the arousal and maintance of activity which leads to feelings of efficacy. Strongly occuring tissue needs (e.g. hunger) can temporarily interrupt intrinsic motivation, but once those needs are satisfied, the activity associated with intrinsic motivation returns. Effectance motivation is persistent and ongoing in that it is always

available to occupy "...the spare working time between episodes of homeostatic crises"(White 1959 p321).

Effectance motivation is undifferentiated in infants and young childern. It becomes differentiated into various motives through life experiences, which emphasize aspects of the individual's interaction with the envirioment. Increased differentiation is accompanied by a tendency toward greater self determination, i.e. a tendency to subordinate external influnces to internal influences.

White acknowledges the complexity of human behavior, and states that he does not wish to convey the impression that effectance motivation is the only model to explain it. However, he does not elaborate on the nature of the relationship between effectance motivation and other theories of intrinsic motivation, or more general theories of human motivation. This is one of the many difficulties posed by White's conceptualization of intrinsic motivation. His conceptualization, while intuitively appealing, is characterized by constructs which are global and vague, making them difficult to operationalize and to test empirically (Harter, 1979). In addition, the model fails to deal with some obvious issues,for example, the role of socializing agents in the development and differentiation of effectance motivation, and the effects of failure in attempting to deal with the environment (Harter 1979).

In spite of these difficulties, the model does have certain heuristic value, as Susan Harter (1979) has shown in her work, as discussed below.

Due to copyright restrictions page 5 has been removed. This page contains Figure 1, White's Model of Effectance Motivation, obtained from Harter, S. (1978). Effectance motivation reconsidered: Toward a developmental model. Human Development, 21, 34-64.

Due to copyright restrictions page 6 has been removed. This page contains Figure 2, Harter's Model of Effectance Motivation, obtained from Harter, S. (1978). Effectance motivation reconsidered: Toward a developmental model. Human Development, 21, 34-64.

B. Intrinsic Motivation: Harter's Conceptualization

In order to alleviate some of the difficulties with White"s formulation, Harter (1979), sought to refine and extend his model (see Figure 1) and to test the constructs empirically. Harter's model which incorporates these refinements is presented in Figure 2.

For Harter, effectance motivation impels the child to engage in mastery attempts. If these attempts are succesful i.e. if they result in competent performance, the child feels pleasure or efficacy. These feelings in turn increase the child's attempts at mastery or effectance motivation. In this respect, Harter's conceptualization does not differ significantly from that of White.

One major focus of Harter's model is to examine the components of effectance motivation, rather than viewing it as a unitary construct as White had done. These components, which Harter identifies as mastery attempts in the cognitive, social and physical realms, are considered developmentally. By considering these components from a developmental perspective, an examination of changes in the structure and content of the motivational system, and the processes which promote change, is facilitated. This is a major refinment of White's model, since he failed to clearly delineate the conditions which produce change in the motivational system.

White did not consider the effects of failure on the motivational system. Harter includes unsuccessful mastery attempts in her model, and has attempted to refine the effects of failure on the system by postulating that anxiety in mastery situations results from a history of failure, which in turn weakens effectance motivation. Harter treats the effects of both success and failure in an oversimplified manner.

However, the value of her approach does direct attention to the effects of success and failure in producing either an intrinsically or extrinsically motivated child (Harter, 1978).

Harter has further refined White's idea of pleasure by relating it to the concept of optimal challenge. A series of studies has demonstrated a positive relationship between pleasure and task difficulty for successfully solved, optimally challenging problems (Harter 1980).

Unlike White, Harter considers the influence of socializing agents on the development of effectance motivation, particularly their influence on the internalization of rewards and mastery goals. This is prehaps her most critical addition since it places the model firmly within a developmental framework. This stresses the child's dependence on adult approval for both incentive to perform the task, and information regarding the quality of performance. It is assumed that in order for the child to develop and maintain his/her effectance motivation, a sufficient degree of positive reinforcement for mastery attempts is required. "Sufficient" is when the frequency of positive reinforcement exceeds negative reinforcement. It is further assumed that positive reinforcement is given for mastery attempts, not just for successful completion.

Harter further postulates that with sufficient positive reinforcement for mastery attempts, the child internalizes two critical systems i.e. a system of self-reward, and a system of standards or mastery goals. As this internalization process develops, the need for external reinforcement gradually diminishes. The left side of Harter's model (Figure 2) shows the idealized representation of positive

development. Here, the child's mastery attempts are always positively reinforced, resulting in a child for whom the major motivational orientation is intrinsic. The left side of the model shows the effects of negative reinforcement on mastery attempts, culminating in an extrinsically motivated child. Childern whose mastery attempts are responded to negatively, show a need for approval and a dependence on externally defined goals for behavior.

This model also maintains that positive outcomes which result in an intrinsically motivated child, will mediate feelings of perceived competence and internal control. These perceptions in turn promote further mastery attempts. Conversely, negative outcomes result in an extrinsically motivated child, who experiences feelings of limited competence and control over external agents and events. These perceptions create anxiety in mastery attempts, which in turn, reduces motivation to engage in mastery attempts.

Harter also examines the function of reward within this developmental framework. In keeping with Bandura's (1971) and Deci's (1975) views of reward, Harter considers that it has both a motivational and an informational component. Reward can be an incentive which influnces the child's behavior and provide feelings of satisfaction once the goal is attained. Reward also provides feedback to the child regarding the quality of his/her performance.

Although a reward may serve both of these functions simultaneously, Harter states that it is necessary to separate them conceptually because they have different implications for different constructs in the model. However, she does not elaborate on what these implications are. In terms of its motivational properties, Harter

maintains that initally reward may have extrinsic properties i.e. the child engages in a particular behavior only to obtain the reward. Gradually, however, the child develops an interest in the activity itself, and the extrinsi properties of the reward become increasingly of less importance. Harter's work (1975a,b) indicates that this occurs during the elementary grades when external approval for mastery attempts is sought with less frequency.

The informational functions of reward can also be described in terms of a shift from extrinsic to intrinsic orientation. Initally, the child is dependent on his/her socializing agents for external feedback regarding the quality of performance. Gradually, through the process of internalization, the child relies more on his/her own judgement with respect to successful performance. In order to empirically test this model, Harter and her associates have constructed several scales which measure various components of this model.

Of particular interest to the present investigation is research which pertains to the Scale of Intrinsic Versus Extrinsic Motivation Orientation in the Classroom. This research will be discussed in Chapter 3 and the scale itself will be described in Chapter 4. In the following Chapter, a selective review of the empirical literature pertaining to intrinsic motivation is presented.

III. A SELECTIVE REVIEW OF THE EMPIRICAL LITERATURE

A. Factors which influence Intrinsic Motivation

In this review, factors which influence intrinsic motivaton will be discussed. This will consist of a review of the literature which deals with the effects of external reward on intrinsic motivation and performance. This area has been reviewed extensively by Condry (1977). The factors which will be considered here are:

(1) Non-contingent contingent rewards

(2) Task inherent rewards

(3) Social reinforcers

B. Non-contingent contingent rewards

Rewards which are given as a result of task performance are called "contingent", while those which are based on task participation only i.e. quality of performance is not a consideration, are called "non-contingent".

One of the earliest studies to examine these types of rewards was that undertaken by Lepper et. al. (1973). Pre-school children who showed initial high interest on drawing tasks were assigned to one of three conditions:

(1) Expected reward ("Good Player Award' Card)

(2) Unexpected reward, and

(3) No reward

The children were then asked to draw pictures for the experimenter. The drawings of children in the expected reward condition deteriorated, while those in the other two groups did not show this decrease. Lepper

et. al. (1973) explain these results in terms of the justification hypothesis, i.e. receiving reinforcement beyond that which justified task participation in the past. Over sufficient rewards, it is postulated, change the perceived locus of behavioral causality from internal to external, thereby undermining intrinsic interest. The above results were replicated by Lepper and Green (1975).

Deci (1975) hypothesised that rewards have different effects depending on the interpretation of the individual, and in keeping with his cognitive evaluation theory. Subjects (college students) were presented with a puzzle to solve and were placed in one of the following conditions:

(1) contingent monetary payments

(2) non-contingent monetary payments

(3) threats of punishment

(4) positive feedback

(5) negative feedback

The results indicate an increase in intrinsic motivation for condition (4), no change for condition (2), and a decrease for conditions (3) and (5), as measured by the time spent engaging in the puzzle solving activity in a free choice period. The results indicate that contingent reward undermines intrinsic motivation, while non-contingent reward does not. The implications of positive and negative feedback will be discussed under the section which deals with social reinforcement.

Deci's research has been criticised on methodological grounds (Calder and Staw 1975). Data tend to be treated on a post hoc basis, and there is frequently a failure to report performance data for the experimental task, so that it is unclear whether any change in time

spent on the activity during the free time period is due to changes in intrinsic motivation, or to differences in task performance. Because of these weaknesses, Deci's results and conclusions regarding non-contingent reward may be unwarrented.

Based on their critique of Deci's work, Calder and Staw (1975), designed an experiment to examine the interaction of level of intrinsic motivation and task persistence and satisfaction. Their predictons were the opposite of Deci's: (1) when a task, initally high on intrinsic interest, is paired with a non-contingent monetary reward, subjects would perceive this reward as the cause of their behavior, and express dissatisfaction with the task, (2) when a task initially low on intrinsic interest, is paired with a non-contingent monetary reward, subjects would perceive this reward as the cause of their behavior, and express satisfaction with the task.

Subjects (college students) were required to solve puzzles which varied in their degree of intrinsic interest. Half of the subjects completed the puzzles without pay, while the other half received one dollar contingent on task completion. After completion of the task, subjects were required to rate it's enjoyableness, and to indicate if they would participate in the future for no reward.

The results indicated that there was a significant interaction between intrinsic and extrinsic factors:

1. subjects in the extrinsic reward and low intrinsic motivation condition, rated the task higher and volunteered more often than subjects in the no extrinsic reward condition.
2. Subjects in the high intrinsic motivation and extrinsic reward condition, rated the task lower and volunteered less often than

subjects who did not receive an extrinsic reward.

These results are in accordance with predictions and support the point made earlier that external reward may actually serve to increase intrinsic motivation.

The review of the above studies indicates that it is not just a simple matter of task contingent rewards undermining intrinsic motivation, and non-contingent rewards enhancing it. Task reward parameters must be carefully delineated to clarify their relationship to intrinsic motivation.

C. Task-inherent Rewards

Task inherent reward is one such parameter which merits consideration. Kruglanski et.al.(1975) proposed that whenever a reinforcer is inherent in the task, it would enhance intrinsic motivation; conversely when a reward is not usually associated with the task, it's presence may undermine intrinsic motivation. Thus, Kruglanski et.al. have distinguished between task-content and task-consequence. The study the used to test this distinction consisted of forty-eight boys 14 to 15 years of age, half of whom were presented with a coin tossing game, and the other half with a block building game. Half of the subjects received money contingenet upon performance, and the other half did not receive money. Kruganski et.al. (1975) maintained that since money is more commonly associated with coin tossing than block building, subjects in the former group should show higher intrinsic motivation than those in the latter group. The dependent variable was measured in terms of a questionnaire, pertaining to interest in, and performance of, the activity. the results support the prediction. Kruglanski et.al.

(1975) replicated this experiment using stock market transactions and athletic games, obtaining similar results. Here is another study which indicates that extrinsic rewards may enhance intrinsic motivation, and again indicates the need to consider the effects of task parameters. This study however, suffers from a weakness similar to those of Deci, in that it fails to report performance data, making it difficult to establish the extent to which inherent task rewards prove to be quantitatively and qualitatively different from extrinsic rewards.

D. Social Reinforcement

It is common for subjects to be given feedback on their performance in learning situations. Several studies have examined the reward value of such feedback. For example, Deci (1971) maintained that positive verbal feedback influences intrinsic motivation in the same way as satisfaction derived from task completion, since it too, can indicate successful completion of a task. To test this hypothesis, Deci used the same methodology as he did in his puzzle solving research mentioned above, except that praise rather than money was the reward. The results indicated the praised subjects spent more time on the target task during a free choice period than did the subjects who were not praised, and Deci interpreted this as supporative of his hypothesis, although the difference between the groups was of marginal statistical significance ($p<.10$). This may be due to the fact that the sex variable was not controlled in this study, either in terms of subject or experimenter participation.

Further studies by Deci et.al. (1973) investigated the effects of verbal reinforcement on intrinsic motivation. Here, sex of the

experimenter and that of the subjects was controlled. The paradigm was similar to Deci's 1971 study. The dependent variable was time spent on-task during a free choice period. The results indicated a significant difference between verbally reinforced males and females, the former spending longer than the latter on-task. That is, verbal feedback increased intrinsic motivation in males and decreased it in females. These differences may be explained in terms of the informational as opposed to the controling aspects of feedback for males and females respectively (Deci 1975).

Studies which have examined the effect of negative feedback on intrinsic motivation indicate that it decreases intrinsic motivation (Deci et.al. 1973; Deci and Cascio 1972). However, these studies have not controlled for sex in the manner described above for positive verbal feedback, therefore ,it is not possible to indicate if there is any effect for sex.

E. Criticism of the Methodologies

The above studies which have been reviewed have suffered from certain methodological inadequacies (Bates 1979). Firstly, few studies have included performance data for the task activity. Secondly, the studies were not concerned with the long term effects of extrinsic reward. Measurement of the dependent variable occured immediately,or at most,after two weeks. Thirdly, the tasks chosen by the experimenter were assumed to be of interest to the participating subjects. It was also assumed that each subject was influenced in a similar manner. Fourthly, attitudinal and behavioral data have been used to measure intrinsic motivation, based on the assumption that their relationship is

inextricable. However, this assumption appears to be unfounded (Bandura 1969).

F. Further Studies of Intrinsic Motivation

The studies discussed here address some of the methodological difficulties mentioned in the preceeding section. Harter (1978), investigated the effects of extrinsic rewards on children's preference for optimally challenging tasks. School grades were chosen as the external reward. The subjects were forty sixth graders (20 boys and 20 girls), and were tested in one of the following conditions:

(1) the anagrams were presented without reinforcement contingencies, and

(2) the children were told that regular school grades would be assigned, depending on how many anagrams they solved correctly.

The dependent variables were: the number of anagrams correctly solved, smiling as an index of task pleasure, and statements as to preferred difficulty level. The results indicated a curvilinear relationship between pleasure derived from task mastery and task difficulty. Preference for challenge was attenuated when children were working for grades. In this condition, children chose the easier anagrams for solution. Similar results were obtained by Maehr and Stallings (1972).

The results of Harter's study appear to be consistent with the general finding that extrinsic reward can, under certain conditions, as discusses, exercise an undermining effect on intrinsic motivation. In addition, this study illustrates the importance of looking closely at the effects of the task on the subjects, and not assuming as the previously cited research has done, that a task chosen by the

experimenter as intrinsically motivating is such to each and every subject.

The importance of task choice is again illustrated in an investigation by Danner and Lonkey (1981). They examined the relationship between cognitive level, intrinsic motivation, and response to extrinsic reward. Ninety children from kindergarten, and grades 1,2,4, served as subjects. In experiment one, the children who differed in performance on a pretest battery of classification tasks (dichotomous sorting, class inclusion and combinational reasoning), were provided with a choice of tasks requiring different levels of understanding for classification. Indices of intrinsic motivation were the amount of time spent on the tasks, and ratings of task interest. The results of this experiment indicate that each cognitive ability group spent more time with, and rated as most interesting, those tasks which were one step ahead of the group's pretest level of classification skill. An inverted U relationship was found between interest and difficulty ratings, indicating that interest is a function of optimal challenge in keeping with Deci (1975) and Harter (1981).

In experiment 2, children received either

(1) reward ('good work certificate')

(2) praise, or

(3) no reward or praise,

for working on a classification task that was either at, above, or below their level of interest as determined from experiment 1. This permitted an investigation of the interaction between type of reward and level of initial intrinsic motivation. This is one of a few studies which examines levels of intrinsic motivation (others are by Loveland and

Olley 1979; and McLoyd 1979). The results indicate that when intrinsic motivation was high, external reward decreased motivation and produced minimal increases in task performance. When intrinsic motivation for a task was low, reward had little effect on motivation, and led to an increase in task performance. Praise had no significant effect on motivation or performance in any of the cognitive groups. This research has some important implications for the study of intrinsic motivation in keeping with the above review. Firstly, it indicates the importance of establishing that a task is of interest to the subjects, since the relationship between task difficulty and intrinsic motivation is curvilinear. Secondly, Piaget's model of cognitive development would appear to be useful in establishing task difficulty level with children. Thirdly, for highly motivated children, extrinsic rewards (tangible-contingent) appear to decrease intrinsic motivation, in accordance with the previosly cited literature (Deci 1975); but slightly increase task performance, which may suggest that children are responding to the reward, in keeping with Levine and Fasnacht's (1974) position. The inclusion of task performance data strengthen's this study, since a criticism leveled at others, most notably Deci's, was the failure to include performance data. Fourthly, praise did not influence intrinsic motivation or task performance, unlike in adult studies. This study did not investigate the interaction between sex and praise. However, given the young age of the subjects, it may be unlikley that sex differences would emerge, since in adults they have been attributed to the socialization process.

G. Intrinsic Motivation and the Learning Process

The studies discussed so far have focused primarily on task performance, and the products of learning (e.g., number of problems solved). Few studies have examined the process of learning i.e. the strategies used by an individual. Condry and Chambers (1978) feel that the study of the learning process i.e. what information is used and how it is used, is more useful than studying only successful performance.

With this in mind, Condry and Chambers conducted an experiment aimed at establishing the activities subjects engaged in during problem solving. The subjects were first introduced to the concept attainment task and then worked through on their own. This was followed by a period during which they chose and worked on problems from a set that varied in difficulty. The problems were designed so that the subjects could gather information, guess at the answer, and obtain feedback at their own pace. During this free exploration period, one group was paid for each problem solved, and the other was not. Unknown to the subjects, each choice was recorded and later analyzed to examine the problem solving strategies.

Results indicated several differences between the paid and unpaid groups. The former were more "answer oriented", i.e. they guessed at the answer earlier and made more guesses before the problem was solved. They also showed less efficient use of information in that they made more redundant choices. The non-rewarded group however, focused on the 'way' to solve the problem rather than its solution. They were more careful and logical in their strategies.

From this research then, it appears that learning strategies are different under intrinsic and extrinsic motivational orientation/conditions. Unfortunately, the authors did not provide more

detailed information regarding for example, the task, the subjects or the amount paid, which makes it difficult to evaluate the study.

H. Intrinsic Motivation, Learning and Special Groups

Terrell and his associates (Terrell et. al. 1958) investigated the relationship between learning and intrinsic motivation. They found that middle class children learned more efficiently under intrinsic than under extrinsic motivation conditions; lower class children learned more efficiently with material incentives. Further work in this area was not undertaken until a study by Haywood and Wachs (1966), who investigated size discrimination as a function of intrinsic-extrinsic motivation orientation, in adolescents of average and below average intelligence. At each IQ level, the intrinsically motivated subjects learned the problem in fewer trials than did the extrinsically motivated subjects. In addition, the former group relearned the problem in fewer trials after a delay of one day. Other work undertaken by Haywood and his associates has dealt with performance rather than acquisition, and has involved primarily the mentally retarded. Relatively intrinsically motivated mentally retarded persisted longer and worked harder on a simple motor task (Haywood and Weaver 1967), and worked harder under-self imposed than under externally imposed reinforcement schedules (Switzky and Haywood 1974).

Motivation has not been studied extensively in the field of learning disabilities. This is because the area is still comparatively young, and so far the emphasis has been placed on developmental and behavioral control issues (Adelman 1978). However, with increasing emphasis on cognition and learning, motivation can no longer be ignored.

Adelman (1978), Adelman and Taylor (1983) have discussed the importance of studying intrinsic motivation in the learning disabled. Children who have a low level of intrinsic motivation for a particular activity (e.g. classroom learning) are unlikely to engage voluntarily in that activity, which in turn is likely to diminish competence in that area. The use of external reward to facilitate the activity may actually interfere with the learning. Children with low intrinsic motivation then, are unlikely to be as efficient learners as those with high intrinsic motivation, given that they have the same ability, opportunity etc.

Looper et al. (1982) found that as young normal readers grow older, they realize that extrinsic reward is less effective than intrinsic motivation. In contract, learning disabled children of comparable ages did not show this awareness. The importance of intrinsic motivation in the performance of adolescents has been recognized by other authors (e.g., Adelman & Taylor, 1983; Deshler et al. 1984; Licht, 1983; Ellis, 1986), who have focused on how such variables as classroom structure and style of teacher feedback that can influence intrinsic motivation.

However, apart from indicating the merits of doing so, few studies directly examine intrinsic motivation in groups of learning disabled children. A few promising studies are appearing in the literature, most notably those of Susan Harter or those based on her scale of intrinsic-extrinsic motivation orientation in the classroom (Harter 1981). For example, Baarstad (cited in Harter 1979), compared learning disabled and normal children on this scale. He found that there were group differences on all five subscales (curiosity, challenge, mastery, judgement, and criteria) particularly those which involved reliance on

the teacher. Similar results were obtained by Lincon and Chazan (1979). The greatest difference between the groups in this study were on those scales which measure criteria for success. Learning disabled children were significantly more dependent on external sources of evaluation, and more reliant on teacher judgement, than were the normal achievers. Although the differences between the groups on the three remaining subscales were not statistically significant, they were in the predicted direction.

Reeve and Leper (1983) investigated the Harter scale as a predictor of classroom performance in learning disabled children. Results showed that there was not a significant correlation between the motivation components of the Harter Scale and standardized tests of achievement. Correlations for the 5 subscales were not reported. A small but significant correlation was found for the motivation component and internality on a locus of control measure; that is, intrinsically motivated children tended to have an internal locus of control. This findings is consistent with Harter's (1978) theoretical model. So while this study did find evidence to support Harter's theoretical model, the findings with respect to intrinsic motivation and achievement are disappointing. However, the fact that the learning disabled children appear to have read the Harter Scale for themselves, may have confounded the motivation responses with reading ability.

Das et.al. (1985) examined the differences in motivational orientation between normal and disabled readers, in grades 3 to 6. The results revealed that there was no significant difference between the groups on any of the measures in grade 3. In grade 4, only the challenge subscale discriminated between the groups ($p<.05$). In grades 5 and 6,

however, the difference between the two reading groups, was more evident. In grade 5, challenge, mastery, criteria and the hierarchical components of motivation and information, distinguished between the two reading groups, the disabled readers being significantly more extrinsic than the normal readers. In grade 6, mastery, criteria, judgement, and the information component, distinguished disabled from normal readers; the former being more extrinsic. A similar pattern of results was obtained when the scale was later readministered. These findings indicate that in the lower grades, the distinction between normal and disabled readers in terms of intrinsic - extrinsic orientation is weak; it is not until grade 5 that the disabled readers become distinguishable than normal readers in their motivational orientation.

I. Conclusions

From the above review some general conclusions may be reached. Firstly, contingent reward exercises, in general, an undermining influence on intrinsic motivation, at least in the short term. However, this may be ameliorated when task parameters are considered. Secondly, non-contingent reward tends not to exercise an undermining influence on intrinsic motivation, but neither does it tend to increase it significanly. Thirdly, positive verbal feedback tends to increase intrinsic motivation, but this may be more apparent for adult males than adult females. Fourthly, rewarded subjects choose easier problems and engage in less efficient problem solving strategies than non-rewarded subjects.

In the next section, a review of the literature which examines the effects of feedback on children's learning and problem solving is

presented.

J. The Effects of Feedback on Children's Learning and Problem Solving

The belief that rewards or feedback enhance learning is prevalent in Psychology. However, there is growing evidence that tangible rewards and feedback may hinder children's learning (Masters and Mokros 1973; McCullers and Martin 1971; Spence 1970,1971; Spence and Dutton 1967; Spence and Segner 1967). The purpose of the present review is to examine types of reinforcement which influence children's discrimination, concept learning and hypothesis testing.

K. Effects of Feedback on Discrimination Learning

The present discussion of the effects of feedback on children's discrimination and concept learning is based on the work of Barringer and Gholson (1979).

Studies of feedback effects on both concept formation and concept identification are prevalent in the literature, but only the latter is of interest here. Concept identification refers to a situation in which the relevant concepts have been previously acquired by a child, and the task is to identify the one concept which leads to problem solution. This generally occurs within a two choice discrimination-paradigm (Barringer and Gholson 1979). The subjects have ranged from pre-schoolers to adults. Feedback has been verbal, tangible or symbolic. A wide range of tasks have been used involving visual or verbal discriminations (Haddat et.al. 1976; Schere 1970; Spence and Dutton 1969; Spence and Segner 1967). The effects of verbal feedback on concept identification are of more interest to the present investigation, and

will now be examined in detail.

Generally, three types of feedback have been compared: (1) feedback which follows both correct and incorrect responses (right/wrong); (2) feedback which follows correct responses only (right/blank); and (3) feedfack which follows incorrect responses only (wrong/blank). The research literature on these types and combinations of feedback, have been reviewed by Barringer and Gholson (1979), and Tumblin and Gholson (1981), and indicate that: (1) the effectiveness of combining positive and negative feedback has not been consistent (Rattiff 1972; Spence and Segner 1967); (2) positive feedback only is less facilitative during acquisition than negative feedback only (Spence 1966; Willams 1972) and is less resistant to extinction (Myers and Seidman 1960); (3) directing a child's attention to relevant stimulus cues increases the impact of verbal feedback (Mims and Gholson 1977). Two broad interpretations have been used to explain these results -motivational and informational.

The motivational interpretation of verbal feedback effects, postulates a reinforcement continuum (Buss and Buss 1956). Wrong was assumed to be a more powerful reinforcer than 'right', and 'blank' was assumed to be neutral. The similar effects of 'wrong-blank' and 'right-wrong' were attributed to the presence of 'wrong', which was thought to be a strong negative reinforcer. 'Right-blank' was not as powerful a reinforcer, hence the slower learning rate during acquisition. This interpretation did account for the acquisition data but not the extinction data. Buchwald (1962), has shown that during extinction, when all feedback is discontinued, subjects interpret 'blank' to mean the opposite of what it did during acquisition. He foun

that subjects trained under the 'wrong-blank' combination, showed greater resistence to extinction, than those trained under the 'right-blank' condition. But since this explanation could not account for the different acquisition rates (i.e. the superiority of 'wrong-blank' over 'right-blank'), Buchwald offered two hypotheses to account for this. Firstly, there is a tendency to interpret 'blank' as indicating the correct response, and secondly, 'blank' acquires it's appropriate meaning earlier when 'wrong-blank' rather than when 'right-blank' is used. Later research provided support for these hypotheses (Levine 1966; Levine et.al. 1964).

Williams (1972) using third grade children, investigated the different rates at which 'blank' acquired it's meaning in the two conditions. He reasoned that if subjects assumed that 'blank' meant 'wrong' they would change their response on the next trial. This would lead to negative feedback and so the assumption would be quickly disconfirmed. In the 'right-blank' condition, the assumption that 'blank' meant 'right, would result in the subject repeating a response, that was in turn followed by a 'blank', thereby not permitting rapid disconfirmation through feedback. The experimental results support the predictions i.e. children treated 'blank' as positive feedback, and 'wrong-blank' resulted in more rapid acquisition. A similar pattern was found for both children and adults (Curry 1960; Meyer and Offenbach 1962; Meyer and Seiderman 1960,1961).

Eventually, the motivational interpretations gave way to informational interpretations of the data, which dealt with the meaning of 'blank' for subjects. However, in many cases the differences between these two types of explanations are not clear.

Informational interpretations have been examined in terms of Levine's hypothesis theory (Levine 1963, 1966). This theory assumes that the subject processes information actively, by formulating hypotheses about a solution to a problem. The subject's responses are determined by these hypotheses, which are evaluated for correctness by the feedback which is given. Levine (1963, 1966) examined the effects of blank trials during concept identification. He found that subjects responded as though 'blank' meant 'right', so maintaining their hypotheses. This has been shown in studies involving both children and adults (Eimas 1969; Gholson et.al. 1972; Ingalls and Dickson 1969; Phillips and Levine 1975; Rieber 1969; Levine 1966, 1963).

A discussion of hypothesis theory will now follow, with particular emphasis placed on studies which deal with children and special populations. Most of the child development literature is based on the work of Gholson and his colleagues. The present discussion is based on the reviews of Gholson and Berlin (1979); Tumblin and Gholson (1981) and Levine (1975).

L. Hypothesis Theory

Hypothesis theory began in the 1960s as a theory of discrimination learning (Levine 1975, 1966, 1963; Brower and Trabasso 1964,1963; Estes 1960; Restle 1962; Trabasso and Brower 1968). As previously stated, this theory assumes that the learner processes the information actively. This process involves the selection, testing and elimination of hypotheses until a solution is found. Feedback influences whether or not a hypothesis is retained or discarded. If the subject receives positive feedback s/he retains the hypothesis for the next trial; if negative

feedback is received, the hypothesis is discarded, and a new one selected for the next trial.

The theory further assumes that these hypotheses can be reliably detected through observable behavior (Tumblin and Gholson 1981). There are two methods used for detection: blank trial probes and introtacts. In a discrimination learning task, the experimenter provides feedback on some trials and not on others; the subject's response on the no-feedback (blank) trials is used to ascertain the specific hypothesis being tested. This method was first used by Levine (1963, 1966). Introtacts involve asking the subject to predict the solution prior to each choice response. With introtacts, feedback is provided after each trial. These two probe techniques have been used with equal effectiveness with both children and adults (Gholson 1980; Levine 1975; Phillips and Levine 1975). Introtacts are used in the present study.

Children have been found to exhibit two types of hypotheses: predictions and response sets (Gholson 1980; Phillips and Levine 1975). Only the former is sensitive to feedback, while the latter is maintained despite repeated disconfirmations.

Gholson et. al. (1972) and Levine (1975) have shown in dealing with children's hypothesis testing, one must consider two hypothesis sampling systems. A system is a plan which regulates the sequence in which hypotheses are manifest (Tumblin and Gholson 1981). The first is strategies which involve systematic sequences that lead to problem solution. The second is stereotypes which involve sequences of response sets, held despite repeated disconfirmation and which never lead to problem solution. There are six systems (three strategies and three stereotypes) which have been observed in human subjects under different

experimental conditions (Gholson and Danziger 1975; Gholson et.al. 1972; Gholson and McConville 1974; Gholson et. al.1973; Goldfield 1974; Levine 1975; Phillips and Levine 1975; Richman 1975).

Gholson and Berlin (1979) and Tumblin and Gholson (1980) have defined the three strategies as: focusing, dimension checking, and hypothesis checking. In focusing, all possible hypotheses are simultaneously considered at the initial stage, and all disconfirmed hypotheses are eliminated after feedback. In dimension checking, which is a less efficient strategy, the subject orders the hypotheses based on the presenting dimensions, one [redacted] time. The least efficient strategy is hypothesis checking, where the subject tests each attribute value of each dimension , one at a time. The three stereotypes are stimulus preference, position preference, and position alternation. Unsystematic hypotheses do not fit either system, and are thought to be imperfect attempts at strategic behavior (Gholson and Berlin 1979; Tumblin and Gholson 1980). These strategies and stereotypes are illustrated in Appendix 4 and are taken from Gholson (1980).

The vast majority of studies in the literature have used bi-valued four dimensional tasks, and the developmental data reveal some consistent patterns. Kindergarten children show stereotypes in 90% of the problems; elementary school children show dimension checking and hypothesis checking in 60%-80% of the problems; college students show focusing in at least 50% of the problems, and no stereotypes (Phillips and Levine 1975; Gholson and Belin 1979; Tumblin and Gholson 1980). Proficency in hypothesis testing is clearly related to age.

Cognitive ability is another factor which is related to hypothesis testing. This has been invesigated in two ways: using mental age and

Piagetian cognitive level. Research has shown that hypothesis selection is a function of mental age. Children with MA below eight years show primarily response set hypotheses, while those whose MA is above eight years show prediction hypotheses. There is no significant relationship between type of hypotheses and IQ. These results were obtained by Harter(1967), Weisz (1977), and Schuper and Gholson (1978).

Work which has examined Piagetian cognitive level and hypothesis testing, has been undertaken primarily by Gholson and his colleagues (Gholson and Beilin 1979). In accordance with Piagetian theory, they found that : preoperational children show about 90% stereotypes ; concrete operational children show primarily hypothesis checking with some dimension checking (45%-75%), and children who are transitional from concrete to formal operations show mainly dimension checking with little focusing (Gholson et.al. 1972; Gholson and Danziger 1975).

Memory demand is another factor which influences strategy selection. For example, Gholson and Danziger (1975),presented second and sixth grade children with an alternating series of problems. They found that the two age groups showed similar strategies on the four dimensional task (75% strategies, 10-15% unsystematic hypothesis sequences). On the eight dimensional tasks, sixth graders continued to show a similar performance level; whereas that of the second graders deteriorated (35% strategies and 40% unsystematic hypothesis sequences). The difference between the two grades on the more complex task, was attributed to the more sophisticated memory organization of the older children.

Coding demands have also been found to influence the hypothesis system sampled. For example, Gholson et. al.(1973), manipulated the ease

with which stimulus information could be coded by second graders and college students, under three conditions. In condition one, the stimulus stayed in view along with a lighted feedback lamp mounted directly above the correct stimulus for three seconds following the response. In condition two, the feedback lamp lighted up when the subject responded, but the stimuli disappeared. In condition three, the stimuli terminated when the subject responded, and the feedback lamp was not lighted until three seconds later. It was assumed that the first condition was the easiest to code, and the third was the most difficult, since it was necessary for the subject to code the stimulus of choice before responding, rehearse the cues in storage prior to feedback, and if the response was correct, recode after the delay in the absence of stimulus information. The results indicate an interaction between age and coding demands. For adults, performance was basically the same for the three conditions, i.e. they used primarily a focusing strategy. For the second graders, however, coding demands significantly influenced their use of strategies. As the coding demands of the task increased, there was a decrease in the frequency with which they used strategies, accompanied by an increase in the use of stereotypes. It appears then, that second grade children unlike adults, are unable to alter their manner of coding to meet the demands of the task. Similar results have been obtained by Gholson and O'Connor (1975); Mims and Gholson (1977); Nuessle (1972); Offenbach (1973); Schonebaum (1973).

Task variables can also influence strategy selection. Gholson and Beilin (1979) reviewed research on task variables which influence the information reaching the subject. Gholson et.al. (1975) have shown that when stimulus differentiation training is combined with feedback,

concrete operational kindergarten children generate strategies in 75% of the problems. When feedback was not provided, these children showed strategies in only 45% of the problems. It was concluded that these children learned more about the relevant cues, than did the children who did not receive feedback. Pre-operational children on the other hand, showed 90% stereotypes in their problems, regardless of whether or not they received feedback and training. This indicates that a certain cognitive level is necessary to generate strategies, and training is of limited usefulness until this level is reached. Similar results have been obtained by Kelley et. al.(1980) and Lineham (1980).

Of interest to the present paper are studies which investigate the relationship between hypothesis testing, reading and intrinsic motivation. The only study of which this writer is aware which investigated the relationship between hypothesis testing and reading level, is that of Barringer and Gholson (1980)(cited in Tumblin and Gholson 1981). The subjects were fourth and fifth grade children who were either one and a half years below grade level, or at their grade level, on a reading test. There was no significant difference between the groups on CA orIQ. The results indicated that normal readers showed either better performance or improved with practice, whereas the under-achievers showed poorer performance and failed to improve with practice.

Planning, which is a variable of interest in the present study, is discussed in the next section.

M. Planning

As indicated previously, two systems, strategies and stereotypes influence children's hypothesis testing. A system has been defined as a plan which regulates the sequence in which hypothese are manifested (Tumblin and Gholson 1981). Planning has been described in behavioral terms as

> ...search for the most important aspect of information, comparing each part of the information with other parts, creating hypotheses and verification of hypotheses with the original feature of the perceived object (Ashman and Das 1980).

The ability to plan well appears, in addition to motivation, to exercise an important influence on strategic behavior in a problem solving task. It is of interest to examine whether children who are good planners use more efficient problem solving strategies than children who are poor planners. For example, do good planners use mainly a dimension checking strategy while poor planners use hypothesis checking or exhibit stereotypes?

Two traditions provide the conceptual framework for examining planning i.e. neuropsychology and cognitive psychology. The former is concerned with the functions of different areas of the brain, and draws heavily upon comparative and clinical work; the latter is concerned with human information processing, and is based on studies of individual differences in cognition.

The conceptualization of planning which emerged from the cognitive psychology tradition is based primarily on the work of Miller, Galanter and Pribram (1960). For them, a plan is a hierarchical process which controls the order in which a sequence of operations is to be performed.

Plans are closely related to Image, which is the cumulated organized knowledge that the organism has about itself and its world. According to this formulation, behavior is directed toward the attainment of a goal, and is guided by the formulation of plans. Images are used to select an appropriate Plan. When a Plan is available, a control process TOTE (test--operate-text-exit) guides behavior and monitors the progress of a plan. This conceptualization of planning has been applied to a number of areas including problem solving. Miller et al. maintain that there are two paradigms involved in problem solving (1) prediction and (2) search. In prediction, the main source of difficulty in problem solving arises in the inadequacy of the Image. It is necessary to collect more information, attempt a different organization of information, and discard disconfirmed information. In order to verify an Image as it develops, it is necessary to make predictions about it and test them. Prediction paradigms are conducive to algorithmic Plans, ie., where each option can be logically and systematically tested, before a solution is reached. In the case of search, there is the added problem that the number of options to be tested may be very large, hence the Plans adopted may have to be heuristic. That is, one may have to engage in systematic "guessing", in order to reduce the number of options to be tested. The type of Plan which is adopted, ie. algorithmic or heuristic, will depend on the nature of the task, i.e. whether it is a prediction or a search task.

Hayes-Roth (1979), who has also emerged from the cognitive psychology perspective, conceptualizes planning as a two stage process. The first stage involves the predetermination of a source of action aimed at achieving a goal. The second stage involves the monitoring and

the execution of a plan. These are referred to as planning and control respectively. Hayes-Roth (1979) sees planning as opportunistic, ie., at various stages in the process, the planners decisions suggest other opportunities for plan development. These decision sequences do not always follow a well ordered path, since the assumption that people plan opportunistically implies that interim decisions can lead to subsequent decisions at different points in the planning sequence. This view of planning suggests that planners will produce many coherent decision sequences but some less coherent ones as well. The relative orderliness of the particular planning sequence reflects individual differences among planners, as well as task demands.

Golden and Hayes-Roth (1981) using thinking aloud protocols, investigated the planning skills of five subjects as they engaged in errand-planning tasks about an imaginary town. The analysis indicated a number of differences between good and poor planners. Good planners: made more decisions establishing criteria for plan generation and evaluation; more decisions controlling allocation of cognitive resources during planning; made more decisions assessing data relevant to planned actions, and in the detailed content of these decisions. They more frequently reviewed and evaluated previous decisions and were more likely to compare alternative plan actions. They were more sensitive to task contraints and the existence of special clusters of errands. Although good and poor planners used the same criteria for generating and evaluating their plans, good planners used most of these criteria more frequently than did poor planners.

Planning from the neuropsychological perspective is derived from the neuropsychological approach of Luria (1973), based on his

observation of patients with lesions in various areas of the brain. He maintained that the brain is organized into three functional units or blocks which are concerned with arousal, coding and planning respectively. Each block is organized into hierarchial zones. These are the primary or projection zones which receives and transmit impulses and is modal specific. The association zone, where input is processed, is less modal specific. The tertiary or overlapping zone, is responsible for more complex forms of cognitive activity and is amodal.

The chief function of Block 1 is to regulate tone and maintain arousal in the cortex. This block consists of the upper and lower brain stem, the reticular formation and the hippocampus. Luria (1973) has indicated the importance of the reticular formation in maintaining wakefulness through three sources of activation. The first is metabolic which maintains homeostatic balance. The second permits the organism to deal with unexpected environmental stimuli. The third is concerned with the maintanence of energy for goal directed behavior. Lesions in Block 1 are associated with disturbances in arousal and alertness (Luria 1973).

The second functional unit, Block 2, is concerned with obtaining, processing and storing information. This block consists of the occipital, temporal and parietal lobes. In this Block, the primary zone receives and analyzes information into its component elements. The secondary zone further organizes and codes the material. The tertiary zone is concerned wiwth the coding of simultaneous and successive information, and is responsible for transforming concrete information into abstract thinking. Lesions in Block 2, result in for example, disturbance of visual synthesis, differentiating speech sounds, and understanding logical-grammatical relationships.

The third functional unit is responsible for goal directed behavior or the formulation and execution of plans. Block 3, is situated in the frontal lobes. The primary zone transmits motor impulses to the efferant nerves. The secondary zone which is situated in the premotor area, is responsible for the formulation, regulation and verification of complex behavior ie. plans (Luria 1973). The prefrontal area receives and integrates, transmits and organizes, through the afferent and efferent system respectively, impulses to all other areas of the contex. In particular, the prefrontal area is connected to the reticular formation, which enables it to regulate tone and arousal. Block 3 then, is concerned with the organization of stimuli into plans of action, as well as the implementation and evaluation of these plans. Since plans or strategic behavior are usually mediated, the frontal lobes are also involved in the control of behavior through speech. Lesions in this area are associated with difficulty in executing complex verbal instructions, planning and evaluating solutions to problems, the ability to self-monitor ones behavior and detect errors (Luria 1973).

Das, Kirby and Jarman (1979) have proposed a model of human information processing based on Luria's clinical observations. This model consists of four components: input, sensory register, central processor and output (see Figure 3). The stimuli can be presented through any of the sense modalities, either simultaneously or successively. The stimuli then enter the center processor via a sensory register. The relationship between the sensory register and the central processor is conceptualized in either one of two ways. Firstly, the central processor questions the sensory registor to see if there is anything there, and if so, a transmission is made. Secondly, the sensory

Due to copyright restrictions page 39 has been removed. This page contains Figure 3, Model of Information Integration, obtained from Das, J.P., Kirby, J.R & Jarman, R. (1979). Simultaneous and successive cognitive processes. New York: Academic Press.

register can interrupt the central processor, focusing it to accept information. Das, Kirby and Jarman (1979) feel that the latter is the more probable function since sensory information cannot be delayed. The central processor has three components: one which processes information into simultaneous groups; one which processes discrete information temporarily into successive groups, and finally, one which utilizes the simultaneously or successively coded information into plans or decisions for action. Both simultaneous and successive codes are assumed to be available to the individual, and the selection is determined by the individual's customary mode of processing information and the demands of the task. The output component of the model organizes performance in keeping with the task demands.

To date, the majority of the work with this model has focused on the simultaneous and successive coding of information using a variety of non-brain damaged populations (Das, Kirby and Jarman 1979).

The planning component of Das' information processing model was discovered by Ashman (1978). He undertook a study using marker tasks for both coding and planning. The independence of planning was inferred from the presence of additional variance over that which can be explained by the coding tasks.

The subjects were 104 grade eight students (52 males, 52 females) attending three city schools. For males the mean CA was 164 months (SD=6.0); mean verbal and non-verbal (Lorge-Thorndike) IQ's were 105 (SD=13.3) and 113 (SD=12.0) respectively. For females, the mean CA was 164 months (SD=5.8), mean verbal and nonverbal IQs were 104 (SD=13.4) and 109 (SD=14.0) respectively. All subjects were administered marker tasks for simultaneous (Figure Copying and Memory-for-Designs), and

successive (Auditory Serial Recall, Visual Short Term memory, and Digit Span) processing, as well as marker tasks for planning (Visual Search, Trail Making, Verbal Fluency Planned Composition and Portens Maze Test).

The coding marker tests were factor analysed by the principal component method. Two factors emerged which were interpreted as simultaneous and successive processing. The loadings for Serial Recall, Digit Span and Visual Short Term memory were .870, .843 and .485 respectively (successive processing). The loadings for Figure copying, and memory for Designs were .819 and .813 respectively (sismultaneous processing).

The five planning marker tasks were also submitted to principal component factor analysis. The factor loadings for Visual Search, Trail Making, Planned Composition and Verbal Fluency were .759, .689, .481, and -.668 respectively. The Proteus Maze test did not load substantially on this factor (-.029), but defined on its own a second factor with a loading of .979. This result could suggest that planning is not a unitary dimension, or that it may involve coding, or some attribute other than coding or planning.

The five coding and five planning marker tasks were then factor analyzed together. Four factors emerged which were interpreted as successive processing, planning, simultaneous processing and visualization. The planning factor therefore emerged as distinct from the coding factors.

Ashman (1979) conducted another study to examine whether planning would emerge orthogonal to coding in a group of "borderline" mentally retarded. The subjects were 22 males and 24 females who were attending rehabilitation centres for retarded adults. Their mean CA was 25.4 years

(SD=8.41) and their mean IQ was 78.6 (SD=7.26). The simultaneous marker tasks administered awere Figure Copying and Memory for Designs; the successive marker tasks were Auditory Serial Recall and Digit Span; the planning marker tasks were Trail making, Visual Search and Verbal Fluency. Correlations were calculated between planning and coding marker tasks, and the intercorrelations were submitted to principal component analysis. Three factors emerged: planning which loaded on Trail Making (.833), Visual Search (.658) and Verbal Fluency (-.803); successive which loaded on Auditory Serial Recall (.925) and Digit Span (.931); and simultaneous which loaded on Figure Copying (.873) and Memory for Designs (.866).

Further evidence of planning as a distinct factor was provided by Heemsbergen (1980). The subjects were 60 (35 female and 25 male) first year college students who volunteered to participate in the study. The age range was 18 to 40 years with a mean of 22.6 years. Simultaneous (Figure Copying and Memory for Designs), successive (Digit Span and Auditory Serial Recall), and planning (Trail Making, Planned composition, Visual Search and Syllogistic Reasoning) marker tasks were administered to each subject. A principal component analysis was performend which resulted in the emergence of three distinct factors. Planning loaded on Planned Composition (.697) Trail Making (.719), Visual Search (.630) and Syllogistic Reasoning Time (.876); successive loaded on Auditory Serial Recall (.831) and Digit Span (.724); simultaneous loaded on memory for Designs (.772) and Figure Copying (.791).

Heemsbergen (1980) in a second study, investigated whether individual differences in planning would be related to differences on a

problem solving task. The subjects were 60 (30 males and 30 females) first year college students. The age range was from 18 to 30 years with a mean of 22.42. Planning was measured by performance on the Visual Search Task. The problem solving task used was the commerically available Mastermined Game developed by Parker Bros. Ltd. In this task, the experimenter set up a line of coloured code pegs, (maximum 6 colours) which were inserted in shielded holes. The subject was required to duplicate the exact colour and position of the coloured pegs. Feedback was given after each attempt at reproduction.

Subjects whose scores fell in the top and bottom quartiles on the Visual Search Task were required to solve the Mastermind Game. Two 2 (groups) x 3 (trials) ANOVAs, repeated measures, were used on the number of rows taken to break the code and the time to complete each row. Significant group effects were found for number of rows only. No other main or interaction effects were found. These results show that subjects scoring high on the planning dimension took fewer rows to break the code than subjects scoring low on planning. Time taken to solve the problem does not appear to be relevant to this task. Qualitiative analyses of the subjects' spontaneous verbalizations during the mastermind game indicated some differences between good and poor problem solvers. The latter showed more superstitions behavior (e.g. "red was good to me the last time) saw little value in the process of reasoning (e.g. "there must be a trick to this") and tended to show some stereotyped responses. Good problem solvers tended to vocalize their thought processes, and relate their task performance to prior behavior. Heemsbergen concluded that the differences which exist between good and poor problem solvers may be due to the relative strength of the higher cognitive process

called planning.

The above conceptualizations of planning, emerging from the two traditions of cognition, and neuropsychology, have some common features. That is, planning involves:

(1) setting a goal to be attained,

(2) examining task features

(3) creating a hypothesis

(4) adopting a specific beahvior pattern (strategy)

(5) regulating and evaluating the strategy in relation to the goal.

There is much confusion in the literature regarding the distinction between plans and strategies. Some use the term interchangeably (Kirby, 1984); others view strategies as a subset of planning (Miller et al., 1960). Perhaps a useful way of conceptualizing plans and strategies, would be to consider the former as "knowing what" and the latter as "doing how". That is, with plans one may know what needs to be undertaken to successfully attain a goal, whereas strategies are specific behaviors employed to attain a goal. Planning involves searching for the means to attain a goal; strategies are the execution of these means.

Several researchers, (e.g., Clark, 1979; Goodman, 1970; Olshovsky, 1979; Smith, 1975) have drawn from the work on Newell and Simon (1972), to conceptualize reading as a problem solving process, and specifically have examined the use of strategies in reading comprehension. Newell and Simon (1972) state that behavior is a function of the interaction between an organism and the task environment in which it seeks to attain its goal. In order to attain its goal, the individual selects and implements strategies. Behavior is determined by the interaction between

the strategy and the task. Success or failure of goal-oriented effort is determined by the appropriateness of the strategy.

Goodman et al. (1980) view the reader as active in the search for meaning. To achieve this meaning, the reader employs a number of complex strategies. These strategies are predicting, confirming and integrating. In prediction, the reader selects cues and predicts the material; then the reader checks semantic and syntactic acceptability (confirming); finally, the reader integrates meaning gained with his/her view of the world (integration). Goodman et al., (1980) provides lesson plans for the classroom to promote these strategies. Collins et al., (1980) offer a similar view of reading comprehension.

A study which examined the relationship between planning in Das' model and reading attainment was conducted by Das and Snart (1982). Four groups of children were studied: 30 normal readers from grades 4 and 6; and 15 poor readers from grade 6 who read at a grade 4 level, and those from grade 4 who read at a grade 2 level respectively. The planning tasks which were used were: Visual Search, Trail Making, Planned Composition and Syllogistic Reasoning. Marker tasks for both simultaneous and successive processing were also included. The results revealed that the planning (and coding tasks) could discriminate normal and poor readers of the same chronological age. That is, good readers were better planners than poor readers. The importance of planning in reading comprehension was also investigated by Ramey (1985). Good and poor junior high school planners were identified using the Visual Search task. The inferential reading comprehension of both groups was examined. Good planners were more likely to make inferential statements, evaluate their responses and modify their hypotheses, than poor planners.

Research indicates that poor readers are deficient in the use of strategies which promote comprehension compared to good readers. For example, they use fewer monitoring procedures (e.g., self-monitoring, underlining difficult words), are unaware of the impact of strategy use, and adopt decoding rather than comprehension as their goal during reading (Paris & Meyers, 1981). Smith (1975) also found that poor readers have decoding individual words rather than sentence meaning as their goal during reading. The difference in reading goals may be due in part, to poor readers being less aware of the existence and value of strategies to promote and regulate reading comprehension (Myers & Paris, 1978).

More recently, attention has been paid to the role of motivational and attitudinal variables, in promoting reading comprehension (Oka, 1984; DeBritto, 1984). As Paris (1984) maintains, since strategic behavior involves intentionality, any analysis which ignores motivation is incomplete. Wiens (1983) reviewed the relevant literature and concluded that reading comprehension skills, motivation, and strategic behavior are interdependent; by improving one, the student can expect improvement in the others. Licht (1983), while discussing the role of motivation in reading, has suggested that failure to learn should be attributed to the ineffective use of strategies, rather than to a lack of ability. Implicit in Licht's approach is the idea that strategies can be taught; hence failure is seen as remediable. As the child's knowledge of the appropriate use of strategies increases through instruction, s/he develops an increasing sense of competence, and more mastery attempts are made eventually leading to the strengthening of intrinsic motivation.

In the following Chapter, the rationale for the present study, and the research questions to be addressed, is presented.

IV. THE PRESENT STUDY

A. Rationale for the Present Study

The preceeding review has shown that few studies have investigated the relationship between intrinsic motivation and learning. The primary purpose of the present investigation is to examine the effect of intrinsic motivation on strategy learning in children. The limited literature indicates that poor school achievers are more extrinsically motivated then their average achieving peers. However, the question remains whether motivational orientation differentially influences learning efficiency on a task which does not involve reading. The learning task used in the present investigation is based the Hypothesis Testing theory of Levine (1975).

Performance on this strategy learning task may, in addition to motivation, be influenced by the ability to plan. The strategic deficiencies shown by poor achievers when dealing with problem solving tasks, may reflect poor planning. A secondary purpose of this investigation is to examine the effect of planning on strategy learning.

There is evidence that average and below average reading achievers use different reading strategies. It would be interesting to establish if the general learning strategies which are manifested by the two reading groups, are in any way related to different reading strategies. However, the relationship between learning strategies and reading attainment would need to be established initially . A third purpose of this study therefore is to examine the relationship between learning strategies and reading attainment.

B. Specific Research Questions

Section I

Limited research indicates that poor school achievers are more extrinsically motivated than normal school achievers (Baarstad 1979; Lincon & Chazan 1979, Das et al., 1984). The present research is designed to answer the question: Are poor readers more extrinsically motivated than good readers? There is evidence to indicate that average and below average achievers in reading comprehension, used different reading strategies (Wilson 1979, Paris and Myers 1981). For the average readers studied, hierarchical classification tasks are predictive of performance on a reading comprehension test (Gillet and Richards 1979).

In this investigation another set of questions will examine whether the strategies shown by the poor and average reading achievers on a non-reading learning task, are predictive of reading attainment. That is, are focusing, dimension checking and hypothesis checking related to performance on a reading attainment test? Do motivation orientation, strategies and planning predict reading attainment?

Section 2

There is evidence that intrinsically and extrinsically motivated individuals set different goals and respond differently to rewards (see the review in Chapter 3). The goal of the former is to derive satisfaction from the behavior itself, and the introduction of an external reward tends to undermine this intrinsic interest. For externally motivated individuals, however, satisfaction is derived from the attainment of the external reward, which is the goal of the

behavior. Motivation orientation then, would appear to influence goal directed behavior. It is of interest in the present investigation to examine the influence of motivation orientation on planning as conceptualized by Das et. al. (1979).

The second set of questions asks what is the interaction between motivation, and reading level, and planning?

Section 3

There is some evidence to indicate intrinsically motivated individuals are more efficient learners then those who are extrinsically motivated (Haywood and Wachs 1966), and those who are motivated by external reward use different problem solving strategies than those not so motivated (Condry and Chambers 1978, Maer and Stallings 1972). However, studies which examine the effect of intrinsic motivation on learning, have not been extensive.

Studies have shown that below average achievers are deficient in the selection and use of strategies on a problem solving tasks, when compared to their average achieving peers (Hall 1979, Torgesen 1979). Such deficiencies may, in part, be due to an inability to form a plan. However, few studies have investigated this executive function in a group of low achieving children (Das & Snart, 1982).

The third set of questions deals with the effects and interactions of motivation (intrinsic-extrinsic), planning (good and poor planners) and reading level (poor, and average) on strategy learning. The following questions are asked: What is the relationship between reading level and strategy learning? What is the relationship between motivation and strategy learning? What is the relationship between planning and

strategy learning?

C. Method

Subjects

The subjects were 106 grade 5 students enrolled in The Edmonton Public School System. The subjects consisted of 43 poor readers and 63 average and above average readers. The former's reading attainment was at or below the 30th percentile on a system wide test of reading comprehension attainment, while the latter's reading attainment was at or above the 50th percentile on the same test. The poor readers received additional assistance in reading in a resource room. All children had IQ's not more than 1 standard deviation below the mean on the Canadian Cognitive Abilities Test. Children who had severe sensory, emotional or behavioral problems, and children for whom English was a second language were excluded. Teacher opinion was sought to confirm the appropriateness of each subjects placement. Children whose placement was ambigious, were excluded from the study. Table 1 shows the means and standard deviations on the initial selection variables. From Table 1 it can be seen that there was a significant difference between the two reading groups not only in reading but also in intelligence - poorer readers had lower IQs. There was no significant difference between the groups in chronological age.

Table 1

Means (and Standard Deviations) for Age, Verbal IQ, Non-Verbal IQ and Reading Scores, for Poor and Good Readers

	Poor Readers	Good Readers
C.A.	9.873 (0.574)	9.874 (0.503)
VIQ	101.558 (8.238)	114.873 (9.560)
NVIQ	96.651 (8.269)	108.698 (11.659)
EPSB4	18.535 (8.678)	64.635 (13.539)

Test Battery

The following is a description of the kinds of the measures used in this study.

A Scale of Intrinsic versus Extrinsic Orientation in the Classroom

This scale was developed by Susan Harter(1981) to measure motivational orientation in the classroom. The final version of the scale consists of five subscales which measure curiosity, mastery, challenge, judgement, and criteria for success. The first three are motivational and the last two are informational components of the scale. There are 30 items in all, 6 per subscale. Within each subscale 3 of the items begin with an intrinsic orientation and 3 with an extrinsic orientation. There are two constraints with respect to item order: firstly, no two consecutive items are from the same subscale, and secondly no more than two consecutive items are keyed in the same direction. Each item can be scored from 1 to 4. Item scores are summed and a mean is obtained for each subscale. A total score is not obtained because it is thought that this would mask profile differences.

The question format is a structured alternative, in which the child is presented with two statements, one of which is of an intrinsic orientation, and the other an extrinsic orientation, and is required to choose between them. Having made a choice, the child is asked to indicate whether the statement is "really true" or "sort of true" of him/her. This format has the advantages of broadening the range of choices over a two-choice format, and since the choices do not involve the response 'false,' the tendency to obtain socially desirable responses is ameliorated. Harter (1981) indicates that there is a slight

negative correlation between the children's Social Desirability Scale (Crandall et al., 1965) and three of the scales subtests (but does not specify which ones), indicating a slight tendency for socially desirable responses to be correlated with an extrinsic orientation.

Standardization data were obtained from 3,000 American children from grades 3 to 9, tested in six samples. In each sample, the socio-economic level ranged from lower-middle to upper-middle class. There were approximately the same number of children at each grade level, and the sex distribution was about equal. The final version of the scale described above, was group administered to the sixth sample, i.e., 120 children in grades 3 to 6 in Colorado.

Factor analysis was performed on the data from 761, 3rd to 9th graders from New York and 793, 3rd to 9th graders from California. Both orthogonal and oblique rotations were used, and revealed the same basic factor structure. The five factors emerged with low cross-loadings in both sample groups. Higher order factoring among the subscales revealed that two factors best described the subscale pattern, curiosity, mastery and challenge defined one factor which was called 'motivation;' judgement and criteria defined the second factor called 'information'.

The means are around 2.5 and the standard deviation is less than 1.00 for each item, indicating that the subjects are using the full scoring range.

The reliability of each subscale was ascertained using the Kuder Richardson coefficient of internal consistency. Coefficients for the five subscales ranged from .54 to .84. Test-retest reliability data were obtained on three samples after 5, 9 and 12 months. These values ranged from .48 to .76.

The validity of the scale has been investigated in several ways. Firstly, the factor analysis described above indicates five distinct factors corresponding to the five subscales; and higher order factoring reveals two distinct factors. Secondly, discriminant analysis between two groups of children attending two schools of differing philosophical orientation, one promoting intrinsic values, the other more traditional values, revealed statistically significant differences on all five subscales. Thirdly, the predictive validity of the preference for challenge subscale was established using a behavioral task. Children were asked to choose anagrams of 3, 4, 5, and 6 letters representing four difficulty levels. The correlation between this subscale and the mean number of letters in the chosen anagrams was .72 (Harter, 1981). Finally, the construct validity of the scale has been investigated using Harter's conceptual model. It was predicted that the higher one's perceived competence, the more intrinsic one's motivation. The data reveal that perceived competence is related to challenge (.57), curiosity (.33), mastery (.54), judgement (.03) and criteria (.26). The first three factors comprise the motivation subscale and the last two factors, the information subscale. Perceived competence would therefore appear to be more closely related to motivation than information.

A study by Das et.al. (1985) sought to examine whether similar results with respect to the scale structure would be found in a sample of Canadian elementary school children. The subjects were 334 children from grades 4 to 7, from 20 elementary schools in Edmonton's Catholic School System. Subjects comprised two groups: 171 children who were identified as "disabled readers" and 163 who were identified as "normal readers." The identification was based on the School System's "Screening

of children with Learning Disabilities." The mean level of reading retardation in the learning disabilities group was 2 years below that of the normal readers. All children had IQ's greater than 80. The children were individually administered the Harter scale by one of several examiners, all of whom had previous experience working with elementary school children. In order to alleviate possible confounding effects produced by differences in reading ability, the examiner read each item aloud, while the child followed along in his/her own booklet, marking the appropriate answer.

Factor analysis performed on the data indicated that no clear five factor solution emerged. An examination of the individual items making up each subscale revealed that challenge 3, curiosity 5 and 6, and mastery 5, were rarely marked for their respective factors. In addition, alpha reliabilities were calculated for each of the 5 subscales, and the two higher order components, for the two reading groups separately. These revealed that the coefficients were the lowest for the curiosity scale (.266 for the reading disabled group and .627 for the normal readers.) The alpha coefficients calculated on the two higher order components (motivation and information) revealed reliabilities of .791 and .759 respectively for the disabled readers, and .816 and .837 respectively for the normal readers. In short then, while the higher order components of motivation and information emerged as stable for the two reading samples, the five subscales did not show the same stability.

The above scale has been chosen as a measure of intrinsic-extrinsic motivation for use in the present study. It can be considered to represent the first systematic attempt to examine intrinsic motivation in a questionnaire as opposed to an experimental

format. It appears to have reliability especially when considered as comprising the two components (motivation and information) as opposed to five subscales (challenge, curiosity, master, judgement and criteria). Because of the greater reliability of the components, they are used in the present investigation. The motivation-revised measure is used in this study.

The instructions for administering the scale, and the scale itself, are found in Appendix 1.

Planning Tasks

Two planning tasks were used in this study and are described below. The tasks originated in the field of neuropsychology, and have been used by Das & his associates to measure the planning process within his model of human information processing (Ashman & Das, 1980; Das & Hawkeye, 1980; Das et al., 1980).

1) Visual Search

This task consists of 12 overhead transparencies each containing 48 shapes, or letters or numbers. In the middle of the transparency a copy of the target is enclosed by a circle. Four transparencies contain a number as a target and 48 picture stimuli (number-picture), four transparencies have a number as a target and 48 letter stimuli (number-letter) and the final set of four transparencies have a letter as a target and 48 letters as stimuli (letter-letter). The first set of transparencies are the easiest to search since the discriminations are obvious, while the third set of transparencies are the most difficult to search since the discriminations are less obvious. The second set of

transparencies are of intermediate difficulty. The subject is required to point to one of the 48 stimuli which match the circled target. Each transparency is viewed through an apparatus which has two timers. The subject starts a trial by pressing a switch which lights the transparency, while s/he searches for the appropriate target from among the 48 stimuli. As soon as the target is detected, the subject removes his/her finger from the switch, which terminates the timer measuring search time, and touches the target on the screen which records the time taken to move from the switch to the target, or reaction time. Therefore, two measures are obtained for each transparency, i.e., search time and reaction time. The total time and a mean for the twelve trials are obtained, as well as the total time for each of the three sets of transparencies. A description of the procedure and diagrams of the apparatus are found in Appendix 2.

2) Trail Making

This task has two levels, primary and intermediate, both of which consist of two parts A and B. At the primary level, Part A consists of a sequence of numbers ranging from 1-15, while in Part B the numbers range from 1 to 23. At the intermediate level, Part A consists of a sequence of numbers 1-23 and Part B consists of alternating numbers and letters, e.g., 1-A, 2-B etc. The primary level is used with young children, and the intermediate level is used with older children. Only the primary level was used in this study. A description of the procedure and a sample of the task are found in Appendix 2.

Problem Solving Task

The problem solving task used in this study will now be described. It involves hypothesis testing and is based on the work of Gholson, Levine, and Phillips (1972). This task was chosen because it met the following criteria:

(1) it is well founded in theory,

(2) there are developmental data associated with it,

(3) it is not confounded with reading,

(4) it permits learning to occur in a short period of time,

(5) it shows clearly differentiated strategies,

(6) it is relatively interesting to learn.

As can be seen from the literature on hypothesis testing, there exists a unique problem when these procedures are applied to children. That is, young children often show position preference and position alternation. Most of the early studies on hypothesis testing with children did not consider this, i.e., position (left/right) was generally one of the four dimensions used (e.g., Ingalls & Dickerson, 1969). This problem was eliminated by constructing children's probes which followed a 3:1 pattern as opposed to the usual 2:2 or 4:0 pattern used with adults (Gholson, 1980). The present task reflects this modification.

Stimulus Materials

Bivalued four dimensional figures, which conform to the restrictions recommended by Levine (1962), are used in this study (see Appendix 4). Eight different stimulus pairs are possible, which are grouped into two different sets of four pairs. In each set, each level

of every dimension occurs twice with each level of every other dimension, i.e., the dimensions are counterbalanced within each set. This conterbalanced set of stimulus pairs is referred to as internally orthogonal. Any three consecutive trials within a problem logically define the solution to that problem.

The stimuli differ along the dimensions of letter, colour, size, and line position (See Appendix 4), and are drawn 2 inches apart on plain 6x4" cards. The large letter is 1 inch in height and the small letter 1/2 inch in height. Different problems use different pairs of letters and colours. These are indicated in Appendix 4.

Pretraining

In order to familiarize subjects with the demands of the task, a pretraining session preceeds the main experiment. The procedure was adapted from a method by Phillips (1976) and Phillips and Levine (1975) for teaching children to voluntarily generate verbal statements about their hypothesis on each trial. The child is asked to state his/her "best bet" as to the solution on each trial, before pointing to the choice on the card. Feedback is given immediately after the child has indicated his/her choice response, and the card remains in view for 5 seconds after feedback. By the fifth and final pretraining problem, the "best best" or introtact, is given voluntarily. There were 5 pretraining problems each of 12 trials each. The type of feedback used in this study was verbal-directional. This procedure involved the experimenter saying, "correct, the answer is in this picture", or "wrong, the answer is in this picture". This type of feedback was previously used by Tumblin and Gholson (1982).

In the first training problem, when the subject is presented with the first pair of stimuli, the eight hypotheses are described by the experimenter, and possible responses on each trial. Twelve trials are then presented to the subject, who is trained offer his/her "best best" as described above. If the subject does not respond correctly, the problem is represented and the subject is told to try the relevant dimension, e.g., colour. If the problem is not correctly solved the second time, the correct answer is stated by the experimenter. This procedure is used throughout the pretraining sessions. The second pretraining problem is similar to the first, except that another relevant dimension is used (see Appendix 4 for details).

Experimental Problems

Each subject receives a series of nine, 12-trial problems, which conform to Levine's (1982) criterion of orthogonality. For internally orthogonal stimuli, the solution can be determined from the third feedback trial, which is always negative. In this study, three different combinations of positive (+) and negative feedback (-) were used on the initial three trial sequence (++-, +--, -+-) as used by Barringer and Gholson (1982). After the third feedback trial, feedback is determined by the logical solution to each problem. The trial sequence (---) was not used in this study, since informal testing [illegible], prior to the administration of this study, revealed that [illegible] negative feedback, for at least three trials was too [illegible]ting for them, and adversely affected their willingness to complete the task.

The present investigation uses nine, 12-trial problems. There were three problems for each of the three feedback sequences used. The

problems were randomly assigned to one of the feedback sequences. The problems were randomly presented to each subject.

As in the pretraining problems, the child was required to state his/her choice, and then point to that choice on the stimulus card. Feedback was given immediately after the choice was indicated and the card remained in view for 5 seconds. A criterion of five consecutive correct responses was used to indicate that a problem was solved. In addition, after each problem, the child was asked to verbalize the solution to the problem. At the end of the nine problems, the child was asked to indicate how the solutions were reached. This was to provide confirmatory evidence of the type of strategies used.

The specific strategies used by each subject during the introtacts are determined in a manner indicated by Levine (1975, 1966, 1963) and Gholson (1980) (see Appendix 4). These will then be investigated in accordance with the research questions of the present investigation.

The Gates-MacGinitie Reading Tests

This reading test was chosen for the current investigation because it met the following criteria:

(1) it provides a measure of reading comprehension

(2) it has Canadian norms

(3) it can be administered in a group

(4) it is not routinely used in the school system.

This is a norm referenced group or individually administered test designed to provide a measure of school achievement in reading vocabulary and reading comprehension.

The test was standardized on 46,000 children throughout the ten Provinces and the Yukon. The sampling design was based on population and school enrollment figures published by Statistics Canada. The sample was drawn so that each province was proportionally represented on the basis of its total school enrollment. Each province was stratified according to the population of city and rural areas, and type of school board. Proportions of students were then tested in schools from boards which had been randomly selected within the defined strata.

The test consists of two subtests vocabulary and comprehension, and four types of scores are obtained for each: percentile ranks, T-scores, stanines, grade equivalents, and extended scale scores. Percentiles are used in this investigation.

The comprehension subtest, which is of interest here, consists of a short passage of Canadian or international material. The student is required to read the passage and answer literal or inferential questions about its content. There are four possible answers, one of which the students chooses. There are approximately 40 such passages at each grade level.

The reliability coefficients of the subtest range from .85 to .92. This test on the whole, appears to be well standardized and it's reliability adequate for screening purposes. This test was administered according to the standardized procedure indicated in the manual.

Procedure

Permission to enter the Edmonton Public School System to obtain subjects to conduct this investigation was made through the Cooperative Activities Program; Faculty of Education at the University of Alberta.

Permission was then obtained from the principals of the schools provided by the School Board, to conduct this research within their schools. The initial identification and selection of subjects was then conducted in the manner outlined. Having identified subjects as potential participants, parental permission was then sought.

To ensure against experimenter bias when presenting the experimental task to the selected subjects, the order of presentation of the various measures (the motivation scale, the planning tasks and the problem solving task) was randomized. The reading comprehension subtest of the Gates MacGinitie was administered on a group basis, after the individual testing was completed in each school.

In the following Chapter, the results of this investigation are presented.

V. RESULTS

The results of this study are presented in three sections. The first section examines the motivation orientation and planning ability of good and poor readers; the strategy skills of good and poor readers, and the prediction of reading comprehensive using motivation and cognitive variables. The second section examines the planning ability and strategy skills of intrinsically and extrinsically motivated children; while the third section examines the strategy skills of good and poor planners.

SECTION 1

The Performance of Good and Poor Readers

(1) Good and Poor Readers, and Motivation

In Table 2 the correlations for the motivation components are presented. The correlation between the original Harter motivation component and the revised motivation component of Das et. al. (1985), is high (r=.935) indicating a high degree of compatability between the two measures for this sample. In the present study, the revised motivation component is used, because as was indicated in the previous Chapter, this was revised on a sample of children similar to those used here. The components, ie., motivation and information, as opposed to the five subscales ie., challenge, curiosity, mastery, criteria and judgement, are used here. The components, as opposed to the subscales, were found to be more reliable with a sample of Canadian children (Das et. al.,

Table 2

Correlations for the Motivation Components for the 106 Subjects.

	Motivation (Revised)	Information
Motivation	0.935 P< .001	0.389 P< .001
Motivation (Revised)		0.345 P< .001

Table 3

Means and (Standard Deviations) for the Motivation Components for Poor and Good Readers

	Motivation	Information
Poor Readers	2.853 (0.573)	2.054 (0.522)
Good Readers	3.224 (0.402)	2.488 (0.440)

1985).

From Table 2, it can be seen that the correlation between the motivation and information components is low (r=.345) supporting the contention that different aspects of motivation are measured (Harter, 1981; Das et. al., 1985).

In Table 3 the means and standard deviation for both components (ie., motivation and information) for good and poor readers are presented. The t-tests for independent samples reveal that there is a significant difference between good and poor readers for both the motivation component (t=3.93, df=104, p<.00) and the information component (t=4.62, df=104, p<.00). In each instance, good readers are significantly more intrinsically motivated than poor readers. This finding is consistent with the results of previous studies (e.g., Das et. al. 1985).

Multiple Regression Analyses were carried out to determine the relative contribution of motivational variables (motivation and information) and cognitive varibles (planning, strategies and number of problems solved) to reading competence. The criterion variable was the score on Gates McGinite Reading Comprehension Test. Stepwise multiple regression on data for the total sample showed that motivation contributed to 13% of the variance, followed by information which increased the predictive value to 19%. The F for both of these was significant at the p<.001 level. No other predictor variable reached the .05 level of significance to be included in the equation. These results are in part, consistent with those previously obtained (Das & Murphy, 1984). As before, taking good and poor readers together, motivation was found to predict reading comprehension. However, this time, the

cognitive tests did not predict reading comprehension, perhaps because only two cognitive tests were used, both of which measured planning.

(2) Good and Poor Readers, and Planning

In Table 4 the intercorrelations for each of the planning variables are presented. The results indicate that visual search (letter-letter) correlates significantly with all other planning variables i.e, trailmaking (a), (b), (ab), visual search (total), visual search (number-picture), and visual search (number-letter).

The composite planning variables (trail making (ab) and visual search (total) correlate significantly with each other. Although the correlation between trail making (ab) and visual search (total) is significant ($p<.002$), it is fairly low (.28), suggesting that different aspects of planning are being measured. A correlation of .28 is lower than what has been found to date. For example, both Ashman (1980) and Heemsbergen (1980) found a correlation of .5 between visual search (total) and trail making (ab).

In this study, each of the two planning tasks, visual search and trail making (ab) will be analyzed separately in relation to reading. The means and standard deviations for the planning tasks are presented in Table 5. On each of the three variables, trail making (ab), visual search (total) and visual search (letter-letter), good readers had faster planning times than poor readers. However, t-tests for independent samples reveal that it is only on trail making (ab), that there is a significant difference between good and poor readers ($t=2.85$, $df=104$, $p<.026$). That is, on this measure, good readers are better planners than poor readers.

Table 4

Intercorrelations for the Planning Variables for the 106 Subjects.

	TRAIL-MAKING (A)	TRAIL-MAKING (B)	TRAIL-MAKING (AB)	VISUAL SEARCH (TOTAL)	VISUAL SEARCH (NUMBER-PICTURE)	VISUAL SEARCH (NUMBER-LETTER)	VISUAL SEARCH (LETTER-LETTER)
TRAIL-MAKING (A)		.3812 P< .001	.6871 P< .001	.1099 P< .131	-.0295 P< .382	.0113 P< .454	.1723 P< .039
TRAIL-MAKING (B)			.9131 P< .001	.3033 P< .001	.1252 P< .101	.2417 P< .006	.2668 P< .003
TRAIL-MAKING (AB)				.2810 P< .002	.0837 P< .197	.1910 P< .025	.2799 P< .002
VISUAL SEARCH (TOTAL)					.5704 P< .001	.7460 P< .001	.8497 P< .001
VISUAL SEARCH (NUMBER-PICTURE)						.4473 P< .001	.2096 P< .016
VISUAL SEARCH (NUMBER-LETTER)							.3540 P< .001

Table 5

Means and (Standard Deviations) for Trail-Making(AB), Visual Search (total) and Visual Search (letter-letter) for Poor and Good Readers.

	Poor Readers	Good Readers
Trail-making (AB)	48.151 (10.766)	43.661 (9.580)
Visual Search (total)	2.161 (1.98)	1.981 (0.510)
Visual Search (letter-letter)	3.195 (1.25)	2.841 (1.08)

Table 6

The Mean Number of Problems Solved (and Standard Deviations) for Poor and Good Readers.

Poor Readers	Good Readers
7.97	8.31
(1.28)	(1.05)
N=43	N=63

(3) Good and Poor Readers, and Number of Problems Solved

In Table 6 the mean number of problems solved for each reading group is presented. A t-test for independent samples revealed that there was no significant different between the two groups ($t=1.46$, $df=104$, $p<.147$). That is, good readers did not solve significantly more problems than poor readers. Since the IQ's of good and poor readers are at least within the average range (see Table 1) gross differences (i.e., number of problems solved) were not expected, and are not found for the two groups. In addition, task difficulty was not a factor, since Levine (1975) constructed the hypothesis testing task to reflect primarily strategic behavior, rather than solution attainment. More subtle individual differences, i.e., strategy use, were also examined in this study.

(4) Good and Poor Readers and Their Strategy Use

In Table 7, the intercorrelations for the strategies and processing errors are presented. Here, it is seen that the correlations are low and not significant, confirming that different aspects of problem solving are being measured by these two sets of variables.

The processing error variables unlike the strategies failed to correlate significantly with reading, motivation, or planning hence they are not considered in further analyses. The data from Table 8 (see Appendix 5) show the range of processing errors for the total sample. From this table it can be seen that the subjects made processing errors over a wide range of problems, hence, the failure of the processing errors to correlate significantly with the other variables, can not be attributed to a restriction in their range.

Table 7

Intercorrelations for Strategies and Processing Errors Based on 106 Subjects

	STRATEGY 1 (hypothesis checking)	STRATEGY 2 (dimension checking)	STRATEGY 3 (focusing)	ERROR 1 (local consistency error)	ERROR 2 (shift)	ERROR 3 (unsystematic sequence)
STRATEGY 1 (hypothesis checking)		-.6153 P< .001	-.5678 P< .001	.0880 P< .192	-.1633 P< .052	.0121 P< .453
STRATEGY 2 (dimension checking)			-.2995 P< .001	-.0486 P< .316	.0461 P< .324	.0212 P< .417
STRATEGY 3 (focusing)				-.0556 P< .291	.1488 P< .070	-.0365 P< .359
ERROR 1 (local consistency error)					-.3615 P< .001	-.8078 P< .001
ERROR 2 (shift)						-.2575 P< .005

To investigate whether good readers use more strategies than poor readers and if their strategies are generally different, the main and interaction effects for the two reading groups and three strategies were examined using log-linear analyses. Since this is a comparatively new statistical technique, the general procedure for using it will now be described briefly. (Detailed discussions of log-linear analyses appear in Knoke & Burke, 1982; Kennedy, 1983; Fienberg, 1977 and Plackett, 1974). As stated by Dixon (1981), the purpose of a log-linear analysis for multi-dimensional tables, is to obtain a description of the relationships between the factors of the table, by forming a model for the data. The analysis is based on fitting a log-linear model to the cell frequencies; i.e., the logarithm of the expected cell frequency is written as an additive function of the main and interaction effects. Because the cells contain frequencies, rather than means, log-linear analysis is appropriate rather than ANOVA.

The steps in employing log-linear analysis have been detailed by Kennedy (1983). These will now be described and examples given from the present study.

(1) Cross-classify subjects on the basis of categorical variables. For example, Reading group i.e., poor readers (1), good readers (2). Number of problems administered to each subject i,e., problems 1 to 9. Strategy type, (i.e., the type each one of the 9 problems can be) hypothesis checking (1), dimension checking (2), focusing (3). This is a 2x3x9 dimensional table. Each cell in the table contains an observed frequency which is the product of these categorical variables or factors.

(2) Specify a number of models appropriate to the research so that

different expected cell frequencies can be generated for the table. For example, in Table 9, three models are specified.

(3) Indicate which model is the best for the data (i.e., the most parsimonious explanation for the data).

Generally, the most parsimonious explanation of the data is from a saturated model i.e., one in which all of the variables and all of their interactions are tested. This model is a perfect fit between the observed and expected frequencies. To test whether a variable, (or the interaction of variables) is significant, it alone is removed from the model to be tested. For example, in Table 9, in the first model, reading group (G) is omitted. All of the other variables, and their higher order interactions are included in the model. The association between the observed and expected frequencies is now tested. If the differences between the observed and expected frequencies are not significant, the test of association expressed by the chi square, will not be significant, and the model is said to fit the data. Conversely, if the differences between the observed and expected frequencies are significant, the chi square will be signficant. The model tested is said not to fit the data well, from which it is inferred, that the omitted variable (or interaction of variables) is signficant.

(4) Follow-up procedures to determine the direction of variable differences (e.g., group), are undertaken qualitatively, by a visual examination of the differences between the observed and expected frequencies (or residuals) to identify trends or patterns in the data. At present, there are no statistical techniques

Table 9

Summary of the Goodness-of-Fit Test Statistic for the Main Effects of Reading Group, Strategy Type, and Interaction Effects of Reading Group and Strategy.

Model	df	Likelihood Ratio Chi Square	Prob.	Pearson Chi Square	Prob.
S,P,SxP,SxG,PxG, SxPxG (G omitted)	1	51.863	0.000	51.863	0.000
G,P,GxP,GxS,PxS, GxPxS (S omitted)	2	0.640	0.728	0.640	0.728
G,P,S,GxP,PxS, GxPxS (GxS omitted)	2	9.651	.008	9.651	0.008

NOTE: (G = reading Group, S = strategy type, P = Number of problems)

available, for multidimensional tables, to determine post hoc, the strength of these patterns. Such interpretations are made subjectively.

From this general description of log-linear analysis, it can be seen from Table 9, that three models were examined. The first tested for the main effects of reading group by omitting this variable (G), and including all the other variables (strategy type (S) and problem number (P)) and their higher order interactions (SxP, SxG, PxG, SxPxG). The Goodness-of-Fit test statistic for the main effects of strategy type (S omitted), and the interaction of reading group and strategy type (GxS omitted) are presented. Of the three models examined, only that which excludes the main effects for strategy, may adequately explain the data, (chi square = .640, df=2, p<.73). Models which exclude the main effects of reading group, (chi square = 51.863, df=1, p<.000), and reading group by strategy interaction, (chi square = 9.651, df=2, p<.008), do not fit the data well, indicating that there is a significant main effect for reading group, and a significant interaction effect for reading group by strategy.

The direction of the difference is determined qualitatively by a visual examination of the observed and expected frequencies for specific patterns (Knoke & Burke, 1982; Kennedy, 1983).

The observed and expected frequencies for reading group main effects are presented in Table 10 (see Appendix 5); while those for the reading group x strategy type interaction effects are presented in Table 11 (see Appendix 5). A qualitative examination of Table 10, reveals a general pattern in which the observed frequencies are greater than the expected frequencies for good readers (group 2), while the opposite is

true for poor readers (group 1). This indicates that good readers used strategies more frequently than poor readers. A qualitative examination of Table 11, of the reading group x strategy type interaction effects reveals a general pattern in which the observed frequencies are greater than the expected frequencies for good readers (group 2) for the dimension checking strategy (strategy 2). For poor readers (group 1), the observed frequencies are greater than the expected frequencies for the hypothesis checking strategy (strategy 1). The results for the focusing strategy (strategy 3) are less clear. Poor readers do appear to be using a focusing strategy more frequently than good readers. However, the significance of this association is difficult to determine.

In summary, a visual inspection of the observed and expected frequencies revealed that good readers used strategies more frequently than poor readers. Good readers used the more efficient, dimension checking strategy, more frequently than poor readers; whereas, poor readers used the less efficient hypothesis checking strategy, more frequently than good readers. The relationship between reading group and the focusing strategy is less clear.

SECTION 2

(1) Motivation Orientation and Planning

The total sample of 106 subjects was divided into three groups based on their performance on the two motivation variables. Taking the motivation component first, those who obtained scores below the 30th percentile, those who obtained scores above the 70th percentile, and those who obtained scores between the 30th and 70th percentiles made up

the three groups. This procedure yielded three groups of children with different motivation orientation levels: extrinsically motivated (bottom 30%), intrinsically motivated (top 30%), intermediate level of motivation (middle 40%). An identical division was made for the information component of the motivation scale. The means, standard deviations and number of poor and good readers for the three levels of orientation, are found in Tables 12 and 13 (in Appendix 5) for the motivation and information components respectively. From these tables it can be seen that poor and good readers are relatively evenly distributed across the three orientation groups; hence, reading group and orientation level are not confounded.

The relationship between motivation orientation (extrinsically intrinsically intermediate levels), and planning was examined in a series of oneway ANOVAS. The first series used trail making (ab) as the dependent measure; the second series used visual search (total) as the dependent measure and the third series uses visual search (letter-letter) as the dependent measure. The motivation and information independent measures were examined separately in each series. That is, six separate oneway ANOVAS were performed to examine the relationship between motivation orientation and planning.

The significant ANOVA results are presented in Tables 14 and 15. These reveal that for both the visual search dependent measures, i.e., visual search (total) and visual search (letter-letter), main effects for motivation group were found, ($p<.004$ and $p<.035$ respectively).

Tables 16 and 17 show the mean score on the visual search variables for each of the three motivation groups. The Student-Newman-Keuls test was used to test the significance of the

Table 14

ANOVA for Visual Search (total) by Motivation (bottom 30%, middle 40%, top 30%)

Source of Variation	DF	Sum of Squares	Mean Square	F Ratio	F Prob.
Between Groups	2	6.4450	3.2225	6.0102	.004
Within Groups	98	52.5451	.5362		
Total	100	58.9901			

Table 15

ANOVA for Visual Search (letter-letter) by Motivation (bottom 30%, middle 40%, top 30%)

Source of Variation	DF	Sum of Squares	Mean Square	F Ratio	F Prob.
Between Groups	2	4.1070	2.0535	3.4785	.035
Within Groups	98	57.8534	.5903		
Total	100	61.9604			

Table 16

Mean Visual Search (total) Scores and (Standard Deviations) for Children who Obtain Low, Medium or High Motivation Scores.

Motivation Scores		
Low	Medium	High
2.5	1.7	1.8
(0.62)	(0.66)	(0.82)
N=32	N=42	N=32

Table 17

Mean Visual Search (letter-letter) Scores and (Standard Deviations) for Children who Obtain Low, Medium or High Motivation Scores.

Motivation Scores		
Low	Medium	High
2.4	1.8	1.9
(0.71)	(0.69)	(0.83)
N=32	N=42	N=32

difference, between all pairs of means, for both visual search measures. The results revealed that for visual search (letter-letter) extrinsically motivated children differed significantly from intrinsically motivated children and from those with an intermediate level of motivation ($p<.05$). Extrinsically motivated children had slower planning times than children with either an intrinsic or intermediate level of orientation. The same results were obtained using the visual search (letter-letter) measure.

For the dependent measure trail making (ab), no significant main effects were observed. There were no signficant main effects for the information component of the motivation scale and any of the planning variables.

As a whole, the results show that on the visual search measures extrinsically motivated children are poorer planners, than those children with either an intrinsic or an intermediate level of motivation orientation. There is no significant difference in planning ability between intrinsically motivated children, and those with an intermediate level of motivation.

(2) Motivation Orientation and Number of Problems Solved

The relationship between motivation orientation (extrinsic, intrinsic and intermediate levels), and the number of problems solved, was examined in oneway ANOVAS for each of the motivation components separately (motivation, information). These results revealed that there were no signficant main effects for the number of problems solved. That is, intrinsically motivated children did not solve more problems than extrinsically motivated children. More subtle individual differences

between the motivation groups, i.e., their use of strategy were also examined.

(3) Motivation Orientation and Strategy Use

To investigate whether intrinsically motivated children used strategies more frequently or use different strategies than extrinsically motivated children, the main effects of motivation, strategy, and their interaction were examined using log linear analyses. Models were tested for each of the motivation components (motivation and information) separately. This method of analysis was again chosen because the data involve a multidimensional cross-classification of discrete variables. These variables were motivation orientation level, extrinsic (1), intermediate (2) and intrinsic (3); strategy type, hypothesis checking (1), dimension checking (2), and focusing (3), and number of problems administered to each subject i.e., 9. (This should not be confused with "the number of problems solved", which could be any number out of 9, for each subject). That is, a 3x3x9 multidimensional table, the cells of which contain frequencies, making log linear, (rather than ANOVA) the technique of choice. Three log linear models were examined. They are presented in Table 18. One tested for the main effects of motivation orientation level; one for the main effects of strategy, and the third examined their interaction.

In Table 18 the Goodness-of-Fit test statistics for the main effects of motivation (M omitted), strategy type (S omitted), and their interaction (MxS omitted) are presented. Of the three models examined, those which exclude the main effects of strategy, and motivation x strategy interaction effects adequately explain the data. The model

Table 18

Summary of the Goodness-of-Fit Test Statistic for the Main Effects of Motivation, Strategy Type; and Interaction Effects of Motivation and Strategy.

Model	df	Likelihood Ratio Chi Square	Prob.	Pearson Chi Square	Prob.
S,P,SxP,SxM,PxM, SxPxM (M omitted)	2	28.822	0.000	28.849	0.000
M,P,MxP,MxS,PxS, MxPxS (S omitted)	2	2.200	0.333	2.169	0.338
M,P,S,MxP,PxS, MxPxS (MxS omitted)	4	4.054	0.399	4.098	0.393

NOTE: (M = Motivation; S = Strategy type; P = Problem Number)

which excludes the main effects for motivation does not fit the data well, indicating that there is a significant main effect for motivation (chi square = 28.849, df=2, p<.00). The direction of the group differences is determined qualitatively by a visual examination of the observed and expected frequencies (see Table 19 in Appendix 5), which revealed that extrinsically motivated children used fewer strategies than either the intrinsically motivated or those with an intermediate level of motivation (main effects). Similar results were obtained with the information component of the motivation scale. Children with an extrinsic orientation used fewer strategies than the intrinsically motivated, and those with intermediate levels of orientation (see Tables 20 and 21, in Appendix 5 for the chi square values, observed and expected frequencies, respectively).

SECTION 3

(1) Good and Poor Planners and Number of Problems Solved

The total sample of 106 subjects was divided into three groups based on their performance on the three planning variables. Taking the trail making (ab) variable first, those who obtained scores below the 30th percentile, those who obtained scores above the 70th percentile, and those who obtained scores between the 30th and 70th percentile, made up three groups This procedure yielded three groups of children with different planning ability levels: good planners (bottom 30%); poor planners (top 30%) and intermediate level planners (middle 40%). An identical division was made for the visual search (total) and visual search (letter-letter) measures. The means, standard deviations and

number of poor and good readers for the three planning levels are found in Tables 22, 23 and 24, in Appendix 5 for the trailmaking (ab), visual search (total) and visual search (letter-letter) measures respectively. From these tables it can be seen that poor and good readers are relatively evenly distributed across the three planning levels; hence, reading group and planning level are not confounded.

The relationship between planning level (good, intermediate, and poor) and the number problems solved was examined in three oneway ANOVAS (using the trail making (ab), visual search (total) and visual mean (letter-letter) variables separately). The results revealed that there were no significant main effects for the number of problems solved. That is, good planners did not solve more problems than poor planners.

(2) Good and Poor Planners and Their Strategy Use

To investigate whether good planners used strategies more frequently or used different strategies than poor planners, the main effects of planning, strategy, and their interaction were examined using log linear analyses. Models were tested for each of the three planning scores, trail making (ab), visual search (total), and visual search (letter-letter), separately. Log linear analysis was chosen, because the data consists of a multidimensional cross-classification of discrete variables. These variables were: planning, good (1), poor (2) and intermediate (3) level planners; strategy type, hypothesis checking (1), dimension checking (2) and focusing (3), number of problems administered to each subject i.e., 9. (This should not be confused with the "number of problems solved", which could be any number out of 9). That is, a 3x3x9 multidimensional table, the cells of which contain frequencies,

making log linear (rather than ANOVA) the technique of choice.

In Table 25 the Goodness-of-Fit test statistic for the main effects of trail making (ab) level (T omitted), strategy type (S omitted), and their interaction (T x S omitted) is given. The test-of-fit for the trail making X strategy model is not significant (chi square = 2.626, df=4, $p<.62$); therefore this model is adequate to explain the relationship between the variables. The test-of-fit for the strategy model is also not significant (chi square = 3.49, df=2, $p<.175$), and is therefore adequate to explain the relationship between the variables. However, the test-of-fit for the trail making (ab) level main effect is significant (chi square = 11.696, df=2, $p<.003$), indicating that this model does not fit the data well and it is rejected as an adequate representation of the relationships among the variables. That is, there is a significant main effect for trail making level (ab). The direction of the differences is determined qualitatiavely by a visual examination of the observed and expected frequencies (see Table 26 in Appendix 5). This revealed that poor planners used fewer strategies than good and intermediate level planners. Similar results were obtained for both visual search variables. The data in Table 27 show that there is a significant main effect for visual search (total) (chi square = 26.597, df=2, $p<.00$). The data in Table 28 (in Appendix 5) show that poor planners used fewer strategies than good and intermediate level planners. The results for visual search (letter-letter) are presented in Tables 29 and 30, in Appendix 5.

The results for the planning variables as a whole are consistent. That is, there is a main effect for planning i.e., poor planners used fewer strategies than good and intermediate level planners.

Table 25

Summary of the Goodness-of-Fit Test Statistic for the Main Effects of Trail-making (AB), Strategy Type, and Interaction Effects of Trail-making and Strategy.

Model	df	Likelihood Ratio Chi Square	Prob.	Pearson Chi Square	Prob.
S,P,SxP,SxT,PxT, SxPxT (T omitted)	2	8.994	0.011	11.696	0.003
T,P,TxP,TxS,PxS, TxPxS (S omitted)	2	3.517	0.175	3.490	0.175
T,P,S,TxP,PxS, TxPxS (TxS omitted)	4	2.169	0.623	2.626	0.622

NOTE: (T = trail-making (AB), S = strategy type, P = problem Number)

Table 27

Summary of the Goodness-of-Fit Test Statistic for the Main Effects of Visual Search (total), Strategy Type, and the Interaction Effects of Visual Search (total) by Strategy.

Model	df	Likelihood Ratio Chi Square	Prob.	Pearson Chi Square	Prob.
S,P,SxP,SxVST,PxVST, SxPxVST (VST omitted)	2	26.957	0.000	26.597	0.000
VST,P,VSTxP,VSTxS,PxS, VSTxPxS (S omitted)	2	1.069	0.586	1.061	0.588
VST,P,S,VSTxP,PxS, VSTxPxS (VSTxS omitted)	4	2.539	0.638	2.558	0.634

NOTE: (VST = Visual Search (total), S = Strategy type, P = Problem Number)

Summary of Results

The results of this study may be summarized as follows:

Good readers are more intrinsically motivated than poor readers; when problem solving, good readers use strategies more frequently than poor readers, they also tend to use a more efficient strategies. However, as expected poor readers solved as many problems as good readers. Extrinsically motivated children, are poorer planners than those who have either an intrinsic or an intermediate level of orientation. Extrinsically motivated children, do not use strategies as frequently as those children with either an intrinsic or an intermediate level of motivation orientation. However, there is no difference between the three motivation groups in terms of the number of problems solved. This is also true for poor planners. These children do not use strategies as frequently as good or intermediate level planners; but they do solve as many problems.

In the following Chapter, these results and their implications are discussed.

VI. GENERAL DISCUSSION AND IMPLICATIONS

The central focus of this study was the relationship between motivation orientation, planning and strategic behavior. The primary purpose of the study was to demonstrate that good and poor readers differ in their motivational orientation, planning ability and strategic behavior. In addition, the study set out to demonstrate that motivational orientation and planning ability have differential effects on strategic behavior.

The Performance of Good and Poor Readers

The results show that good readers are more intrinsically motivated than poor readers. This finding is consistent with previous studies found in the literature (Baarstad, 1979; Lincon & Chazan, 1979; Das et. al., 1985).

The results from this study are consistent in particular with those of Das et. al., (1985), which show that by grade 5 (which is where the subjects in this study were) poor readers are less challenged by difficult work, are less curious, and make fewer attempts at independent mastery. They are also more dependent on external sources to evaluate the accuracy of their performance.

The fact that poor readers are significantly more extrinsically motivated than good readers, raises questions as to the cause-effect relationship between motivation and reading attainment. That is, is extrinsic motivation the cause or the effect of repeated failure in school? Licht (1983) as well as Das et. al., (1985) indicate that it is the latter.

The finding that poor readers are more extrinsically motivated than good readers, also lends support for Harter's theoretical model,

although this model was not tested directly. One would expect from this model that repeated failure would result in an extrinsic orientation. Such appears to be the case.

What implications do these findings for classroom management? Intervention strategies to increase student's intrinsic motivation have generally focused on two broad aspects. First, teacher or program variables which include the following (i) matching the instructional method and motivation orientation (Pascarella & Pflaum, 1981; Bendall et al., 1980) (ii) examining the type of teacher oriented feedback and (iii) examining classroom structure (Ellis, 1986). Second, of equal important are the student variables such as (i) increasing personal choice (Adelman & Taylor, 1983) (ii) feedback which emphasizes student effort and ability (Adelman & Taylor, 1983) and (iii) attributing failure to the ineffective use of strategies rather than to a lack of ability or effort (Adelman & Chaney, 1873; Licht, 1983; Deshler et al., 1984; Ellis, 1986).

Atributing failure to the ineffective use of strategies is particularly appealing in view of the fact that the poor readers in the present study, did not use as many strategies as good readers, nor did they tend to use as efficient strategies. This, in spite of the fact that both groups solved the same number of problems. The importance of examining how a child learns, rather than what a child produces, is clearly indicated. A child may arrive at a correct solution by guessing, unsystematically applying rules or using less effective strategies. An examination of correct performance alone is of limited utility. The process by which a solution is attained must also be considered. At some point in learning the weakness of an inefficient strategy will become

manifest and successful performance can no longer be assured. Of greater utility then, is an examination of what information is used and what is ignored, and what rules are generated when problem solving. This is particularly important when one realizes that even when children perform badly, they often attempt to systematically apply rules, rather than approach a task haphazardly (Ginzberg, 1977). This observation is consistent with that of Adelman and Taylor (1983) and Licht (1983). These authors recognized the need to consider process in addition to outcome variables with respect to learning. Deshler et al., (1984) consider the goals of educating the learning disabled to be twofold: one of making them competent in learning strategies, and second, intrinsically motivate them to use strategies. With an increase in the child's knowledge of the appropriate use use of strategies, his/her sense of competence should also increase, as more mastery attempts are successful, eventually leading to intrinsic motivation (Licht, 1983).

The present study found that on one measure of planning (which was trail making ab) good readers are better planners than poor readers. These results may be interpreted as Torgesen (1977) has done, to suggest that reading strategies and planning require some basic processing skill common to both, in which poor readers are incompetent. That is, they do not know "what" is appropriate to learn in addition to not knowing "how" to go about acquiring learning (Flavell, 1978). If the learning disabled child is taught what to learn and how to learn it, it is possible that his/her motivation to learn will also improve (Wiens, 1983).

By teaching learning disabled to use appropriate strategies they become more active in the learning process and more willing to learn (Torgesen, 1977). Some of these strategies to improve reading

comprehension in poor readers have been outlined by various authors (e.g., Brown, 1979; Goodman, 1980; Paris et.al., 1984). These strategies are essentially ones of predicting planning checking and monitoring (Brown, 1978; Flavell, 1978; Paris et.al., 1984). Wiens (1983) and Licht (1983) state that reading comprehension skills, metacognitive skills and motivation are interdependent; by improving one, the others also improve. Teachinig a child appropriate strategies with which to approach reading or other learning activities, should result in increased mastery attempts and a sense of competence, leading to a strengthening of intrinsic motivation.

The results of the present investigation would support this position. That is, poor readers used strategies less frequently than good readers; they also used less efficient strategies. Poor readers were also found to be extrinsically motivated. Following the argument advanced by wiens (1983) and Licht (1983), it is possible that teaching poor readers to use more efficient strategies when reading would result in an improvement. The resulting sense of competence would lead to an intrinsic orientation. In addition, the results here suggest that poor readers are not strategy deficient - clearly they were using strategies in their problem solving behavior. Rather, they appear to be strategy-"inefficient". They are also using strategies less frequently. This interpretation is consistent with the "production deficient" approach of Flavell (1970) and Torgesen (1977, 1979).

Group Differences in Motivation

The present study is the first systematic attempt to examine the relationship between motivation orientation and strategic behavior in

children. The results indicate that extrinsically motivated children use fewer problem solving strategies than those children who are either intrinsically motivated, or those who have an intermediate level of motivation. Contrary to expectation, there were no motivation x strategy interaction effects. That is, extrinsically motivated children did not use less efficient strategies: they used strategies less frequently. On a more general measure of planning ability, extrinsically motivated children were found to have the slowest planning times. Clearly, extrinsically motivated children are at a disadvantage compared to intrinsically motivated children when it comes to strategy and planning skills.

The results of the present study do indicate the importance of focusing on the process of learning rather than merely its end product. This is particularly important when one considers that in this study, the extrinsically motivated, the intrinsically motivated and those with intermediate levels of motivation, solved the same number of problems. To have focused on the gross measures of learning, would have been to have masked important and subtle differences in learning. This process-product distinction in learning has also been made by Condry and Chambers (1978). The results of this study for classroom management and teaching practices are clear. Attention needs to be paid to strategies adopted to solve a problem rather than just its solution. Educational systems have generally focused on extrinsic considerations (e.g., grades) to reinforce the products of learning (e.g, correct answers). Traditionally, little attention has been paid to how a skill is acquired (process), and how individual differences in motivational systems influence that process.

Differences in Planning Related to Strategies

The relationship between planning ability and strategic behavior in children was also examined in this study. The results show that poor planners, used fewer strategies when engaged in a problem solving task, than did good planners, or these with an intermediate level of planning ability. Generally, this finding is consistent with the limited research in the area. Heemsbergen (1980), has shown that poor planners use fewer strategies than good planners when solving a strategy game ("Master Mind"). However, in the present study, there was no strategy x planning interaction effect. It was anticipated that good planners would use cognitively more efficient strategies (e.g., dimension checking, focusing) than poor planners thus contributing to an interaction effect. In the present study, there was no signficant difference between good, poor and intermediate level planners in terms of the number of problems solved. Like good and poor reading ability it would appear that planning is exercising a clear yet subtle influence on problem solving. Nevertheless, the results of the present study are clear: poor planners use fewer strategies than good or intermediate level planners. This finding is consistent with the interpretation that defective problem solving may originate in defective planning (Flavell, 1978; Brown 1978), and that incompetence in problem solving may be due to the relative inability of the children to initiate and execute a plan of action (Das et al., 1975).

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235-245.

APPENDIX 1

A Scale of Intrinsic Versus Extrinsic Orientation in the Classroom

Due to copyright restrictions page 112 has been removed. This page contains the Instructions to the Subjects, used in A Scale of Intrinsic versus Extrinsic Orientation in the Classroom, obtained from Harter, S. (1981). A new self-report scale of intrinsic versus extrinsic orientation in the classroom: Motivational and informational components. Developmental Psychology, 7(3), 300-312.

Due to copyright restrictions page 113 has been removed. This page contains Sample Items from a Scale of Intrinsic versus Extrinsic Orientation in the Classroom, obtained from Harter, S. (1981). A new self-report scale of intrinsic versus extrinsic orientation in the classroom: Motivational and informational components. Developmental Psychology, 7(3), 300-312.

APPENDIX 2

Visual Search Task

Due to copyright restrictions page 115 and 116 have been removed. These pages contain the Instructions to the Subects, used in the Visual Search Task, obtained from Ashman, A. (1978). The relationship between planning and simultaneous and successive synthesis. Unpublished doctoral dissertation, Department of Educational Psychology, University of Alberta.

Due to copyright restrictions page 117 has been removed. This page contains the Description of the Visual Search Apparatus, obtained from Ashman, A. (1978). The relationship between planning and simultaneous and successive synthesis. Unpublished doctoral dissertation, Department of Educational Psychology, University of Alberta.

Due to copyright restrictions page 118 has been removed. This page contains an Example of the Visual Search (Letter-Letter) Task, obtained from Ashman, A. (1978). The relationship between planning and simultaneous and successive synthesis. Unpublished doctoral dissertation, Department of Educational Psychology, University of Alberta.

Due to copyright restrictions page 119 has been removed. This page contains Diagrams of the Visual Search Apparatus Closed and Cut-Away Views, obtained from Ashman, A. (1978). The relationship between planning and simultaneous and successive synthesis. Unpublished doctoral dissertation, Department of Educational Psychology, University of Alberta.

APPENDIX 3

Trail-Making Task

Due to copyright restrictions page 121 has been removed. This page contains the Instructions to the Subjects, used in the Trail-Making (AB) Task, obtained from Ashman, A. (1978). The relationship between planning and simultaneous and successive synthesis. Unpublished doctoral dissertation, Department of Educational Psychology, University of Alberta.

Due to copyright restrictions page 122 has been removed. This page contains an Example of the Trail-Making (AB) Task, obtained from Ashman, A. (1978). The relationship between planning and simultaneous and successive synthesis. Unpublished doctoral dissertation, Department of Educational Psychology, University of Alberta.

APPENDIX 4

Problem Solving Task

THE HYPOTHESIS SAMPLING SYSTEMS, THEIR DEFINITIONS, AND AN EXAMPLE OF THEIR MANIFESTATIONS[a]

System	Definition	Example of manifestation							
		H_1	F_1	H_2	F_2	H_3	F_3	H_4	F_4
Focusing	The subject eliminates all logically disconfirmed hypotheses on each feedback trial	big	+	big	-	green	-	X (solution)	+
Dimension checking	The subject checks all four dimensions systematically, one dimension at a time	big	+	big	-	green	-	up	-
Hypothesis checking	The subject checks all eight hypotheses systematically, one hypothesis at a time	big	+	big	-	small	-	up	-
Stimulus preference	The subject stays with one hypothesis, despite repeated disconfirmation	big	+	big	-	big	-	big	-
Position alternation	The subject alternates from one side of the card to the other throughout each probe	LRLR		RLRL		LRLR		RLRL	
Position preference	The subject chooses the same side of the card on each trail throughout each probe	LLLL (or) RRRR		LLLL (or) RRRR		LLLL (or) RRRR		LLLL (or) RRRR	

[a] H_1 = Hypothesis 1; F_1 = Feedback Trail 1

(after Gholson, 1980)

THE PROCESSING ERRORS, THEIR DEFINITIONS, AND AN EXAMPLE OF THEIR MANIFESTATION

Processing Error	Definition	Example of manifestation							
		H_1	F_1	H_2	F_2	H_3	F_3	H_4	F_4
Local Consistency	The subject fails to sample from those hypotheses included in the positive stimulus array following negative feedback.	big	+	big	-	y	-	red	-
Unsystematic sequencies	The subject retains a disconfirmed hypothesis and then rejects it.	big	+	big	-	big	-	green	-
Shift	The subject rejects a confirmed hypothesis.	big	+	small	-	down	-	yellow	-

[a] H_1 = Hypothesis 1; F_1 = Feedback Trail 1

(after Gholson, 1980)

A. Instructions to the subjects

Training Series

"I want to find out how children solve problems.

Here, I have some cards (indicate the first set of training cards). These cards make up one problem. The problem will have only one answer. Each card will always have two letters. The letters will have two colours. The letters will have two sizes. The letters will also have a line either above or below them. (Point out the values on the card as you speak).

On this card (select the first card from the first training problem), the two letters are ___ and ____; the two colours are ___ and ___; the two sizes are ___ and ___; and the two lines are ___ and ___. (Have the subject point to, and verbalize the 8 values). Now, there are 8 things on this card, aren't there? (Name the 8 values). I have decided that one of the letters, or one of the colours or one of the sizes, or one of the lines is the right answers. I want you to try to work out which one of the 8 things is the right answer. I want you to give me your "best [illegible], or tell me what you think the answer is, then I want you to point to the answer on the card. If you are going right I will say "Yes, the answer is in this picture." If you are going wrong, I will say "No, the answer is in the other picture." Do you understand? (Have the subject verbalize the instructions to ensure understanding.)

B. Training Problem 1

Here, is the first problem. Can you tell me the names of the 8 things on the card? (Check the subjects response, and supply the names of any missing values). Good. Now remember, only one of those things is

the right answer. Now, what is your best bet? Which one do you think is the right answer? (Wait for the subject's response and cue him/her to point to the value if necessary). (Respond to the subject's choice with the appropriate feedback). After M trials, stop the subject and say "do you notice what one is right all the time?" (If the subject gives an incorrect answer or says I don't know, provide him/her with a hint) Try one of the ___ (whatever the relevant dimension is.) (If the subject gives a compound answer e.g., big R, remind him/her that only one attribute at a time can be right.) Remember, only one thing at a time can be right. (If at the end of the problem, the subject is unable to verbalize the correct solution, present the same problem and ask the subject to pick out every problem containing the correct attribute). "On these cards try ___ and see what happens. You see every time you chose ___ I said "yes, the answer is in that picture." What do you think that means? (Wait for the subject to explain.) Yes, it means that ___ is coming up right all the time. So what do you think the right answer is? (Wait fo the subject's response) Very good, It means that ___ is the right answer.

C. Training Problem 2

The same set of cards is used for training problem 2, using another relevant attribute: Can you name the 8 things for me? (Supply the names of any missing values). Good, that was well done. Remember, that I have decided that one of the 8 things is the right answer to the problem. That is, I have decided that one of the letters, or one of the colours, or one of the sizes, or one of the lines is the right answer, and I want you to try to figure out which one it is. Do you understand?

(Check the subject's understanding of the problem so far). For each card I show you, I want you to tell me which of the 8 things you think is the right answer, that is, give me your "best bet" as to the right answer. Then I want you to point to the thing on the card you tell me Do you understand? (Check the subject's understanding of the instructions so far). If you are right, I will say "yes, the answer is in that picture," but if you are wrong, I will say "no, the answer is in the picture" (Demonstrate). That way you will be able to figure out whether the correct answer is one of the letters, one of the colours or one of the sizes or one of the lines. Do you understand? (Again, have the subject verbalize the instructions to ensure understanding.)

D. Training Problems 3 and 4

These problems use two different sets of cards from those used previously. The instructions are the same as in training problem 2.

E. Training Problem 5

This problem utilizes yet a different set of cards. Requests for "best bets" are discontinued after this training series. By now, they are generally given voluntarily.

F. Experimental Series

The experimental problems are presented immediately after the training problems. At this stage, the subject voluntary names the 8 values at the outset of each problem. No cues are given to the subject to assist in solving the problem. "The rest of the problems are just like the ones you did. Remember, tell me which one of the 8 things you

think is right, point to it on the card, and listen carefully to what I say, to know if you are going right or wrong. Ready?" (The nine experimental problems are presented and the subjects and hypotheses and choices are recorded on the response sheet). A criterion of five consecutive correct responses was used to indicate that a problem was solved. In addition, after each problem, the subject was asked to verbalize the solution to the problem. At the end of the nine experimmental problems, the subject was asked to indicate how the solutions were reached. This was to provide confirmatory evidence of the strategies used.

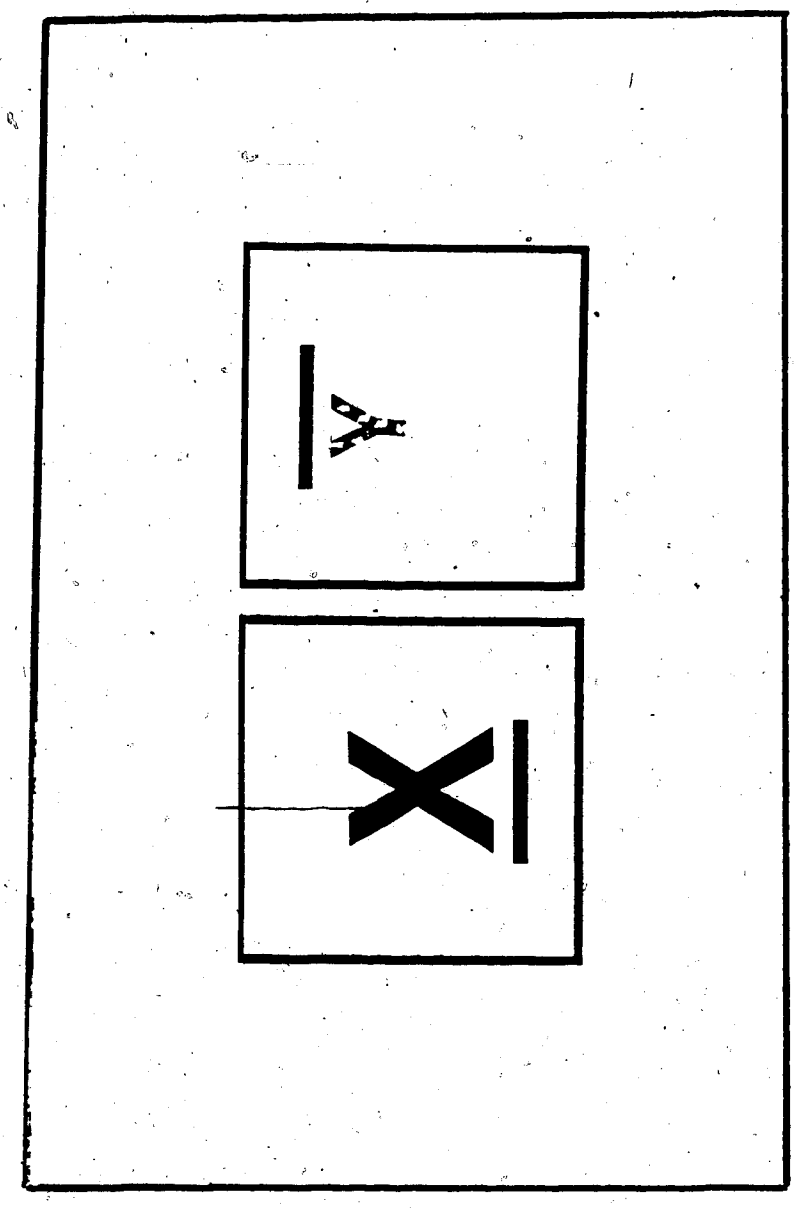
STIMULI USED IN THE PROBLEM SOLVING TASK

DIMENSIONS

LETTER	COLOUR		SIZE		LINE POSITION	
C M	red	blue	big	small	up	down
Z W	blue	green	big	small	up	down
V P	green	yellow	big	small	up	down
S N	green	red	big	small	up	down
E U	green	yellow	big	small	up	down
O A	red	blue	big	small	up	down
D F	yellow	red	big	small	up	down
T L	blue	yellow	big	small	up	down
X Y	red	green	big	small	up	down

EXAMPLE OF STIMULUS CARD

(CARD 1)



APPENDIX 5

Statistical Tables

Table 8

Means (Standard Deviations) and Range of the Processing Errors for the Total Sample.

ERROR 1 (local consistency error)	ERROR 2 (shift)	ERROR 3 (unsystematic sequence)
1.283	.632	1.358
(1.285)	(1.054)	(1.818)
0 - 6	0 - 5	0 - 5

Table 10

Observed, Expected Frequencies and Residuals for Reading Group Main Effects.

Factor	Code	OBS. count & PCT.	EXP. count & PCT.	Residual	Std. Resid.
GROUP	1				
PROBLEM	1				
STRATEGY	1	8.00 (1.37)	9.00 (1.54)	-1.0000	-.3333
STRATEGY	2	8.00 (1.37)	11.00 (1.88)	-3.0000	-.9045
STRATEGY	3	11.00 (1.88)	15.50 (2.65)	-4.5000	-1.1430
PROBLEM	2				
STRATEGY	1	8.00 (1.37)	10.00 (1.71)	-2.0000	-.6325
STRATEGY	2	4.00 (.68)	7.50 (1.28)	-3.5000	-1.2780
STRATEGY	3	15.00 (2.56)	16.50 (2.82)	-1.5000	-.3693
PROBLEM	3				
STRATEGY	1	8.00 (1.37)	7.50 (1.28)	.5000	.1826
STRATEGY	2	4.00 (.68)	9.50 (1.62)	-5.5000	-1.7844
STRATEGY	3	10.00 (1.71)	15.50 (2.65)	-5.5000	-1.3970
PROBLEM	4				
STRATEGY	1	11.00 (1.88)	9.50 (1.62)	1.5000	.4867
STRATEGY	2	7.00 (1.19)	12.50 (2.13)	-5.5000	-1.5556
STRATEGY	3	4.00 (.68)	5.00 (.85)	-1.0000	-.4472
PROBLEM	5				
STRATEGY	1	7.00 (1.19)	7.50 (1.28)	-.5000	-.1826
STRATEGY	2	6.00 (1.02)	16.00 (2.73)	-10.0000	-2.5000
STRATEGY	3	3.00 (.51)	5.00 (.85)	-2.0000	-.8944
PROBLEM	6				
STRATEGY	1	5.00 (.85)	8.50 (1.45)	-3.5000	-1.2005
STRATEGY	2	9.00 (1.54)	13.00 (2.22)	-4.0000	-1.1094
STRATEGY	3	8.00 (1.37)	10.00 (1.71)	-2.0000	-.6325
PROBLEM	7				
STRATEGY	1	9.00 (1.54)	11.00 (1.88)	-2.0000	-.6030
STRATEGY	2	7.00 (1.19)	12.00 (2.05)	-5.0000	-1.4434
STRATEGY	3	4.00 (.68)	9.00 (1.54)	-5.0000	-1.6667
PROBLEM	8				
STRATEGY	1	9.00 (1.54)	13.00 (2.22)	-4.0000	-1.1094
STRATEGY	2	6.00 (1.02)	11.00 (1.88)	-5.0000	-1.5076
STRATEGY	3	10.00 (1.71)	12.00 (2.05)	-2.0000	-.5774
PROBLEM	9				
STRATEGY	1	7.00 (1.19)	10.00 (1.71)	-3.0000	-.9487
STRATEGY	2	4.00 (.68)	9.50 (1.62)	-5.5000	-1.7844
STRATEGY	3	9.00 (1.54)	16.50 (2.82)	-7.5000	-1.8464

GROUP	2				
PROBLEM	1				
STRATEGY	1	10.00 (1.71)	9.00 (1.54)	1.0000	.3333
STRATEGY	2	14.00 (2.39)	11.00 (1.88)	3.0000	.9045
STRATEGY	3	20.00 (3.41)	15.50 (2.65)	4.5000	1.1430
PROBLEM	2				
STRATEGY	1	12.00 (2.05)	10.00 (1.71)	2.0000	.6325
STRATEGY	2	11.00 (1.88)	7.50 (1.28)	3.5000	1.2780
STRATEGY	3	18.00 (3.07)	16.50 (2.82)	1.5000	.3693
PROBLEM	3				
STRATEGY	1	7.00 (1.19)	7.50 (1.28)	-.5000	-.1826
STRATEGY	2	15.00 (2.56)	9.50 (1.62)	5.5000	1.7844
STRATEGY	3	21.00 (3.58)	15.50 (2.65)	5.5000	1.3970
PROBLEM	4				
STRATEGY	1	8.00 (1.37)	9.50 (1.62)	-1.5000	-.4867
STRATEGY	2	18.00 (3.07)	12.50 (2.13)	5.5000	1.5556
STRATEGY	3	6.00 (1.02)	5.00 (.85)	1.0000	.4472
PROBLEM	5				
STRATEGY	1	8.00 (1.37)	7.50 (1.28)	.5000	.1826
STRATEGY	2	26.00 (4.44)	16.00 (2.73)	10.0000	2.5000
STRATEGY	3	7.00 (1.19)	5.00 (.85)	2.0000	.8944
PROBLEM	6				
STRATEGY	1	12.00 (2.05)	8.50 (1.45)	3.5000	1.2005
STRATEGY	2	17.00 (2.90)	13.00 (2.22)	4.0000	1.1094
STRATEGY	3	12.00 (2.05)	10.00 (1.71)	2.0000	.6325
PROBLEM	7				
STRATEGY	1	13.00 (2.22)	11.00 (1.88)	2.0000	.6030
STRATEGY	2	17.00 (2.90)	12.00 (2.05)	5.0000	1.4434
STRATEGY	3	14.00 (2.39)	9.00 (1.54)	5.0000	1.6667
PROBLEM	8				
STRATEGY	1	17.00 (2.90)	13.00 (2.22)	4.0000	1.1094
STRATEGY	2	16.00 (2.73)	11.00 (1.88)	5.0000	1.5076
STRATEGY	3	14.00 (2.39)	12.00 (2.05)	2.0000	.5774
PROBLEM	9				
STRATEGY	1	13.00 (2.22)	10.00 (1.71)	3.0000	.9487
STRATEGY	2	15.00 (2.56)	9.50 (1.62)	5.5000	1.7844
STRATEGY	3	24.00 (4.10)	16.50 (2.82)	7.5000	1.8464

NOTE: Strategy: 1 = Hypothesis Checking; 2 = Dimension Checking; 3 = Focusing
Group 1 = Poor Readers; Group 2 = Good Readers

Table 11

Observed, Expected Frequencies and Residuals for Reading Group X Strategy Interaction Effects.

Factor	Code	OBS. count & PCT.	EXP. count & PCT.	Residual	Std. Resid.
GROUP	1				
PROBLEM	1				
STRATEGY	1	8.00 (1.37)	6.52 (1.11)	1.4838	.5813
STRATEGY	2	8.00 (1.37)	9.58 (1.63)	-1.5811	-.5108
STRATEGY	3	11.00 (1.88)	10.90 (1.86)	.0973	.0295
PROBLEM	2				
STRATEGY	1	8.00 (1.37)	6.52 (1.11)	1.4838	.5813
STRATEGY	2	4.00 (.68)	5.58 (.95)	-1.5811	-.6693
STRATEGY	3	15.00 (2.56)	14.90 (2.54)	.0973	.0252
PROBLEM	3				
STRATEGY	1	8.00 (1.37)	6.52 (1.11)	1.4838	.5813
STRATEGY	2	4.00 (.68)	5.58 (.95)	-1.5811	-.6693
STRATEGY	3	10.00 (1.71)	9.90 (1.69)	.0973	.0309
PROBLEM	4				
STRATEGY	1	11.00 (1.88)	9.52 (1.62)	1.4838	.4810
STRATEGY	2	7.00 (1.19)	8.58 (1.46)	-1.5811	-.5397
STRATEGY	3	4.00 (.68)	3.90 (.67)	.0973	.0493
PROBLEM	5				
STRATEGY	1	7.00 (1.19)	5.52 (.94)	1.4838	.6318
STRATEGY	2	6.00 (1.02)	7.58 (1.29)	-1.5811	-.5742
STRATEGY	3	3.00 (.51)	2.90 (.50)	.0973	.0571
PROBLEM	6				
STRATEGY	1	5.00 (.85)	3.52 (.60)	1.4838	.7913
STRATEGY	2	9.00 (1.54)	10.58 (1.81)	-1.5811	-.4861
STRATEGY	3	8.00 (1.37)	7.90 (1.35)	.0973	.0346
PROBLEM	7				
STRATEGY	1	9.00 (1.54)	7.52 (1.28)	1.4838	.5412
STRATEGY	2	7.00 (1.19)	8.58 (1.46)	-1.5811	-.5397
STRATEGY	3	4.00 (.68)	3.90 (.67)	.0973	.0493
PROBLEM	8				
STRATEGY	1	9.00 (1.54)	7.52 (1.28)	1.4838	.5412
STRATEGY	2	6.00 (1.02)	7.58 (1.29)	-1.5811	-.5742
STRATEGY	3	10.00 (1.71)	9.90 (1.69)	.0973	.0309
PROBLEM	9				
STRATEGY	1	7.00 (1.19)	5.52 (.94)	1.4838	.6318
STRATEGY	2	4.00 (.68)	5.58 (.95)	-1.5811	-.6693
STRATEGY	3	9.00 (1.54)	8.90 (1.52)	.0973	.0326

GROUP	2				
PROBLEM	1				
STRATEGY	1	10.00 (1.71)	11.48 (1.96)	-1.4838	-.4378
STRATEGY	2	14.00 (2.39)	12.42 (2.12)	1.5811	.4487
STRATEGY	3	20.00 (3.41)	20.10 (3.43)	-.0973	-.0217
PROBLEM	2				
STRATEGY	1	12.00 (2.05)	13.48 (2.30)	-1.4838	-.4041
STRATEGY	2	11.00 (1.88)	9.42 (1.61)	1.5811	.5152
STRATEGY	3	18.00 (3.07)	18.10 (3.09)	-.0973	-.0229
PROBLEM	3				
STRATEGY	1	7.00 (1.19)	8.48 (1.45)	-1.4838	-.5094
STRATEGY	2	15.00 (2.56)	13.42 (2.29)	1.5811	.4316
STRATEGY	3	21.00 (3.58)	21.10 (3.60)	-.0973	-.0212
PROBLEM	4				
STRATEGY	1	8.00 (1.37)	9.48 (1.62)	-1.4838	-.4818
STRATEGY	2	18.00 (3.07)	16.42 (2.80)	1.5811	.3902
STRATEGY	3	6.00 (1.02)	6.10 (1.04)	-.0973	-.0394
PROBLEM	5				
STRATEGY	1	8.00 (1.37)	9.48 (1.62)	-1.4838	-.4818
STRATEGY	2	26.00 (4.44)	24.42 (4.17)	1.5811	.3200
STRATEGY	3	7.00 (1.19)	7.10 (1.21)	-.0973	-.0365
PROBLEM	6				
STRATEGY	1	12.00 (2.05)	13.48 (2.30)	-1.4838	-.4041
STRATEGY	2	17.00 (2.90)	15.42 (2.63)	1.5811	.4026
STRATEGY	3	12.00 (2.05)	12.10 (2.06)	-.0973	-.0280
PROBLEM	7				
STRATEGY	1	13.00 (2.22)	14.48 (2.47)	-1.4838	-.3899
STRATEGY	2	17.00 (2.90)	15.42 (2.63)	1.5811	.4026
STRATEGY	3	14.00 (2.39)	14.10 (2.41)	-.0973	-.0259
PROBLEM	8				
STRATEGY	1	17.00 (2.90)	18.48 (3.15)	-1.4838	-.3451
STRATEGY	2	16.00 (2.73)	14.42 (2.46)	1.5811	.4164
STRATEGY	3	14.00 (2.39)	14.10 (2.41)	-.0973	-.0259
PROBLEM	9				
STRATEGY	1	13.00 (2.22)	14.48 (2.47)	-1.4838	-.3899
STRATEGY	2	15.00 (2.56)	13.42 (2.29)	1.5811	.4316
STRATEGY	3	24.00 (4.10)	24.10 (4.11)	-.0973	-.0198

NOTE: Strategy: 1 = Hypothesis Checking; 2 = Dimension Checking; 3 = Focusing
Group 1 = Poor Readers; Group 2 = Good Readers

Table 12

Means (Standard Deviations) and Number of Poor and Good Readers who obtain Low, Medium or High Motivation Scores.

	Motivation Scores		
	Low	Medium	High
Poor Readers	2.173 (.242) N=23	2.861 (.161) N=10	3.521 (.270) N=10
Good Readers	2.789 (.166) N=9	3.173 (.128) N=32	3.727 (.186) N=22

Table 13

Means (Standard Deviations) and Number of Poor and Good Readers who obtain Low, Medium or High Information Scores.

	Information Scores		
	Low	Medium	High
Poor Readers	1.455 (.154) N=13	2.034 (.167) N=17	2.679 (.280) N=13
Good Readers	1.981 (.193) N=20	2.454 (.123) N=25	3.046 (.207) N=18

Table 19

Observed, Expected Frequencies and Residuals for Motivation Main Effects.

Factor	Code	OBS. count & PCT.	EXP. count & PCT.	Residual	Std. Resid.
PROBLEM	1				
STRATEGY	1				
MOTIVE	1	5.00 (.85)	6.79 (1.16)	-1.7943	-.6884
MOTIVE	2	7.00 (1.19)	5.28 (.90)	1.7239	.7505
MOTIVE	3	6.00 (1.02)	5.93 (1.01)	.0704	.0289
STRATEGY	2				
MOTIVE	1	8.00 (1.37)	9.79 (1.67)	-1.7943	-.5733
MOTIVE	2	9.00 (1.54)	7.28 (1.24)	1.7239	.6391
MOTIVE	3	5.00 (.85)	4.93 (.84)	.0704	.0317
STRATEGY	3				
MOTIVE	1	8.00 (1.37)	9.79 (1.67)	-1.7943	-.5733
MOTIVE	2	10.00 (1.71)	8.28 (1.41)	1.7239	.5992
MOTIVE	3	13.00 (2.22)	12.93 (2.21)	.0704	.0196
PROBLEM	2				
STRATEGY	1				
MOTIVE	1	5.00 (.85)	6.79 (1.16)	-1.7943	-.6884
MOTIVE	2	9.00 (1.54)	7.28 (1.24)	1.7239	.6391
MOTIVE	3	6.00 (1.02)	5.93 (1.01)	.0704	.0289
STRATEGY	2				
MOTIVE	1	4.00 (.68)	5.79 (.99)	-1.7943	-.7454
MOTIVE	2	6.00 (1.02)	4.28 (.73)	1.7239	.8337
MOTIVE	3	5.00 (.85)	4.93 (.84)	.0704	.0317
STRATEGY	3				
MOTIVE	1	9.00 (1.54)	10.79 (1.84)	-1.7943	-.5461
MOTIVE	2	10.00 (1.71)	8.28 (1.41)	1.7239	.5992
MOTIVE	3	14.00 (2.39)	13.93 (2.38)	.0704	.0189
PROBLEM	3				
STRATEGY	1				
MOTIVE	1	5.00 (.85)	6.79 (1.16)	-1.7943	-.6884
MOTIVE	2	5.00 (.85)	3.28 (.56)	1.7239	.9524
MOTIVE	3	5.00 (.85)	4.93 (.84)	.0704	.0317
STRATEGY	2				
MOTIVE	1	4.00 (.68)	5.79 (.99)	-1.7943	-.7454
MOTIVE	2	8.00 (1.37)	6.28 (1.07)	1.7239	.6881
MOTIVE	3	7.00 (1.19)	6.93 (1.18)	.0704	.0267
STRATEGY	3				

MOTIVE	1	7.00 (1.19)	8.79 (1.50)	-1.7943	-.6051
MOTIVE	2	15.00 (2.56)	13.28 (2.27)	1.7239	.4731
MOTIVE	3	9.00 (1.54)	8.93 (1.52)	.0704	.0236
PROBLEM	4				
STRATEGY	1				
MOTIVE	1	7.00 (1.19)	8.79 (1.50)	-1.7943	-.6051
MOTIVE	2	8.00 (1.37)	6.28 (1.07)	1.7239	.6881
MOTIVE	3	4.00 (.68)	3.93 (.67)	.0704	.0355
STRATEGY	2				
MOTIVE	1	8.00 (1.37)	9.79 (1.67)	-1.7943	-.5733
MOTIVE	2	11.00 (1.88)	9.28 (1.58)	1.7239	.5660
MOTIVE	3	6.00 (1.02)	5.93 (1.01)	.0704	.0289
STRATEGY	3				
MOTIVE	1	1.00 (.17)	2.79 (.48)	-1.7943	-1.0734
MOTIVE	2	3.00 (.51)	1.28 (.22)	1.7239	1.5261
MOTIVE	3	6.00 (1.02)	5.93 (1.01)	.0704	.0289
PROBLEM	5				
STRATEGY	1				
MOTIVE	1	3.00 (.51)	4.79 (.82)	-1.7943	-.8195
MOTIVE	2	4.00 (.68)	2.28 (.39)	1.7239	1.1427
MOTIVE	3	8.00 (1.37)	7.93 (1.35)	.0704	.0250
STRATEGY	2				
MOTIVE	1	6.00 (1.02)	7.79 (1.33)	-1.7943	-.6427
MOTIVE	2	16.00 (2.73)	14.28 (2.44)	1.7239	.4563
MOTIVE	3	10.00 (1.71)	9.93 (1.69)	.0704	.0223
STRATEGY	3				
MOTIVE	1	3.00 (.51)	4.79 (.82)	-1.7943	-.8195
MOTIVE	2	4.00 (.68)	2.28 (.39)	1.7239	1.1427
MOTIVE	3	3.00 (.51)	2.93 (.50)	.0704	.0411
PROBLEM	6				
STRATEGY	1				
MOTIVE	1	3.00 (.51)	4.79 (.82)	-1.7943	-.8195
MOTIVE	2	10.00 (1.71)	8.28 (1.41)	1.7239	.5992
MOTIVE	3	4.00 (.68)	3.93 (.67)	.0704	.0355
STRATEGY	2				
MOTIVE	1	5.00 (.85)	6.79 (1.16)	-1.7943	-.6884
MOTIVE	2	12.00 (2.05)	10.28 (1.75)	1.7239	.5378
MOTIVE	3	9.00 (1.54)	8.93 (1.52)	.0704	.0236
STRATEGY	3				
MOTIVE	1	5.00 (.85)	6.79 (1.16)	-1.7943	-.6884
MOTIVE	2	5.00 (.85)	3.28 (.56)	1.7239	.9524
MOTIVE	3	10.00 (1.71)	9.93 (1.69)	.0704	.0223

PROBLEM	7				
STRATEGY	1				
MOTIVE	1	2.00 (.34)	3.79 (.65)	-1.7943	-.9212
MOTIVE	2	11.00 (1.88)	9.28 (1.58)	1.7239	.5660
MOTIVE	3	9.00 (1.54)	8.93 (1.52)	.0704	.0236
STRATEGY	2				
MOTIVE	1	2.00 (.34)	3.79 (.65)	-1.7943	-.9212
MOTIVE	2	12.00 (2.05)	10.28 (1.75)	1.7239	.5878
MOTIVE	3	10.00 (1.71)	9.93 (1.69)	.0704	.0223
STRATEGY	3				
MOTIVE	1	5.00 (.85)	6.79 (1.16)	-1.7943	-.6884
MOTIVE	2	8.00 (1.37)	6.28 (1.07)	1.7239	.6881
MOTIVE	3	5.00 (.85)	4.93 (.84)	.0704	.0317
PROBLEM	8				
STRATEGY	1				
MOTIVE	1	8.00 (1.37)	9.79 (1.67)	-1.7943	-.5733
MOTIVE	2	10.00 (1.71)	8.28 (1.41)	1.7239	.5992
MOTIVE	3	8.00 (1.37)	7.93 (1.35)	.0704	.0250
STRATEGY	2				
MOTIVE	1	5.00 (.85)	6.79 (1.16)	-1.7943	-.6884
MOTIVE	2	13.00 (2.22)	11.28 (1.92)	1.7239	.5134
MOTIVE	3	4.00 (.68)	3.93 (.67)	.0704	.0355
STRATEGY	3				
MOTIVE	1	4.00 (.68)	5.79 (.99)	-1.7943	-.7454
MOTIVE	2	11.00 (1.88)	9.28 (1.58)	1.7239	.5660
MOTIVE	3	9.00 (1.54)	8.93 (1.52)	.0704	.0236
PROBLEM	9				
STRATEGY	1				
MOTIVE	1	5.00 (.85)	6.79 (1.16)	-1.7943	-.6884
MOTIVE	2	11.00 (1.88)	9.28 (1.58)	1.7239	.5660
MOTIVE	3	4.00 (.68)	3.93 (.67)	.0704	.0355
STRATEGY	2				
MOTIVE	1	4.00 (.68)	5.79 (.99)	-1.7943	-.7454
MOTIVE	2	9.00 (1.54)	7.28 (1.24)	1.7239	.6391
MOTIVE	3	6.00 (1.02)	5.93 (1.01)	.0704	.0289
STRATEGY	3				
MOTIVE	1	9.00 (1.54)	10.79 (1.84)	-1.7943	-.5461
MOTIVE	2	14.00 (2.39)	12.28 (2.09)	1.7239	.4920
MOTIVE	3	10.00 (1.71)	9.93 (1.69)	.0704	.0223

NOTE: Strategy: 1 = Hypothesis Checking; 2 = Dimension Checking; 3 = Focusing
MOTIVE = Motivation: 1 = lower 30% (extrinsic); 2 = middle 40% (intermediate); 3 = upper 30% (intrinsic)

Table 20

Summary of the Goodness-of-Fit Test Statistic for the Main Effects of Information, Strategy Type, and Interaction Effects of Information and Strategy.

Model	df	Likelihood Ratio Chi Square	Prob.	Pearson Chi Square	Prob.
S,P,SxP,SxI,PxI, SxPxI (I omitted)	2	194.579	0.000	131260.172	0.000
I,P,IxP,IxS,PxS, IxPxS (S omitted)	2	0.000	1.000	0.000	1.000
I,P,S,IxP,PxS, IxPxS (IxS omitted)	4	3.689	0.815	3.853	0.797

NOTE: (I = Information level, S = Strategy type, P = Problem Number)

Table 21

Observed, Expected Frequencies and Residuals for Information Main Effects.

Factor	Code	OBS. count & PCT.	EXP. count & PCT.	Residual	Std. Resid.
PROBLEM	1				
STRATEGY	1				
INFO	1	.00 (.00)	5.47 (.85)	-5.4672	-2.3382
INFO	2	14.00 (2.19)	11.00 (1.72)	2.9999	.9045
INFO	3	4.00 (.62)	3.56 (.56)	.4423	.2345
STRATEGY	2				
INFO	1	2.00 (.31)	7.47 (1.17)	-5.4672	-2.0007
INFO	2	11.00 (1.72)	8.00 (1.25)	2.9999	1.0606
INFO	3	9.00 (1.40)	8.56 (1.34)	.4423	.1512
STRATEGY	3				
INFO	1	3.00 (.47)	8.47 (1.32)	-5.4672	-1.8789
INFO	2	16.00 (2.50)	13.00 (2.03)	2.9999	.8320
INFO	3	12.00 (1.87)	11.56 (1.80)	.4423	.1301
PROBLEM	2				
STRATEGY	1				
INFO	1	1.00 (.16)	6.47 (1.01)	-5.4672	-2.1498
INFO	2	13.00 (2.03)	10.00 (1.56)	2.9999	.9487
INFO	3	6.00 (.94)	5.56 (.87)	.4423	.1876
STRATEGY	2				
INFO	1	.00 (.00)	5.47 (.85)	-5.4672	-2.3382
INFO	2	9.00 (1.40)	6.00 (.94)	2.9999	1.2247
INFO	3	6.00 (.94)	5.56 (.87)	.4423	.1876
STRATEGY	3				
INFO	1	1.00 (.16)	6.47 (1.01)	-5.4672	-2.1498
INFO	2	16.00 (2.50)	13.00 (2.03)	2.9999	.8320
INFO	3	16.00 (2.50)	15.56 (2.43)	.4424	.1121
PROBLEM	3				
STRATEGY	1				
INFO	1	1.00 (.16)	6.47 (1.01)	-5.4672	-2.1498
INFO	2	11.00 (1.72)	8.00 (1.25)	2.9999	1.0606
INFO	3	3.00 (.47)	2.56 (.40)	.4423	.2766
STRATEGY	2				
INFO	1	.00 (.00)	5.47 (.85)	-5.4672	-2.3382
INFO	2	11.00 (1.72)	8.00 (1.25)	2.9999	1.0606
INFO	3	8.00 (1.25)	7.56 (1.18)	.4423	.1609

STRATEGY	3				
INFO	1	1.00 (.16)	6.47 (1.01)	-5.4672	-2.1498
INFO	2	17.00 (2.65)	14.00 (2.19)	2.9999	.8018
INFO	3	13.00 (2.03)	12.56 (1.96)	.4424	.1248
PROBLEM	4				
STRATEGY	1				
INFO	1	2.00 (.31)	7.47 (1.17)	-5.4672	-2.0007
INFO	2	14.00 (2.19)	11.00 (1.72)	2.9999	.9045
INFO	3	3.00 (.47)	2.56 (.40)	.4423	.2766
STRATEGY	2				
INFO	1	1.00 (.16)	6.47 (1.01)	-5.4672	-2.1498
INFO	2	19.00 (2.97)	16.00 (2.50)	2.9999	.7500
INFO	3	5.00 (.78)	4.56 (.71)	.4423	.2072
STRATEGY	3				
INFO	1	.00 (.00)	5.47 (.85)	-5.4672	-2.3382
INFO	2	3.00 (.47)	.00 (.00)	2.9999	362.0839
INFO	3	7.00 (1.09)	6.56 (1.02)	.4423	.1727
PROBLEM	5				
STRATEGY	1				
INFO	1	.00 (.00)	5.47 (.85)	-5.4672	-2.3382
INFO	2	11.00 (1.72)	8.00 (1.25)	2.9999	1.0606
INFO	3	4.00 (.62)	3.56 (.56)	.4423	.2345
STRATEGY	2				
INFO	1	1.00 (.16)	6.47 (1.01)	-5.4672	-2.1498
INFO	2	15.00 (2.34)	12.00 (1.87)	2.9999	.8660
INFO	3	16.00 (2.50)	15.56 (2.43)	.4424	.1121
STRATEGY	3				
INFO	1	.00 (.00)	5.47 (.85)	-5.4672	-2.3382
INFO	2	9.00 (1.40)	6.00 (.94)	2.9999	1.2247
INFO	3	1.00 (.16)	.56 (.09)	.4423	.5923
PROBLEM	6				
STRATEGY	1				
INFO	1	.00 (.00)	5.47 (.85)	-5.4672	-2.3382
INFO	1	12.00 (1.87)	9.00 (1.40)	2.9999	1.0000
INFO	3	5.00 (.78)	4.56 (.71)	.4423	.2072
STRATEGY	2				
INFO	1	2.00 (.31)	7.47 (1.17)	-5.4672	-2.0007
INFO	2	16.00 (2.50)	13.00 (2.03)	2.9999	.8320
INFO	3	8.00 (1.25)	7.56 (1.18)	.4423	.1609
STRATEGY	3				
INFO	1	.00 (.00)	5.47 (.85)	-5.4672	-2.3382
INFO	2	8.00 (1.25)	5.00 (.78)	2.9999	1.3416
INFO	3	12.00 (1.87)	11.56 (1.80)	.4423	.1301

PROBLEM	7				
STRATEGY	1				
INFO	1	1.00 (.16)	6.47 (1.01)	-5.4672	-2.1498
INFO	2	10.00 (1.56)	7.00 (1.09)	2.9999	1.1339
INFO	3	11.00 (1.72)	10.56 (1.65)	.4423	.1361
STRATEGY	2				
INFO	1	1.00 (.16)	6.47 (1.01)	-5.4672	-2.1498
INFO	2	11.00 (1.72)	8.00 (1.25)	2.9999	1.0606
INFO	3	12.00 (1.87)	11.56 (1.80)	.4423	.1301
STRATEGY	3				
INFO	1	.00 (.00)	5.47 (.85)	-5.4672	-2.3382
INFO	2	13.00 (2.03)	10.00 (1.56)	2.9999	.9487
INFO	3	5.00 (.78)	4.56 (.71)	.4423	.2072
PROBLEM	8				
STRATEGY	1				
INFO	1	1.00 (.16)	6.47 (1.01)	-5.4672	-2.1498
INFO	2	15.00 (2.34)	12.00 (1.87)	2.9999	.8660
INFO	3	10.00 (1.56)	9.56 (1.49)	.4423	.1431
STRATEGY	2				
INFO	1	1.00 (.16)	6.47 (1.01)	-5.4672	-2.1498
INFO	2	14.00 (2.19)	11.00 (1.72)	2.9999	.9045
INFO	3	7.00 (1.09)	6.56 (1.02)	.4423	.1727
STRATEGY	3				
INFO	1	3.00 (.47)	8.47 (1.32)	-5.4672	-1.8789
INFO	2	13.00 (2.03)	10.00 (1.56)	2.9999	.9487
INFO	3	8.00 (1.25)	7.56 (1.18)	.4423	.1609
PROBLEM	9				
STRATEGY	1				
INFO	1	1.00 (.16)	6.47 (1.01)	-5.4672	-2.1498
INFO	2	12.00 (1.87)	9.00 (1.40)	2.9999	1.0000
INFO	3	7.00 (1.09)	6.56 (1.02)	.4423	.1727
STRATEGY	2				
INFO	1	.00 (.00)	5.47 (.85)	-5.4672	-2.3382
INFO	2	14.00 (2.19)	11.00 (1.72)	2.9999	.9045
INFO	3	5.00 (.78)	4.56 (.71)	.4423	.2072
STRATEGY	3				
INFO	1	1.00 (.16)	6.47 (1.01)	-5.4672	-2.1498
INFO	2	19.00 (2.97)	16.00 (2.50)	2.9999	.7500
INFO	3	13.00 (2.03)	12.56 (1.96)	.4424	.1248

NOTE: Strategy: 1 = Hypothesis Checking; 2 = Dimension Checking; 3 = Focusing
INFO = Information: 1 = Lower 30% (extrinsic); 2 = Middle 40% (intermediate); 3 = Upper 30% (intrinsic)

Table 22

Means (Standard Deviations) and Number of Poor and Good Readers who obtain Low, Medium or High Trail-Making (AB) Scores.

	Trail-Making (ab) Scores		
	Low	Medium	High
Poor Readers	36.822 (3.665) N=11	47.344 (2.524) N=16	60.535 (8.808) N=16
Good Readers	33.274 (4.236) N=21	42.951 (2.172) N=26	54.983 (6.478) N=16

Table 23

Means (Standard Deviations) and Number of Poor and Good Readers who obtain Low, Medium or Visual Search (total) Scores.

	Visual Search (total) Scores		
	Low	Medium	High
Poor Readers	1.443 (.383) N=13	2.122 (.214) N=17	2.930 (.451) N=13
Good Readers	1.464 (.166) N=19	1.919 (.141) N=25	2.581 (.418) N=19

Table 24

Means (Standard Deviations) and Number of Poor and Good Readers who obtain Low, Medium or Visual Search (letter-letter) Scores.

	Visual Search (letter-letter) Scores		
	Low	Medium	High
Poor Readers	2.010 (.570) N=10	3.014 (.311) N=15	4.502 (1.147) N=18
Good Readers	1.953 (.212) N=23	2.641 (.219) N=26	3.991 (1.261) N=14

Table 26

Observed, Expected Frequencies and Residuals for Trail-making (AB) Main Effects.

Factor	Code	OBS. count & PCT.	EXP. count & PCT.	Residual	Std. Resid.
PROBLEM	1				
STRATEGY	1				
TAB	1	5.00 (.85)	4.92 (.84)	.0812	.0366
TAB	2	9.00 (1.54)	8.15 (1.39)	.8535	.2990
TAB	3	4.00 (.68)	4.93 (.84)	-.9347	-.4208
STRATEGY	2				
TAB	1	7.00 (1.19)	6.92 (1.18)	.0812	.0309
TAB	2	7.00 (1.19)	6.15 (1.05)	.8535	.3442
TAB	3	8.00 (1.37)	8.93 (1.52)	-.9347	-.3127
STRATEGY	3				
TAB	1	11.00 (1.88)	10.92 (1.86)	.0812	.0246
TAB	2	12.00 (2.05)	11.15 (1.90)	.8535	.2556
TAB	3	8.00 (1.37)	8.93 (1.52)	-.9347	-.3127
PROBLEM	2				
STRATEGY	1				
TAB	1	6.00 (1.02)	5.92 (1.01)	.0812	.0334
TAB	2	12.00 (2.05)	11.15 (1.90)	.8535	.2556
TAB	3	2.00 (.34)	2.93 (.50)	-.9347	-.5456
STRATEGY	2				
TAB	1	7.00 (1.19)	6.92 (1.18)	.0812	.0309
TAB	2	4.00 (.68)	3.15 (.54)	.8535	.4811
TAB	3	4.00 (.68)	4.93 (.84)	-.9347	-.4208
STRATEGY	3				
TAB	1	9.00 (1.54)	8.92 (1.52)	.0812	.0272
TAB	2	15.00 (2.56)	14.15 (2.41)	.8535	.2269
TAB	3	9.00 (1.54)	9.93 (1.70)	-.9347	-.2965
PROBLEM	3				
STRATEGY	1				
TAB	1	6.00 (1.02)	5.92 (1.01)	.0812	.0334
TAB	2	5.00 (.85)	4.15 (.71)	.8535	.4191
TAB	3	4.00 (.68)	4.93 (.84)	-.9347	-.4208
STRATEGY	2				
TAB	1	4.00 (.68)	3.92 (.67)	.0812	.0410
TAB	2	7.00 (1.19)	6.15 (1.05)	.8535	.3442
TAB	3	8.00 (1.37)	8.93 (1.52)	-.9347	-.3127

STRATEGY	3				
TAB	1	8.00 (1.37)	7.92 (1.35)	.0812	.0289
TAB	2	13.00 (2.22)	12.15 (2.07)	.8535	.2449
TAB	3	10.00 (1.71)	10.93 (1.87)	-.9347	-.2827
PROBLEM	4				
STRATEGY	1				
TAB	1	7.00 (1.19)	6.92 (1.18)	.0812	.0309
TAB	2	7.00 (1.19)	6.15 (1.05)	.8535	.3442
TAB	3	5.00 (.85)	5.93 (1.01)	-.9347	-.3837
STRATEGY	2				
TAB	1	10.00 (1.71)	9.92 (1.69)	.0812	.0258
TAB	2	11.00 (1.88)	10.15 (1.73)	.8535	.2679
TAB	3	4.00 (.68)	4.93 (.84)	-.9347	-.4208
STRATEGY	3				
TAB	1	3.00 (.51)	2.92 (.50)	.0812	.0475
TAB	2	1.00 (.17)	.15 (.03)	.8535	2.2295
TAB	3	6.00 (1.02)	6.93 (1.18)	-.9347	-.3549
PROBLEM	5				
STRATEGY	1				
TAB	1	5.00 (.85)	4.92 (.84)	.0812	.0366
TAB	2	4.00 (.68)	3.15 (.54)	.8535	.4811
TAB	3	6.00 (1.02)	6.93 (1.18)	-.9347	-.3549
STRATEGY	2				
TAB	1	11.00 (1.88)	10.92 (1.86)	.0812	.0246
TAB	2	13.00 (2.22)	12.15 (2.07)	.8535	.2449
TAB	3	8.00 (1.37)	8.93 (1.52)	-.9347	-.3127
STRATEGY	3				
TAB	1	2.00 (.34)	1.92 (.33)	.0812	.0586
TAB	2	5.00 (.85)	4.15 (.71)	.8535	.4191
TAB	3	3.00 (.51)	3.93 (.67)	-.9347	-.4712
PROBLEM	6				
STRATEGY	1				
TAB	1	3.00 (.51)	2.92 (.50)	.0812	.0475
TAB	2	9.00 (1.54)	8.15 (1.39)	.8535	.2990
TAB	3	5.00 (.85)	5.93 (1.01)	-.9347	-.3837
STRATEGY	2				
TAB	1	7.00 (1.19)	6.92 (1.18)	.0812	.0309
TAB	2	10.00 (1.71)	9.15 (1.56)	.8535	.2822
TAB	3	9.00 (1.54)	9.93 (1.70)	-.9347	-.2965
STRATEGY	3				
TAB	1	7.00 (1.19)	6.92 (1.18)	.0812	.0309
TAB	2	7.00 (1.19)	6.15 (1.05)	.8535	.3442
TAB	3	6.00 (1.02)	6.93 (1.18)	-.9347	-.3549

PROBLEM	7				
STRATEGY	1				
TAB	1	9.00 (1.54)	8.92 (1.52)	.0812	.0272
TAB	2	6.00 (1.02)	5.15 (.88)	.8535	.3762
TAB	3	7.00 (1.19)	7.93 (1.35)	-.9347	-.3318
STRATEGY	2				
TAB	1	9.00 (1.54)	8.92 (1.52)	.0812	.0272
TAB	2	9.00 (1.54)	8.15 (1.39)	.8535	.2990
TAB	3	6.00 (1.02)	6.93 (1.18)	-.9347	-.3549
STRATEGY	3				
TAB	1	5.00 (.85)	4.92 (.84)	.0812	.0366
TAB	2	11.00 (1.88)	10.15 (1.73)	.8535	.2679
TAB	3	2.00 (.34)	2.93 (.50)	-.9347	-.5456
PROBLEM	8				
STRATEGY	1				
TAB	1	6.00 (1.02)	5.92 (1.01)	.0812	.0334
TAB	2	14.00 (2.39)	13.15 (2.24)	.8535	.2354
TAB	3	6.00 (1.02)	6.93 (1.18)	-.9347	-.3549
STRATEGY	2				
TAB	1	10.00 (1.71)	9.92 (.69)	.0812	.0258
TAB	2	6.00 (1.02)	5.15 (.88)	.8535	.3762
TAB	3	6.00 (1.02)	6.93 (1.18)	-.9347	-.3549
STRATEGY	3				
TAB	1	9.00 (1.54)	8.92 (1.52)	.0812	.0272
TAB	2	10.00 (1.71)	9.15 (1.56)	.8535	.2822
TAB	3	5.00 (.85)	5.93 (1.01)	-.9347	-.3837
PROBLEM	9				
STRATEGY	1				
TAB	1	7.00 (1.19)	6.92 (1.18)	.0812	.0309
TAB	2	10.00 (1.71)	9.15 (1.56)	.8535	.2822
TAB	3	3.00 (.51)	3.93 (.67)	-.9347	-.4712
STRATEGY	2				
TAB	1	7.00 (1.19)	6.92 (1.18)	.0812	.0309
TAB	2	7.00 (1.19)	6.15 (1.05)	.8535	.3442
TAB	3	5.00 (.85)	5.93 (1.01)	-.9347	-.3837
STRATEGY	3				
TAB	1	11.00 (1.88)	10.92 (1.86)	.0812	.0246
TAB	2	10.00 (1.71)	9.15 (1.56)	.8535	.2822
TAB	3	12.00 (2.05)	12.93 (2.21)	-.9347	-.2599

NOTE: Strategy: 1 = Hypothesis Checking; 2 = Dimension Checking; 3 = Focusing
TAB = Trail-making (AB): 1 = lower 30% (good planners); 2 = middle 40% (intermediate planners); 3 = upper 30% (poor planners)

Table 28

Observed, Expected Frequencies and Residuals for Visual Search (total) Main Effects.

Factor	Code	OBS. count & PCT.	EXP. count & PCT.	Residual	Std. Resid.
PROBLEM	1				
STRATEGY	1				
VST	1	6.00 (1.02)	5.84 (1.00)	.1576	.0652
VST	2	7.00 (1.19)	5.35 (.91)	1.6516	.7142
VST	3	5.00 (.85)	6.81 (1.16)	-1.8092	-.6933
STRATEGY	2				
VST	1	5.00 (.85)	4.84 (.83)	.1576	.0716
VST	2	9.00 (1.54)	7.35 (1.25)	1.6516	.6093
VST	3	8.00 (1.37)	9.81 (1.67)	-1.8092	-.5777
STRATEGY	3				
VST	1	11.00 (1.88)	10.84 (1.85)	.1576	.0479
VST	2	13.00 (2.22)	11.35 (1.94)	1.6516	.4903
VST	3	7.00 (1.19)	8.81 (1.50)	-1.8092	-.6096
PROBLEM	2				
STRATEGY	1				
VST	1	7.00 (1.19)	6.84 (1.17)	.1576	.0602
VST	2	7.00 (1.19)	5.35 (.91)	1.6516	.7142
VST	3	6.00 (1.02)	7.81 (1.33)	-1.8092	-.6474
STRATEGY	2				
VST	1	5.00 (.85)	4.84 (.83)	.1576	.0716
VST	2	4.00 (.68)	2.35 (.40)	1.6516	1.0778
VST	3	6.00 (1.02)	7.81 (1.33)	-1.8092	-.6474
STRATEGY	3				
VST	1	9.00 (1.54)	8.84 (1.51)	.1576	.0530
VST	2	15.00 (2.56)	13.35 (2.28)	1.6516	.4521
VST	3	9.00 (1.54)	10.81 (1.84)	-1.8092	-.5503
PROBLEM	3				
STRATEGY	1				
VST	1	4.00 (.68)	3.84 (.66)	.1576	.0804
VST	2	7.00 (1.19)	5.35 (.91)	1.6516	.7142
VST	3	4.00 (.68)	5.81 (.99)	-1.8092	-.7506
STRATEGY	2				
VST	1	3.00 (.51)	2.84 (.49)	.1576	.0935
VST	2	11.00 (1.88)	9.35 (1.60)	1.6516	.5402
VST	3	5.00 (.85)	6.81 (1.16)	-1.8092	-.6933
STRATEGY	3				

VST	1	11.00 (1.88)	10.84 (4.85)	.1576	.0479
VST	2	13.00 (2.22)	11.35 (1.94)	1.6516	.4903
VST	3	7.00 (1.19)	8.81 (1.50)	-1.8092	-.6096
PROBLEM	4				
STRATEGY	1				
VST	1	7.00 (1.19)	6.84 (1.17)	.1576	.0602
VST	2	8.00 (1.37)	6.35 (1.08)	1.6516	.6555
VST	3	4.00 (.68)	5.81 (.99)	-1.8092	-.7506
STRATEGY	2				
VST	1	10.00 (1.71)	9.84 (1.68)	.1576	.0502
VST	2	10.00 (1.71)	8.35 (1.42)	1.6516	.5716
VST	3	5.00 (.85)	6.81 (1.16)	-1.8092	-.6933
STRATEGY	3				
VST	1	3.00 (.51)	2.84 (.49)	.1576	.0935
VST	2	4.00 (.68)	2.35 (.40)	1.6516	1.0778
VST	3	3.00 (.51)	4.81 (.82)	-1.8092	-.8250
PROBLEM	5				
STRATEGY	1				
VST	1	5.00 (.85)	4.84 (.83)	.1576	.0716
VST	2	7.00 (1.19)	5.35 (.91)	1.6516	.7142
VST	3	3.00 (.51)	4.81 (.82)	-1.8092	-.8250
STRATEGY	2				
VST	1	13.00 (2.22)	12.84 (2.19)	.1576	.0440
VST	2	16.00 (2.73)	14.35 (2.45)	1.6516	.4360
VST	3	3.00 (.51)	4.81 (.82)	-1.8092	-.8250
STRATEGY	3				
VST	1	2.00 (.34)	1.84 (.31)	.1576	.1161
VST	2	4.00 (.68)	2.35 (.40)	1.6516	1.0778
VST	3	4.00 (.68)	5.81 (.99)	-1.8092	-.7506
PROBLEM	6				
STRATEGY	1				
VST	1	6.00 (1.02)	5.84 (1.00)	.1576	.0652
VST	2	6.00 (1.02)	4.35 (.74)	1.6516	.7921
VST	3	5.00 (.85)	6.81 (1.16)	-1.8092	-.6933
STRATEGY	2				
VST	1	5.00 (.85)	4.84 (.83)	.1576	.0716
VST	2	14.00 (2.39)	12.35 (2.11)	1.6516	.4700
VST	3	7.00 (1.19)	8.81 (1.50)	-1.8092	-.6096
STRATEGY	3				
VST	1	10.00 ([illegible])	9.84 (1.68)	.1576	.0502
VST	2	6.00 ([illegible])	4.35 (.74)	1.6516	.7921
VST	3	4.00 (.68)	5.81 (.99)	-1.8092	-.7506

PROBLEM	7				
STRATEGY	1				
VST	1	8.00 (1.37)	7.84 (1.34)	.1576	.0563
VST	2	10.00 (1.71)	8.35 (1.42)	1.6516	.5716
VST	3	4.00 (.68)	5.81 (.99)	-1.8092	-.7506
STRATEGY	2				
VST	1	8.00 (1.37)	7.84 (1.34)	.1576	.0563
VST	2	10.00 (1.71)	8.35 (1.42)	1.6516	.5716
VST	3	6.00 (1.02)	7.81 (1.33)	-1.8092	-.6474
STRATEGY	3				
VST	1	9.00 (1.54)	8.84 (1.51)	.1576	.0530
VST	2	6.00 (1.02)	4.35 (.74)	1.6516	.7921
VST	3	3.00 (.51)	4.81 (.82)	-1.8092	-.8250
PROBLEM	8				
STRATEGY	1				
VST	1	9.00 (1.54)	8.84 (1.51)	.1576	.0530
VST	2	10.00 (1.71)	8.35 (1.42)	1.6516	.5716
VST	3	7.00 (1.19)	8.81 (1.50)	-1.8092	-.8096
STRATEGY	2				
VST	1	7.00 (1.19)	6.84 (1.17)	.1576	.0602
VST	2	13.00 (2.22)	11.35 (1.94)	1.6516	.4903
VST	3	2.00 (.34)	3.81 (.65)	-1.8092	-.9270
STRATEGY	3				
VST	1	12.00 (2.05)	11.84 (2.02)	.1576	.0458
VST	2	8.00 (1.37)	6.35 (1.08)	1.6516	.6555
VST	3	4.00 (.68)	5.81 (.99)	-1.8092	-.7506
PROBLEM	9				
STRATEGY	1				
VST	1	8.00 (1.37)	7.84 (1.34)	.1576	.0563
VST	2	8.00 (1.37)	6.35 (1.08)	1.6516	.6555
VST	3	4.00 (.68)	5.81 (.99)	-1.8092	-.7506
STRATEGY	2				
VST	1	8.00 (1.37)	7.84 (1.34)	.1576	.0563
VST	2	8.00 (1.37)	6.35 (1.08)	1.6516	.6555
VST	3	3.00 (.51)	4.81 (.82)	-1.8092	-.8250
STRATEGY	3				
VST	1	11.00 (1.88)	10.84 (1.85)	.1576	.0479
VST	2	12.00 (2.05)	10.35 (1.77)	1.6516	.5134
VST	3	10.00 (1.71)	11.81 (2.02)	-1.8092	-.5265

NOTE: Strategy: 1 = Hypothesis Checking; 2 = Dimension Checking; 3 = Focusing
VST = Visual Search (total): 1 = Lower 30% (good planners); 2 = Middle 40% (intermediate planners); 3 = Upper 30% (poor planners)

Table 29

Summary of the Goodness-of-Fit Test Statistic for the Main Effects of Visual Search (letter-letter), Strategy Type, and Interaction Effects of Visual Search (letter-letter) and Strategy.

Model	df	Likelihood Ratio Chi Square	Prob.	Pearson Chi Square	Prob.
S,P,SxP,SxVSL,PxVSL, SxPxVSL (VSL omitted)	2	10.396	0.006	10.409	0.005
VSL,P,VSLxP,VSLxS,PxS, VSLxPxS (S omitted)	2	1.343	0.511	1.331	0.514
VSL,P,S,VSLxP,PxS, VSLxPxS (VSLxS omitted)	4	1.969	0.742	1.970	0.741

NOTE: (VSL = Visual Search (letter-letter), S = Strategy Type, P = Problem Number)

Table 30

Observed, Expected Frequencies and Residuals for Visual Search (letter-letter) Main Effects.

Factor	Code	OBS. count & PCT.	EXP. count & PCT.	Residual	Std. Resid.
PROBLEM	1				
STRATEGY	1				
VLL	1	4.00 (.85)	4.95 (.84)	.0508	.0228
VLL	2	7.00 (1.19)	5.97 (1.02)	1.0266	.4200
VLL	3	6.00 (1.02)	7.08 (1.21)	-1.0773	-.4050
STRATEGY	2				
VLL	1	5.00 (.85)	4.95 (.84)	.0508	.0228
VLL	2	11.00 (1.88)	9.97 (1.70)	1.0266	.3251
VLL	3	6.00 (1.02)	7.08 (1.21)	-1.0773	-.4050
STRATEGY	3				
VLL	1	13.00 (2.22)	12.95 (2.21)	.0508	.0141
VLL	2	7.00 (1.19)	5.97 (1.02)	1.0266	.4200
VLL	3	11.00 (1.88)	12.08 (2.06)	-1.0773	-.3100
PROBLEM	2				
STRATEGY	1				
VLL	1	7.00 (1.19)	6.95 (1.19)	.0508	.0193
VLL	2	6.00 (1.02)	4.97 (.85)	1.0266	.4603
VLL	3	7.00 (1.19)	8.08 (1.38)	-1.0773	-.3791
STRATEGY	2				
VLL	1	5.00 (.85)	4.95 (.84)	.0508	.0228
VLL	2	5.00 (.85)	3.97 (.68)	1.0266	.5150
VLL	3	5.00 (.85)	6.08 (1.04)	-1.0773	-.4370
STRATEGY	3				
VLL	1	9.00 (1.54)	8.95 (1.53)	.0508	.0170
VLL	2	15.00 (2.56)	13.97 (2.38)	1.0266	.2746
VLL	3	9.00 (1.54)	10.08 (1.72)	-1.0773	-.3394
PROBLEM	3				
STRATEGY	1				
VLL	1	5.00 (.85)	4.95 (.84)	.0508	.0228
VLL	2	6.00 (1.02)	4.97 (.85)	1.0266	.4603
VLL	3	4.00 (.68)	5.08 (.87)	-1.0773	-.4781
STRATEGY	2				
VLL	1	2.00 (.34)	1.95 (.33)	.0508	.0364
VLL	2	9.00 (1.54)	7.97 (1.36)	1.0266	.3635
VLL	3	8.00 (1.37)	9.08 (1.55)	-1.0773	-.3576
STRATEGY	3				

VLL	1	12.00 (2.05)	11.95 (2.04)	.0508	.0147
VLL	2	11.00 (1.88)	9.97 (1.70)	1.0266	.3251
VLL	3	8.00 (1.37)	9.08 (1.55)	-1.0773	-.3576
PROBLEM	4				
STRATEGY	1				
VLL	1	7.00 (1.19)	6.95 (1.19)	.0508	.0193
VLL	2	8.00 (1.37)	6.97 (1.19)	1.0266	.3887
VLL	3	4.00 (.68)	5.08 (.87)	-1.0773	-.4781
STRATEGY	2				
VLL	1	9.00 (1.54)	8.95 (1.53)	.0508	.0170
VLL	2	11.00 (1.88)	9.97 (1.70)	1.0266	.3251
VLL	3	5.00 (.85)	6.08 (1.04)	-1.0773	-.4370
STRATEGY	3				
VLL	1	4.00 (.68)	3.95 (.67)	.0508	.0256
VLL	2	3.00 (.51)	1.97 (.34)	1.0266	.7308
VLL	3	3.00 (.51)	4.08 (.70)	-1.0773	-.5335
PROBLEM	5				
STRATEGY	1				
VLL	1	6.00 (1.02)	5.95 (1.02)	.0508	.0208
VLL	2	3.00 (.51)	1.97 (.34)	1.0266	.7308
VLL	3	6.00 (1.02)	7.08 (1.21)	-1.0773	-.4050
STRATEGY	2				
VLL	1	16.00 (2.73)	15.95 (2.72)	.0508	.0127
VLL	2	12.00 (2.05)	10.97 (1.87)	1.0266	.3099
VLL	3	4.00 (.68)	5.08 (.87)	-1.0773	-.4781
STRATEGY	3				
VLL	1	1.00 (.17)	.95 (.16)	.0508	.0521
VLL	2	3.00 (.51)	1.97 (.34)	1.0266	.7308
VLL	3	6.00 (1.02)	7.08 (1.21)	-1.0773	-.4050
PROBLEM	6				
STRATEGY	1				
VLL	1	5.00 (.85)	4.95 (.84)	.0508	.0228
VLL	2	6.00 (1.02)	4.97 (.85)	1.0266	.4603
VLL	3	6.00 (1.02)	7.08 (1.21)	-1.0773	-.4050
STRATEGY	2				
VLL	1	6.00 (1.02)	5.95 (1.02)	.0508	.0208
VLL	2	13.00 (2.22)	11.97 (2.04)	1.0266	.2967
VLL	3	7.00 (1.19)	8.08 (1.38)	-1.0773	-.3791
STRATEGY	3				
VLL	1	11.00 (1.88)	10.95 (1.87)	.0508	.0153
VLL	2	6.00 (1.02)	4.97 (.85)	1.0266	.4603
VLL	3	3.00 (.51)	4.08 (.70)	-1.0773	-.5335

PROBLEM	7				
STRATEGY	1				
VLL	1	7.00 (1.19)	6.95 (1.19)	.0508	.0193
VLL	2	13.00 (2.22)	11.97 (2.04)	1.0266	.2967
VLL	3	2.00 (.34)	3.08 (.53)	-1.0773	-.6141
STRATEGY	2				
VLL	1	6.00 (1.02)	5.95 (1.02)	.0508	.0208
VLL	2	9.00 (1.54)	7.97 (1.36)	1.0266	.3635
VLL	3	9.00 (1.54)	10.08 (1.72)	-1.0773	-.3394
STRATEGY	3				
VLL	1	8.00 (1.37)	7.95 (1.36)	.0508	.0180
VLL	2	6.00 (1.02)	4.97 (.85)	1.0266	.4603
VLL	3	4.00 (.68)	5.08 (.87)	-1.0773	-.4781
PROBLEM	8				
STRATEGY	1				
VLL	1	6.00 (1.02)	5.95 (1.02)	.0508	.0208
VLL	2	13.00 (2.22)	11.97 (2.04)	1.0266	.2967
VLL	3	7.00 (1.19)	8.08 (1.38)	-1.0773	-.3791
STRATEGY	2				
VLL	1	12.00 (2.05)	11.95 (2.04)	.0508	.0147
VLL	2	6.00 (1.02)	4.97 (.85)	1.0266	.4603
VLL	3	4.00 (.68)	5.08 (.87)	-1.0773	-.4781
STRATEGY	3				
VLL	1	9.00 (1.54)	8.95 (1.53)	.0508	.0170
VLL	2	11.00 (1.88)	9.97 (1.70)	1.0266	.3251
VLL	3	4.00 (.68)	5.08 (.87)	-1.0773	-.4781
PROBLEM	9				
STRATEGY	1				
VLL	1	8.00 (1.37)	7.95 (1.36)	.0508	.0180
VLL	2	5.00 (.85)	3.97 (.68)	1.0266	.5150
VLL	3	7.00 (1.19)	8.08 (1.38)	-1.0773	-.3791
STRATEGY	2				
VLL	1	8.00 (1.37)	7.95 (1.36)	.0508	.0180
VLL	2	9.00 (1.54)	7.97 (1.36)	1.0266	.3635
VLL	3	2.00 (.34)	3.08 (.53)	-1.0773	-.6141
STRATEGY	3				
VLL	1	8.00 (1.37)	7.95 (1.36)	.0508	.0180
VLL	2	15.00 (2.56)	13.97 (2.38)	1.0266	.2746
VLL	3	10.00 (1.71)	11.08 (1.89)	-1.0773	-.3237

NOTE: Strategy: 1 = Hypothesis Checking; 2 = Dimension Checking; 3 = Focusing
VLL = Visual Search (letter-letter): 1 = Lower 30% (good planners); 2 = Middle 40% (intermediate planners); 3 = Upper 30% (poor planners)