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GOAL SETTING, COGNITIVE ABILITY AND TASK STRATEGY

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ABSTRACT

GOAL SETTING, COGNITIVE ABILITY AND TASK STRATEGY

By

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Research has demonstrated that the positive motivational effects of specific and difficult goals commonly found for simple tasks is less reliable on complex tasks. The present study attempts to describe the effects of goals on performance on complex tasks through the influence of strategy type, strategy development effort and cognitive ability. Subjects working on a crossword puzzle task were assigned either a general goal, an easy to moderate goal, or a difficult goal. Two general types of strategies used by subjects contributed unique variance on performance. Results indicated no relationship between goals and performance. However, for one strategy type, individuals with difficult goals chose a strategy leading to better performance than those with general goals. For the other type of strategy, this relationship was moderated by general cognitive ability. In addition, although there was no main effect of effort on strategy type, this relationship was moderated by ability for one strategy type.

To my parents, Max and Lois Shapiro,

with love and gratitude.

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INTRODUCTION

Goal setting is a well researched area in organizational psychology. Much of this research has focused on the effects of goal characteristics, such as goal specificity and goal difficulty, on performance. While it has long been accepted that specific and difficult goals lead to improved performance, researchers are more recently exploring the factors that moderate this goal-performance relationship.

Task type has proven to be a consistent moderator of the relationship between goal characteristics and performance. Recent research has shown that on complex tasks, the effects of goals are less pronounced than on simple tasks (Wood, Mento, & Locke, 1986). Further, goal setting may influence performance through its effect on task planning (e.g., Earley, Connoly, & Ekegren, 1989).

This thesis addresses the effects of specific, difficult goals on task plans on a complex task and the role of cognitive ability on this relationship. The first section of this thesis reviews goal setting literature. Following this, literature regarding task strategy and task type as it relates to goal setting is discussed. Cognitive

ability is addressed as a potential moderator of goal effects on strategy.

Goal Setting

Goals are defined by Locke, Shaw, Saari, & Latham (1981) as "what an individual is trying to accomplish; [they are] the object or aim of action" (p.126). At the individual level, research has often shown task performance to be related to goal setting. This relationship is the result of two primary functions of goals. First, goals motivate people to put forth effort. Second, goals serve to guide this effort in the correct direction. The occurrence of these two functions is largely dependent upon the characteristics of goals. In particular, goal specificity and difficulty are primarily related to task performance. The following sections will define and discuss these two aspects of goals.

Goal Difficulty and Specificity, Defined

According to Locke et al. (1981), a major attribute of a goal is its content. Content refers to the actual task performance outcome expected, such as the amount of product assembled. Dimensions of goal content that have received the most attention in literature are goal difficulty and goal specificity.

Goal specificity refers to the precision with which the quality or quantity of the expected outcome is described (Locke et al., 1981). Specificity is usually stated in terms of quantity per amount of time, such as words per

terms of quantity per amount of time, such as words per minute or miles per hour . A more specific goal is one that is stated in more precise quantitative or qualitative units (Ilgen, Salas, Shapiro & Weiss, 1989). For example, a goal of 'typing sixty words per minute' is more specific than a goal of 'improving typing'. Likewise, a goal of 'improving typing' is more specific than a goal of 'learning office skills'. Most studies define the most general goal as a 'do your best' condition.

In addition to goal specificity, goal difficulty is a frequently addressed construct in the literature. A more difficult goal is one that requires more effort and attention for goal accomplishment than an easy goal. A difficult goal may also require more knowledge and skill than an easy goal (Locke et al., 1981). According to Terborg (1976), goal difficulty has two elements. The first of these is the normative probability of goal attainment. This represents the level of difficulty of the task from the perspective of all who perform the task. It is described by a ratio of the number of individuals who attain a goal to the number who attempt it. A second component of goal difficulty is an individual's probability of goal attainment. This category of goal difficulty is characterized by the ratio of an individual's success at goal attainment to his or her attempts. A third element of goal difficulty is the cost of goal attainment (Naylor &

Ilgen, 1984). This cost may be reflected in varying amounts of ability, time and effort, skill, and experience.

Many empirical studies describe goal difficulty in terms of absolute or objective probability of goal attainment (e.g., Garland, 1984; Hollenbeck & Brief, 1987; Latham, Steele & Saari, 1982; Locke, 1982; Terborg & Miller, 1978). If this is the case, researchers may partition goal difficulty levels by an absolute probability of goal attainment based on a pilot sample or by a post hoc analysis of performance. Some studies have used the ability of the individual performing the task and his or her past performance as a relative index of difficulty for each subject (e.g., Yukl & Latham, 1978; Hollenbeck, Williams & Klein, 1989). Few, if any, studies define goal difficulty in terms of the cost of goal attainment to the task performer (Naylor & Ilgen, 1984).

Goal Specificity and Difficulty Effects

Locke's (1968) goal theory asserts that specific, difficult goals, if accepted by the task performer, result in higher levels of task performance relative to easy goals, 'do best' goals or no goals. This is because specific, difficult goals, when accepted by the task performer, serve to increase and improve effort, persistence, direction, and strategy development (Locke, et al., 1981).

A large majority of studies have found a positive relationship between difficult, specific goals and performance in both the laboratory and the field (although

results in the field are sometimes contaminated) (Locke, et al., 1981).

Most goal setting studies have varied only goal difficulty (e.g., Yukl & Latham, 1978; Latham, Steele & Saari, 1982) or have varied both difficulty and specificity (e.g., Latham & Saari, 1979; Ivancevich, 1977). In general, studies do not vary goal specificity alone. This may be because increased difficulty often occurs concurrently with increased goal specificity. That is, as specificity increases above a 'do best' level, task demands also tend to increase simultaneously.

For example, Locke (1982) varied the goal level of specific goals in a laboratory experiment. Locke's subjects participated in a one minute brainstorming task to give uses for common objects. Locke assigned fourteen different goal levels among subjects. These ranged from easy to impossible. The goal levels began at a value of 2 (easy) and increased by increments of two until a value of 28 (impossible). Results showed that performance continued to increase as a function of goal level, even for goals that were beyond the capabilities of all subjects. Other studies have found similar results (e.g., Hollenbeck & Brief, 1987).

Latham and Steele (1983) compared 'do best' goals with various levels of specific and difficult goals in a laboratory study. Subjects in this experiment participated in a toy assembly project. Results of the experiment showed that specific goals led to higher performance than 'do your

best' goals and that performance was positively and linearly related to goal difficulty. Similar results have been repeated in other experiments (e.g., Latham & Saari, 1979).

A recent laboratory experiment by Locke, Chah, Harrison and Lustgargen (1989) addressed the issue of separating the effects of goal specificity and difficulty. Locke et al. (1989) found that as goal specificity decreased, performance variance increased. Further, they found that task performance improved as a function of goal level. The authors explain that while goal difficulty acts to 'energize' effort and, over time, contribute to persistence, goal specificity serves to direct task activity (Locke, et al., 1989).

Although the results of the studies described above have been consistent, the extent of the relationship between difficult, specific goals and easy or 'do best' goals is influenced by task type. A meta-analysis by Wood et al. (1986) showed this relationship is moderated by task complexity such that the performance gains associated with specific, difficult goals are greater for simple than for complex tasks. The following section will define task complexity and discuss this relationship.

Task Complexity and Goal Setting

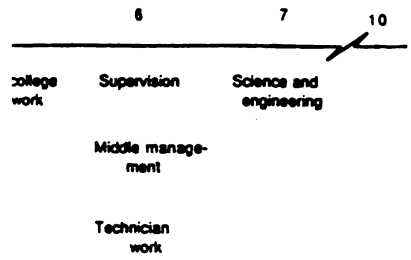
In contrast to simple tasks, complex tasks generally have multiple and conflicting end states, multiple and conflicting paths to end states, and uncertain linkages among outcomes and paths to outcomes. These characteristics

contribute to increased information load and cognitive demands on individuals (Campbell, 1988).

Wood (1986) describes a model of tasks in which there are two types of input components for any task. These are acts and information cues. Acts are the activities required by the task for the creation of a product (e.g., lifting). Information cues are pieces of information regarding the task that an individual can use to make judgments required during the course of the task. In this model, there are three types of task complexity. These are (1) component complexity, (2) coordinative complexity, and (3) dynamic complexity.

Component complexity is a function of the number of acts and information cues required for task completion. As these increase, component complexity increases. Coordinative complexity refers to relationships between task inputs and products. This includes timing, frequency, intensity, and location requirements for performing task acts. Dynamic complexity is described by the degree to which individuals performing a task need to adjust to changes in the means-ends hierarchy of task acts during task activity.

Wood (1986) describes total task complexity as a linear combination of these three types of complexity, where dynamic complexity is weighted more heavily than coordinative complexity and coordinative complexity is weighted more heavily than component complexity.



various complexity
418).

Originally, goal setting theory and research focused on simple tasks and avoided issues of ability and strategy. Locke (1968) emphasized ". . . simple tasks in which learning complex new skills and making long-term plans and strategies is not necessary to achieve goals -- tasks of the type in which effort and concentration are likely to have a relatively direct effect on output or choice." (p. 161.)

Only recently, as researchers explore more facets of goal theory, has task complexity been increasingly considered to be of primary importance for goal setting research (e.g., Huber, 1985; Wood, Mento & Locke, 1986; Locke, et al., 1981). Therefore, there is a need to further study goal effects on complex tasks.

Using the Wood (1986) definition of task complexity, Wood, et al. (1986) did a meta-analysis examining the relationship between task complexity and goal setting. Based on a complexity scale ranging from one to ten, the authors were able to classify general task types (e.g., toy assembly, school or college course work) on the scale. This classification is shown in Figure 1. Of the 125 studies examined in the meta-analysis, eighty-seven had a complexity rating of three or less and the remaining thirty eight fell between four and seven.

Wood et al. found that task complexity moderated the relationships between goal attributes (i.e., specificity and difficulty) and task performance. The authors found that the performance gains associated with specific, difficult

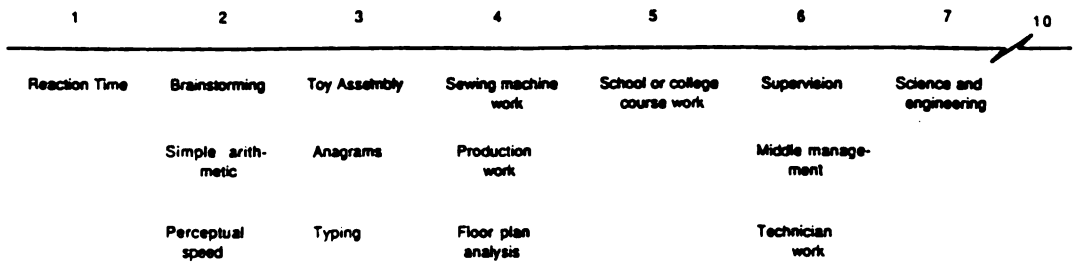


Figure 1. Representative tasks for various complexity levels. From Wood et al. (1986, p. 418).

goals were greater for simple tasks than for complex tasks. The results of the meta-analysis indicated that the moderating effect of task complexity was greater for the relationship between difficult goals and performance than for the relationship between difficult and specific goals and performance. Overall, at all levels of task complexity, some performance improvement resulted from setting specific and difficult goals as opposed to easy, general goals. However, this effect was largest for simple tasks and smallest for complex tasks (12.15% and 7.79% productivity increases respectively). The level of productivity increase for moderately complex tasks fell between that of simple and most complex tasks. The authors suggest that the differences in goal effects between complex and simple tasks may disappear over time as individuals develop effective strategies and gather relevant information for task completion. Therefore, they stress that future research be aimed at looking at the effects of information sharing, cognitive abilities, and strategy development on goal setting.

The Wood et al. finding is consistent with Locke's (1968) belief that strategy and ability issues associated with complex tasks will influence goal effects. If research is to study goal difficulty effects on complex tasks, researchers must integrate strategy and ability issues into goal setting models. The following sections will discuss

task strategy, strategy development and the relationship between strategy and goal setting.

Task Strategy

Task Strategy, Strategy Development and Goal Setting

Task Strategy Defined. A generally accepted definition of task strategy is that it is a plan of action (Locke, et al., 1981). This is a very general definition, and therefore permits a great degree of variance in its operationalization and description across studies. Many experimenters operationalize strategy by using only a post-experimental self-report measure (e.g., Locke, Frederick, Lee & Bobko, 1984; Earley & Perry, 1987; Earley, Wojnaroski and Prest, 1987). For example, a laboratory study by Earley et al. (1987) assessed strategy, which was defined as the "planning or organizing activities of an individual (p. 108)." This assessment was made by giving subjects a four item post task questionnaire reflecting the number of steps of a plan, a plan's importance to task accomplishment, the presence of a pre-task plan development, and the presence of any plan at all.

Locke, et al. (1984) distinguish between two facets of task activity. These are persistence and direction of effort on one hand and strategy on the other. According to Locke et al. (1984) while these first two behaviors do lead to goal accomplishment, they are not strategies. Strategies are different in that they involve different ways of performing a task. Like Earley et al. (1987), Locke et al.

measured strategy with a post experimental questionnaire. The questionnaire listed possible strategies and asked subjects to specify if they used these strategies and to what extent they were used.

Earley, Lee and Hanson (1990) defined task strategy as the series of steps that an individual goes through to complete a task. Earley et al. (1990) used the strategic management literature in conjunction with expert lists of strategies to develop dimensions of task strategy quality. The dimensions arrived at were time frame of the plan, the breadth of duties encompassed by the plan, contingency aspects of the plan (e.g., "I make sure that if something unexpected happens, my work plan will give me the flexibility to handle things"), and the resources involved by the plan.

Overall, the literature on task strategy does not present a single description of task strategy. It may be the case, however, that strategy does not lend itself to such a description. Different dimensions of task strategy are relevant only for different tasks. For example, on some tasks, unexpected events may not occur. In such a case, Earley et al.'s (1990) dimension of contingency would not be relevant. Therefore, it is necessary to define strategy generally, as the procedure followed to accomplish a task and to note that these procedures may vary with respect to detail, complexity, or other dimensions, depending on the task.

Strategy Development. The production of the procedures considered and the process of selection of options by an individual is the process of strategy development. Locke et al. (1981) describe strategy development as the fourth mechanism through which goal setting influences performance (effort, persistence, and direction being the other three). Like effort, persistence, and direction, strategy development is motivated by goals, but unlike these other three mechanisms its effect is indirect, due to the cognitive nature of strategy development and its dependence upon skill development and creative problem solving (Locke et al., 1981).

Wood and Locke (1990) discuss the process by which individuals arrive at task strategies. Wood and Locke's model describes the steps that an individual goes through to arrive at a task strategy. The model assumes individual goal commitment. First, the authors explain that the task and the goal themselves automatically prompt an individual to search for a "stored plan." A stored plan of action is one that exists in an individuals subconscious prior to the introduction of a task or goal. This type of plan is brought to a person's attention by association with a relevant task. A stored plan is either universal or task specific. A universal plan is one that applies to all tasks. Specifically, a universal plan may be the direction of attention, the expending of effort, or persistence of task behavior. Individuals are generally only marginally

aware of these plans. A task specific plan is one that has been previously learned through task experience or modeling. It has been learned to the extent that even though the behavior it generates is applicable only to one task or a set of analogous tasks, it is used almost automatically by an individual. Several stored plans may be prompted simultaneously. If this is the case, an individual must decide which plan is best.

"New task specific plans" are developed by an individual when he or she decides that none of the available stored plans are appropriate to the task at hand. The authors explain that the production of these plans, unlike the stored plans, require the individual to consider the task and situation in order to gather relevant task information. The quality and comprehensiveness of this process may determine the effectiveness of the new strategies developed.

After an individual has decided upon a task strategy, the next step in the development of the strategy is to perform the task and respond to task performance feedback by either continuing to use the same strategy or by altering the current strategy to make it more effective.

In this model of strategy development, there are several points at which an individual must make a strategy relevant decision. First, an individual must decide whether a stored plan is appropriate or which stored plan is most appropriate for effective task performance. If a stored

plan is judged to be inappropriate, then an individual must develop a new plan. Further, the acceptability of the plan in use is judged during task activity according to the task feedback received. At any of these decision points, errors can be made that will affect task performance. These decisions and their error variance may be affected by task goal attributes (Wood & Locke, 1990).

Lord and Hanges (1987) describe three alternative methods by which individuals make strategy relevant decisions. These are 1) rational choice model, 2) routinized choice processes, and 3) action first choice processes. The rational choice model involves an analytic approach to developing strategies. Using rational choice, an individual will take care to develop effective, well thought out strategies early on in the task. Routinized choice involves sequential testing of alternative strategies, without much effort given to choosing at once the best way to approach the task. Action first choice incorporates trial and error, with only a limited search for effective strategy alternatives.

All three of the methods described by Lord and Hanges (1987) operate in a control systems framework. Therefore, the model chosen by the task doer is dependent upon the frequency of the feedback loop available. When feedback is slow, the modification of a strategy is also slow and therefore the cost of strategy errors is high. When a task is familiar (at least something is known about expected

outcomes) and also has slow feedback, a rational choice model will be used because it is important for initial strategy decisions to be correct. On the other hand, when feedback is fast, and errors can be quickly corrected, changes in strategy are less costly and a task doer will employ routinized choice. When a task is unfamiliar and the feedback loop is fast, individuals will employ action first choice processes so they can learn about the task by trying many strategies and receiving much feedback.

Locke et al.'s (1981), Wood and Locke's (1990), and Lord and Hanges' (1987) conceptualizations of strategy development are consistent. They are all dependent upon goals as the initiators of strategy development. Further, Wood and Locke's (1990) and Lord and Hanges' (1987) models describe goals as the regulators of behavior. They are the standards upon which strategy effectiveness is judged. Also, all three models point to the role of cognitive abilities in strategy development. Locke et al. (1981) describes the performance effects of goals through strategy development as indirect, because of the factor that cognitive processes play in the formulation of strategies. Wood and Locke's (1990) necessitates a consideration of cognitive abilities because of the many judgments that a task doer faces with respect to strategy appropriateness and because of the task doer's reliance upon cognitive storage and retrieval of information regarding task strategies. Lord and Hanges' (1987) model of strategy decisions involves

cognitive abilities in the same sense that Wood and Locke's model does, especially in the rational choice process.

While theory regarding strategy development issues has reflected the role of goal setting and cognitive processes, empirical research thus far has primarily focused on the direct relationship between difficult, specific goals and strategy development and on the relationships among difficult, specific goals, strategy, and performance. The following section will discuss empirical research this area.

Task Strategy and Goal Setting, Empirical Research. At the individual level, several empirical studies have examined the effects of goal setting on task strategy and of the relationship of these constructs to task performance. Earley et al. (1987) recently found results in a laboratory study that showed a positive relationship between goal specificity and the use of relevant task strategies. Included in the authors' hypotheses were predictions that (1) individuals who were assigned a specific goal would plan more than individuals given a 'do best' goals and that (2) planning would be a mediator in the relationship between goal setting and performance. Subjects participated in a business simulation where they had to choose a medium in which to advertise a fictitious product and write statements in support of their choice of media. Subjects in the assigned condition were told to produce four arguments justifying a choice of medium for thirty-five products. Planning was assessed by post-task questions that addressed

the number of steps in a plan, the amount of time spent planning, and the importance of planning to the individual. The results of the experiment supported the first hypothesis, but did not demonstrate that planning mediated the relationship between goal setting and performance. Goal setting predicted performance even after the variance due to planning and information had been removed. The authors also found a main effect for goals on performance and on the amount of effort individual put towards task accomplishment. There was also a positive relationship between strategy development and performance and between task effort and performance.

In this experiment, Earley et al. (1987) also manipulated the amount of information individuals received with respect to the product markets and advertising media of the products. The authors hypothesized that being given task relevant information is much like receiving a more specific goal in that it gives an individual a basis on which to plan. Therefore, the authors hypothesized that giving task relevant information would stimulate planning and that increased planning would result in increased performance. Results indicated that, as with specific versus 'do best' goals, subjects who received information planned more, expended more energy on the task, had more strategy development, and performed better than individuals who did not receive information. There was no interaction found between goal setting and planning.

In a field study by the same authors (Earley et al., 1987) similar results were found. The purpose of the field study was to examine the relationships of the laboratory study described above in the work environment across a number of jobs and tasks. The planning measure used by the authors emphasized the length of plan (described as the number of separate steps used in working on a project) and the amount of time spent planning rather than aspects of plan effectiveness or development. Results showed that the presence of goals was positively correlated with the length of plan as well as for performance and effort for a variety of jobs (service, management, production, and clerical). Also, the amount of training received by individuals was positively related to the amount of planning, performance, and effort. This relationship may be analogous to the effect of providing task relevant information on planning in the laboratory study. The authors suggest the cognitive benefit of goals is to get an individual to think about both the task and how to perform it. The authors note that asking subjects to list the number of steps in a task in a questionnaire may be confounded by the ability of the participant to express himself or herself.

In a later field study, Earley et al. (1990) found that quality of task strategy did affect the relationship of goals to performance. The authors surveyed 347 employees of varying job types (e.g., production, clerical) and of three levels of job tenure. The survey reported whether

individuals had goals, the difficulty and specificity of their goals, the complexity of their jobs, and the presence of task strategies. The results of this field study indicated that job experience affects the relationships among goal setting, strategy, and performance. Specifically, the authors concluded that, on a task with a number of independent acts and a variety of information cues, while goal setting stimulated strategy development, job experience was necessary for an individual to be able to judge the effectiveness of the strategy. Other results of the study illustrated that specific, difficult goals led to more effective work strategies than general goals and this strategy effectiveness resulted in better performance.

Earley, Connoly and Ekegren (1989) found that on a stock market prediction task specific and difficult goals increased the amount of strategy search activities by individuals, but resulted in decreased performance. The authors attribute this decrease in performance to the ineffectiveness of strategy search in a situation where there are so many possible strategies that not all of them can be tested and evaluated. Subjects in one experiment had either a difficult, specific goal or a 'do your best' goal. In a second study, the authors gave subjects either a specific-easy, specific-moderate, specific-difficult, tapering-specific (decreasing with number of predictions), or a 'do your best' goal. Similar results were found in study 2. Additionally, it appeared that the differences in

performance occurred in part as a result of the specific goal subjects shifting strategies more frequently in the early task trials than the general goal subjects.

Similar results were found in a third study. In this study, subjects in the difficult goal condition performed worse than 'do your best' subjects because they shifted strategies too frequently. The authors conclude that in addressing goal setting and strategy research more attention should be paid to task characteristics and individual characteristics that distinguish boundary conditions for the helpfulness of goal setting.

A recent study by Earley, Lee and Lituchy (1989) considered the strategy development issue from a control systems perspective. In this laboratory study the authors hypothesized that compared to having a 'do your best' goal, having a specific, difficult goal or having a learning goal would cause individuals to develop specific criteria by which to judge the accuracy of a particular strategy. A learning goal was one that advised subjects not to focus on the outcome of the task, but on developing an effective strategy. The hypotheses were supported.

Subjects in the specific, challenging condition and in the learning condition developed specific criteria by which to judge their strategies, spent more time developing and changing their strategies, and had better performance. Time spent developing strategies and amount of strategy change mediated the relationship between goal and strategy quality.

Further, subjects who received task training engaged in less strategy change throughout the task compared to subjects who received no training. Subjects who had a specific, challenging goal, but who did not receive training had difficulty finding a strategy that satisfied their criteria.

At the group level, Smith, Locke and Barry (in press) addressed strategy issues on an organizational simulation. The authors varied goal specificity and difficulty and time spent planning and assessed the quality of the planning process, and performance. The authors had two goal conditions; a 'do best' goal and a specific, challenging goal. Planning quality was assessed with a questionnaire that evaluated communication, integration, degree of comprehensive and systematic analysis, and degree to which resources were considered. Results of the study indicated that specific and challenging goals were positively correlated with performance in all but the first game session (there were six sessions in all). The highest correlations occurred in sessions four, five, and six. Further, specific and difficult goals were positively related to planning quality, and time spent planning was positively related to performance when the quality of the planning process was high. Formal planning time did not improve performance when planning quality was low.

Although the groups that were not required to spend time planning were not prevented from planning, the authors

did not hypothesize a relationship between goals and time spent planning.

Overall, the strategy/goal setting literature arrives at two main conclusions: (1) specific and difficult goals on complex tasks direct attention to a task and thereby stimulate strategy development (most often measured by time spent developing strategies and the detail of those strategies) and (2) factors such as task relevant information, training, and task experience may enhance the benefit of goal setting on performance through strategy.

The first conclusion cited above is consistent with Locke et al.'s (1981) discussion of strategy. It is well accepted that on simple tasks specific, difficult goals increase individuals' desire to perform well. While on simple tasks this desire is directly transferred to task performance through increased effort, it appears that on complex tasks, the desire to perform well functions to increase strategy development.

This relationship, however, does not always result in improved performance and may in fact result in decreased performance (e.g., Earley, Connoly & Ekegren, 1989; Earley and Perry, 1987). The link to performance is achieved through the effectiveness or quality of the strategy used. Individuals who spend much time developing ineffective strategies will not benefit with respect to performance. The key to good performance is not the time spent developing strategies or the detail of those strategies, but the

quality of them. The second conclusion cited above indicates the importance of variables that mediate the relationship between strategy development and strategy effectiveness. Neither strategy development or specific, difficult goals themselves lead to strategy quality. The relationship of strategy development to strategy quality is dependent upon influences such as information, experience, or training (e.g., Earley et al., 1987; Earley, Connoly & Ekegren, 1989; Earley, Lee & Lituchy, 1989).

In summary, the goal setting research points to a model of goals leading to strategy development, which in turn lead to high quality strategies in the presence of certain moderating variables. While several moderating variables have been researched, empirical research has not addressed the potential of cognitive ability as a mediating variable in the relationship between strategy development and strategy quality. In the absence of experience, training, or information, cognitive ability may enable individuals to develop effective strategies. The following section will discuss cognitive ability and its role in the relationship between strategy development and strategy effectiveness.

Cognitive Processes and Task Strategy

Cognitive Ability Defined. Many constructs exist that describe cognitive processes. Those that address individual capacity to process multiple pieces of information and to make judgments regarding the applicability of information to relevant situations are relevant to the study of task

strategy development. Individuals who are able to comprehend and process more pieces of information may be able to generate a greater number of strategies than individuals who are less able to do so. Further, individuals who have greater cognitive abilities may be better able to judge the applicability of those strategies to tasks. The cognitive abilities relevant to strategy development occur at three levels. These are (1) general cognitive abilities, (2) specific cognitive abilities, and (3) task specific skills.

General Cognitive Ability. General cognitive ability (in this thesis, the term general cognitive ability will be used interchangeably with general intelligence) was described as early as the nineteenth century by Francis Galton, was empirically examined in the early twentieth century by Charles Spearman, and is still often analyzed and debated in many aspects (Jensen, 1986). Humphreys (1985) described three categories of definitions of general intelligence. These are traditional, cognitive processes, and factor-analytic. Traditional definitions of general intelligence describe it as an innate ability or a potential for learning. Such an interpretation is characterized by the use of intelligence tests to describe ability level and by the use of descriptors of intelligence, such as adaptability, innovativeness, or ability to deal with symbols. A cognitive processes view of intelligence is a more recent perspective on intelligence. Research in this

area assesses intelligence through laboratory experiments that tap the cognitive operations of activities such as problem-solving and attention.

The factor-analytic approach to intelligence is based on Spearman's work. According to this approach general intelligence (labeled g) is the broadest factor in a hierarchy of factors that emerge from tests of intelligence (Humphreys, 1985). Factors on the hierarchy below this are less general and are termed primary and secondary (and so on) factors or group factors. Examples of group factors are verbal, spatial, and numerical abilities (Jensen, 1986).

Although the g factor describes intelligence, it does not completely define it. According to Spearman (1927), it can not be concluded that g measures intelligence, only that it says something about it. Spearman felt that while scientists could measure g, they could not pin its relationship to the specific cognitive and neurological workings of the brain.

According to Jensen (1986), this is still the case when g is discussed solely in terms of psychometrics. A cognitive process approach to understanding intelligence, however, studies the relationships among cognitive processes such as attention, memory, and information processing. Jensen (1986) notes that a close look at the relationship between g loadings on various tests indicates that the size of the g loading seems to reflect the amount of cognitive processing necessary to arrive at a correct solution. Other

empirical work supports similar relationships (e.g., Vernon, 1983; Ackerman, 1986).

Specific Cognitive Abilities. The study of specific cognitive abilities originated in the 1930's with L. L. Thurstone who became interested in how many and what kinds of factors accounted for g (Nunnally, 1978). Nunnally describes several main ability factors. Examples of these are 1) verbal factors, 2) numerical ability, and 3) reasoning factors.

Verbal factors generally include verbal comprehension and verbal fluency. Verbal comprehension is often measured by a vocabulary test. Verbal fluency focuses on the ability to quickly produce words or sentences. It is often measured by asking individuals to list synonyms or to list words that fall into some type of category (Nunnally, 1978).

Numerical facility centers on the rapidity and accuracy with which individuals can solve arithmetic problems. Reasoning factors fall into three main categories. The first, general reasoning, involves the ability to develop solutions to problems (often mathematical reasoning problems). Deductive reasoning concerns the ability to draw conclusions based on given information. The third category of reasoning, according to Nunnally (1978) is seeing relationships and involves an ability consider a relationship between to ideas and use it to understand a relationship between other ideas. Verbal or picture

analogies are often used to assess this category (Nunnally, 1978).

Task Specific Skills. Task specific skills are those skills that enable a person to effectively perform a specific task but that are not necessarily generalizable to other tasks. Literature on differences between experts and novices is relevant in understanding task specific skills. Experts (those high on task specific skills and performance on those tasks) have more task specific knowledge than novices and differ in their cognitive organization of that knowledge (de Jong & Ferguson-Hessler, 1986). Experts represent information differently in their long term (Larkin, McDermott, Simon, & Simon, 1980) and short term memories (Chase & Simon, 1973) than do novices. Expertise is characterized by three cognitive components. These are (1) chunking, (2) hierarchical cognitive organization, and (3) problem-type-centered cognitive structures.

Chunks are units of information differentiated by some rule or pattern from other chunks (Best, 1986). Experts are able to recall both more and larger chunks (Chase & Simon, 1973). For example, master chess players are able to reconstruct chess board set ups from memory better than novices because they are able to organize chunks on a chess board in a meaningful way so that more chunks can be stored and recalled (Chase & Simon, 1973).

Problem-type centered cognitive structures enable a problem solver to identify an appropriate procedure by which

to solve a problem. These cognitive structures are called problem schemata and describe a particular problem or set of problems. A specific and appropriate schema contains the necessary knowledge and procedure to solve the problem easily and quickly. A more general schema provides only a general prescription. If an appropriate schema is not available, then a more general schema is activated. An expert will have specific problem schema available so that he or she will have and be able to access the knowledge with which to solve a problem (Chi & Glaser, 1985).

Hierarchical problem organization is present in experts and is characterized by having relevant knowledge arranged hierarchically with respect to detail. Higher levels are characterized by general laws and definitions which become more detailed at lower levels (Reif & Heller, 1982). For example, physics experts are able to sort cards with physics problems written on them into a few unifying or superordinate principles. Novices can not perceive these unifying principles (Chi, Glaser, & Rees, 1982).

Ability and Goal Setting

Both Locke (1968) and Locke et al. (1981) asserted that task skill was a necessary condition for goal setting to work. If an individual does not have the ability with which to perform the task, he or she will not be able to achieve a goal. Usually, research has treated ability with a task pre-test or a measure of self-efficacy, assessing perceived or real task skills. Wood et al. (1987) recognized that

there is a differentiation between goal effects for simple versus complex tasks and that this differentiation may be based on cognitive abilities. Wood et al. suggested that in the future researchers examine the role of cognitive abilities and goal setting on strategy development.

One promising area with which to begin assessing the role of cognitive abilities and goal setting on strategy development is with research linking general cognitive abilities and information processing.

For example, studies have linked cognitive abilities with attention and speed of information processing. In one study, Ackerman (1986) found that g was more highly correlated with tasks that require controlled cognitive processing than those that require automatic processing. Controlled processing is required when there are no consistent rules or consistent sequences of information-processing components involved in the task. Automatic processing, on the other hand, is fast and cognitively effortless. Automatic processes permit other cognitive processes to be carried on simultaneously. Tasks that facilitate automatic processing are those with invariant rules and invariant components and sequences components of information-processing. Automatic processing is achieved through extensive practice (Ackerman, 1986).

Ackerman used a consistent mapping task (CM) to induce automatic processing and a varied mapping task (VM) to induce controlled processing. An example of a consistent

mapping task is one in which a subject is asked to identify a target letter from a group of other letters (distractors). The target letter is one of a group of letters that does not change for any trial. Over time, subjects will identify target letters with increased speed. The task becomes automatized to the extent that the subject can perform other tasks simultaneously with no performance decrement. On a similar task using a varied mapping task, subjects would also identify a target letter among distractors, but the set of memory items (the potential targets) would change for each trial. In this case, performance only improves slightly with early practice and the task can not become automatic (Ackerman, 1986).

Ackerman employed several CM and VM tasks as well as several measures of intelligence (which were factor analyzed to assess g). The results of his study showed that g and the specific cognitive ability test (e.g., verbal test) associated with a specific task (e.g., a verbal task) accounted for a significantly larger percent of the performance variance for the VM tasks than for the CM tasks. General cognitive ability accounted for most of this variance (as compared to the primary factor, such as verbal ability). The association between g and VM performance continued for hundreds of trials. In the CM condition the relationship between performance and g attenuated over time. For the CM task, the high ability subjects showed relatively little performance improvement over time. On the other

hand, the low ability subjects showed substantial improvement over trials. However, although the high ability subjects were in effect learning less than the low ability subjects, they still maintained relative performance superiority.

Vernon (1983) also addressed the relationship of general cognitive ability and information processing. Vernon proposed that individual differences in intelligence may be partially due to differences in the speed and efficiency with which individuals can perform basic components of information-processing that are related to memory encoding, short term memory (STM) processing, and long term memory (LTM) retrieval.

Using several tasks involving these processes Vernon found that the speed with which individuals can perform these various cognitive tasks was significantly and highly related to their intelligence (as measured by the Wechsler Adult Intelligence Scale). Further, Vernon proposed that individuals with a broader knowledge base and strategy base have acquired these over time as a result of faster and more efficient information-processing capabilities.

The relationship between intelligence and information-processing supports a link between intelligence and strategy development on complex tasks if information processing is considered an integral part of strategy development for such tasks. According to Wood (1986), task complexity is defined by acts, products, and information cues. Task complexity

increases as the number of acts, products, and information cues increases as well as when the number and dynamics of relationships among these components increases. In order to develop effective strategies, individuals must be able to make sense of all the components of a task. Clearly, on a complex cognitive task, individuals must use controlled cognitive processes to achieve this. Further, such processes have a strong positive relationship with intelligence and this relationship is maintained over time and practice (Ackerman, 1986).

Also, the speed at which individuals can carry out basic information processing components, such as memory encoding, short term memory (STM) processing, and long term memory (LTM) retrieval may be reflected in the speed at which they are able to process task information cues and relationships between cues, products, and actions. This ability may enable individuals with high intelligence to develop strategies faster and more effectively. Further, high cognitive ability individuals may have a broader base of stored strategies from which to chose and develop new strategies.

While the relationship between cognitive information processing and intelligence may point to a connection between intelligence and strategy development, another way to conceptualize the latter relationship may be developed from research on validation of intelligence tests. A meta-analysis by Hunter (1986) showed that general cognitive

ability predicts performance in all jobs, beyond the relationship between job knowledge and general cognitive ability. Hunter's data showed that the validity of this relationship increased as a function of job complexity. Cognitive ability also predicted training success. However, the validity of this relationship did not vary systematically across job complexity (Hunter, 1986). The fact that the predictive validity of general intelligence increased as a function of job complexity for job performance but not for training success may indicate that the relationship between job complexity and intelligence is a long term, rather than a short term, relationship.

Gutenberg, Arvey, Osburn, and Jeanneret (1983) also found that tests of cognitive ability are most valid for complex jobs (i.e., jobs that require high levels of information processing and decision making). Wood et al. (1986) pointed out that this relationship is converse of the relationship between goal setting and task complexity, where goal setting is least effective for complex tasks and most effective for simple tasks. Campbell (1988) noted that cognitive search skills are more important on complex tasks because of the non-routine nature of such tasks. The relationship of cognitive ability to task activity is also most relevant on complex tasks because several alternative behaviors aimed at task accomplishment are possible and choices must be made among them. Therefore, one primary difference between complex and simple tasks lies in the

potential necessity of strategy development on complex tasks. Key to the development of effective strategies are the choices made among possible strategies. The quality of such choices may stem from an individual's cognitive ability.

According to social learning theory individuals with high cognitive abilities will be better able to exercise the forethought necessary to see future consequences (i.e., goals) as current regulators of behavior (Bandura & Cervone, 1983). This combined with Wood and Locke's (1990) model of strategy development suggests that individuals high on cognitive ability will be better able to make effective strategy relevant decisions. These decisions include whether a stored plan is appropriate or if a new plan needs to be developed and if a new plan, once developed and possibly implemented, is acceptable. Therefore, it follows that research take a closer look at the relationship between cognitive processes and strategy development.

Task specific skills, unlike cognitive processes, are directed only at a specific task or set of tasks and therefore may have effects on strategy development that are different from those of general or specific cognitive abilities. Increased knowledge along with chunking, hierarchically arranged cognitive structures, and problem specific cognitive schema may enable expert performers to bypass some if not all of the strategy development that novices must proceed to.

Conclusions

Cognitive ability research points to a need to look at this important construct as it relates to strategy development. Cognitive ability is related to information processing and as such may have an important positive effect on strategy effectiveness. While goal difficulty and specificity act to increase effort towards task accomplishment, on a complex task an individual with low cognitive ability, either general or specific, will not be able to harness that effort into constructive task activity.

However, there are two conditions that may negate the need for strategy development. Expert/novice research and theory indicates that expert task doers may not require strategy development. A second condition that preempts strategy development is task simplicity. Strategy development is not required on simple tasks because strategies are not necessary for task completion or are so obvious as not to require thought.

These two conditions, task expertise and task complexity, will be held constant in this study. The task will be complex and no participants in the study will be experts.

Summary

In summary, the strategy/goal setting research looks at the relationship between goal specificity and difficulty and length (in terms of time and detail) of strategy, relevance of strategy, and strategy search. The results of empirical

research show that increased difficulty and specificity are positively correlated with these dimensions of strategy in some situations. Some studies have shown that information, experience and training affect goal setting effects. Also, although it has been suggested that cognitive processes may influence the relationship between strategy and performance, empirical research has not to date addressed this issue.

This experiment will re-examine the relationship of goal specificity and difficulty to strategy development. The hypotheses will address the role of cognitive processes as a moderator in this relationship. The following section proposes specific hypotheses addressing these issues.

Hypotheses

The main thrust of this study is to integrate the effects of specific, difficult goals and ability on a complex task. This study will assess how goals affect performance via the moderating effect of ability on the relationship between goal setting and performance. Specific hypotheses are discussed below.

Hypothesis 1: The Overall Interaction of Goal Setting and Cognitive Ability on Performance

Hypothesis 1a proposes that individuals with specific, difficult goals will perform better than individuals with general or less difficult goals. Specifically, individuals with difficult, specific (SD) goals will perform better than individuals with easy to moderate, specific (EM) goals or general, 'do best' (DB) goals. This is consistent with the

Wood et. al. (1986) meta-analysis. Further, hypothesis 1b proposes that this positive relationship between goal specificity and difficulty and performance will be moderated by cognitive ability on a complex task. Specifically, the positive relationship between SD goals and performance will be greater for high cognitive ability subjects as compared to low ability subjects. Figures 2 and 3 illustrate these relationships.

Hypothesis 2: Goal Setting and Cognitive Effort

Hypothesis 2 is concerned with the relationship between the effort that individuals put towards developing strategies and the type of goal that they have. On a complex task, the focus is on cognitive effort, as opposed to physical effort, as may be involved with a simple task, such as a psychomotor exercise. Specifically, hypothesis 2 proposes that as goal difficulty and specificity increase, the cognitive effort that individuals put toward strategy development will also increase. This is consistent with studies by Earley et al. (1987) which found that individuals with more specific, difficult goals spent more time developing strategies, had strategies of more detail, and found strategy development to be more important to task activity than individuals with 'do best' goals. This is also consistent with Earley, Connoly and Ekegren (1989) who found that goal specificity and difficulty led to greater strategy search. The mechanism through which this occurs is based on theory and research that shows that difficult,

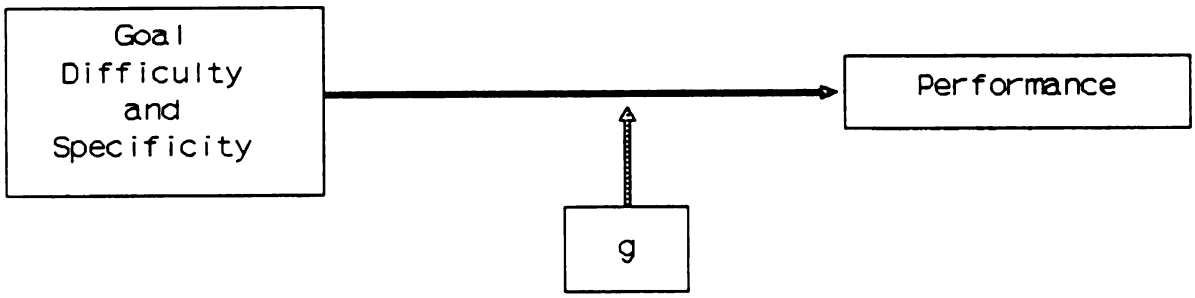


Figure 2. Expected relationships among ability, goals, and performance.

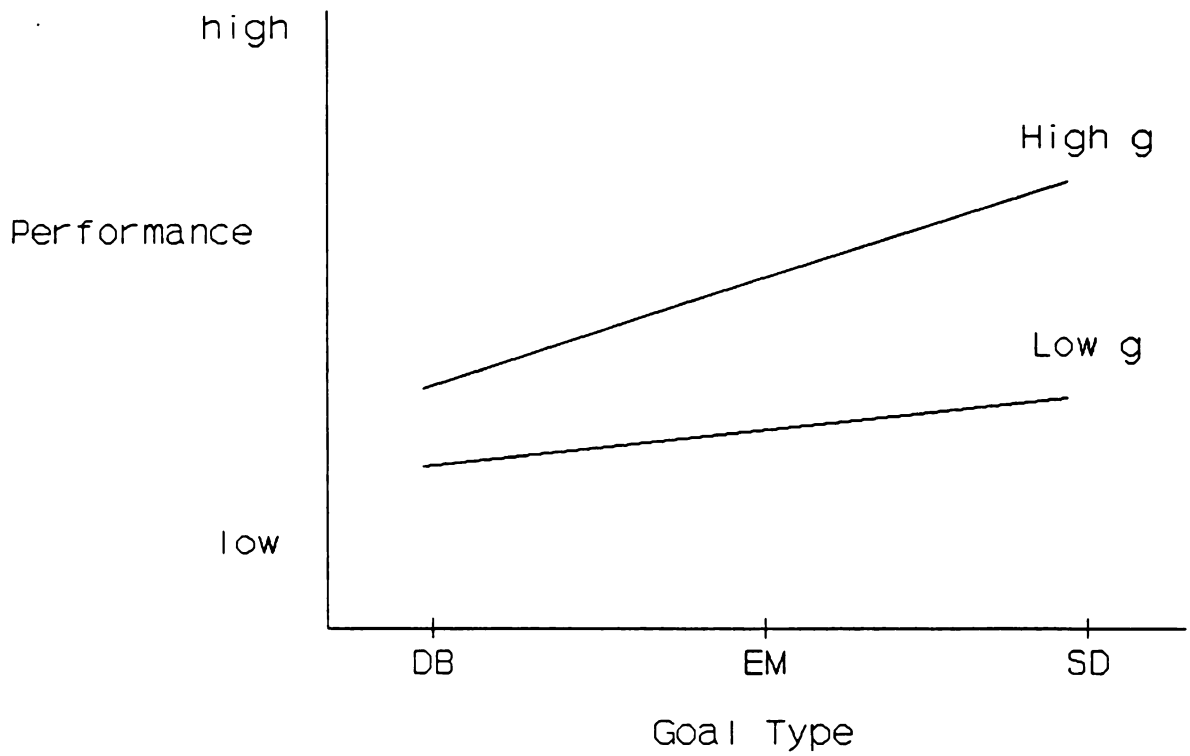


Figure 3. Expected interaction between ability and goals on performance.

specific goals increase the effort that individuals apply toward task activity (Locke et al., 1981). It is proposed here that on a complex task, performers will be inclined to focus this increased effort on the development of strategies for task accomplishment.

Hypothesis 3: Overall Interaction of Goal Setting and Cognitive Ability on Strategic Choice

Individuals may choose one or several different strategies out of many possible strategies available to perform a task. These strategies may be of different qualities, indicating that some will result in better performance than others. Hypothesis 3a proposes a main effect of goal setting on choice of strategy type such that the difficulty and specificity of the goal that an individual is striving for will affect the type of strategy that he or she will choose. This is indirectly supported by work by Smith, Locke and Barry (in press) and by Earley et al. (1990). Further, hypothesis 3b proposes that this relationship will be moderated by cognitive ability. Specifically, the relationship between goal specificity and difficulty and strategy choice will be different for individuals high on cognitive ability. Recalling that different strategies may be associated with different levels of quality (i.e., high quality defined here as associated with high performance) this cognitive ability effect parallels the effect of training found by Earley, Lee and Lituchy (1989) and the effects of experience found by Earley

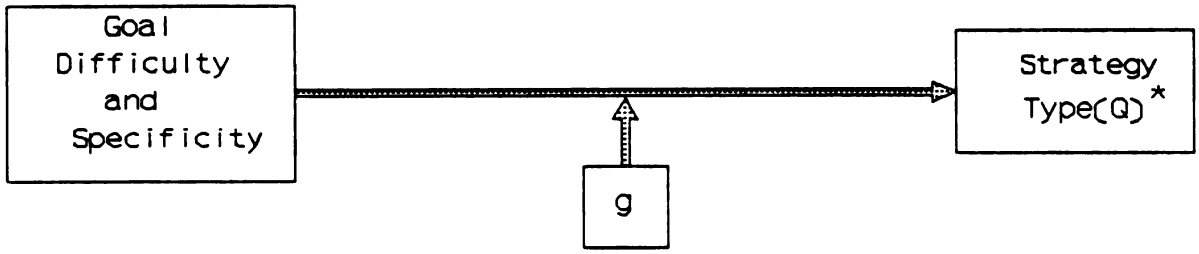
et al. (1990) and is supported by work on information processing and cognitive ability by Ackerman (1986) and Vernon (1983). These relationships are illustrated in Figures 4 and 5.

Hypothesis 4: The Strategic Choice Process

Hypothesis 4 deals with the process through which individuals choose the strategies that they will use. More specifically, hypothesis 4a proposes that the cognitive effort that individuals put towards strategy development will determine the type of strategy that they choose. Further, hypothesis 4b proposes that this relationship will be moderated by cognitive ability. Individuals may put much effort into strategy development, but on a complex task, where they have little or no experience, individuals will be able to develop high quality strategies only if they are high on cognitive ability. This is illustrated by Figures 6 and 7.

Hypothesis 5: Factors that Mediate the Relationship Between Goals and Strategic Choice

Hypothesis 5 proposes that hypothesis 4 is a mediator of hypothesis 3 such that if the relationship in hypothesis 4 is controlled for, the effect of hypothesis 3 will go to zero. This would indicate that without the effects of strategy development effort, goals will not influence strategy choice. This is indirectly supported by work by Earley, Lee and Lituchy (1989) who assessed time spent developing strategies and amount of strategy change and



* 'Q' indicates a level of strategy quality

Figure 4. Expected relationships among goals, ability, and strategy type.

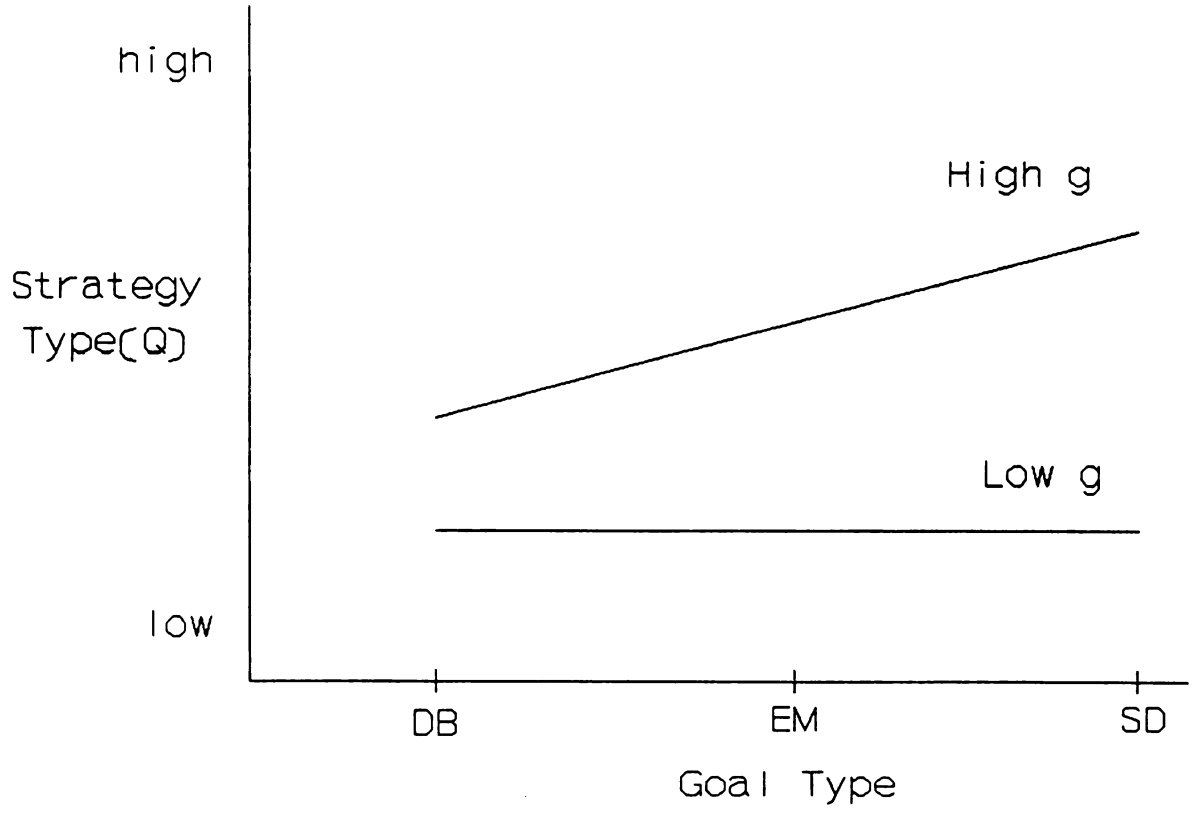


Figure 5. Expected interaction between ability and goals on strategy type.

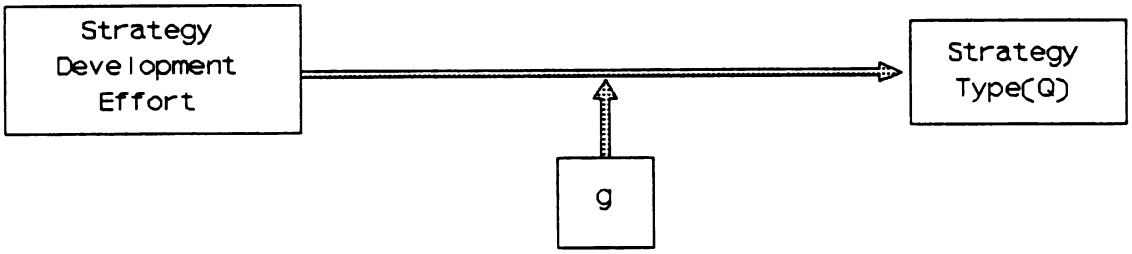


Figure 6. Expected relationships among strategy development effort, ability, and strategy type.

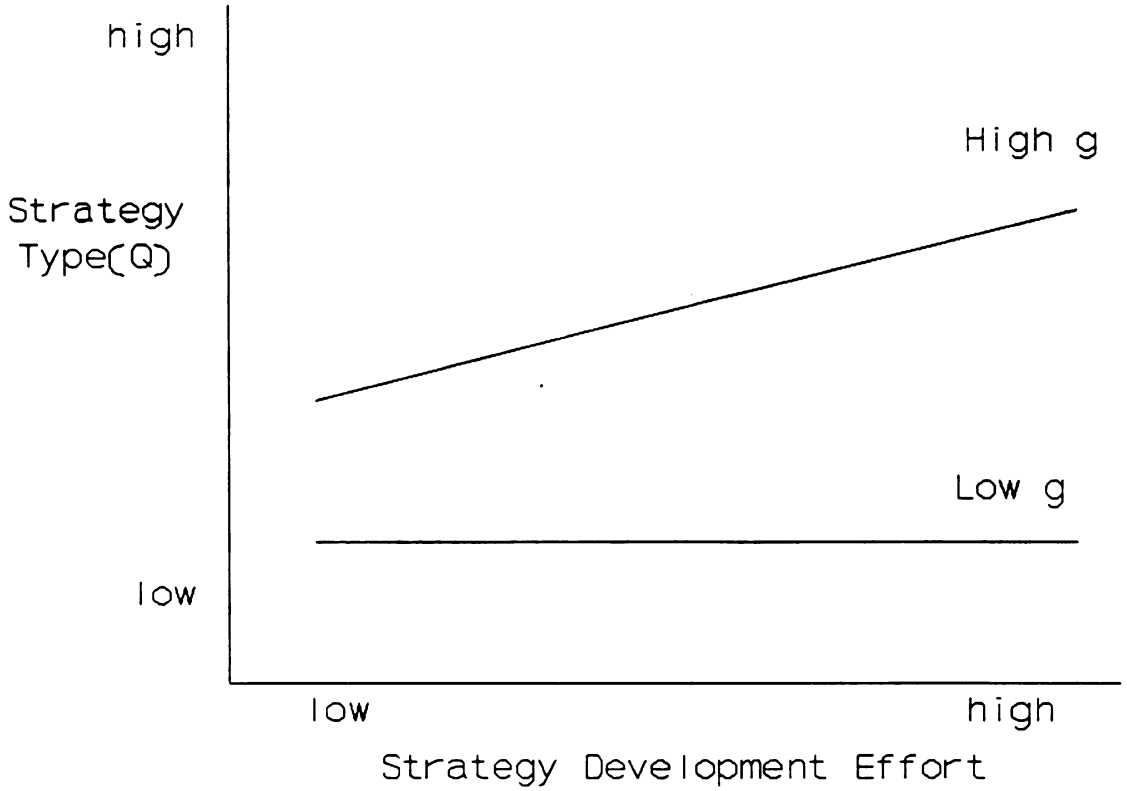


Figure 7. Expected interaction between strategy development effort and ability on strategy type.

found that these variables mediated the relationship of goals to the quality of strategies that individuals chose. Figure 8 shows this relationship.

Hypothesis 6: The Immediate Determinants of Performance

Hypothesis 6a proposes that the type of strategy that individuals choose will have a main effect on performance. Some strategies will be of higher quality than others and will lead to better performance. Hypothesis 6b proposes that there will also be a positive main effect of cognitive ability on performance. Individuals who are higher on cognitive ability will perform better due to their better information processing skills and knowledge.

Hypothesis 7: Factors that Mediate the Relationship Between Goals and Performance

Hypothesis 7 proposes that hypothesis 6a and hypothesis 4 mediate the relationships stated in hypothesis 1 such that the effects of goals on performance will not be seen if strategy type and effort towards strategy development are controlled. This emphasizes the role of strategy choice and strategy development effort on the relationship between goals and performance. This relationship is shown in Figure 9.

Hypothesis 8: The Determinants of Strategy Quality

Since different types of strategies will lead to different levels of performance, the issue of the quality of strategy becomes relevant when discussing strategy choice. In this study, strategy quality is defined by the effect of

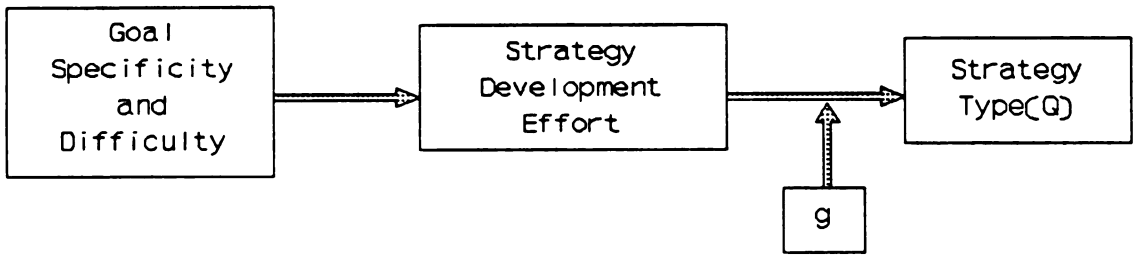


Figure 8. Expected mediating effect of strategy development effort on the relationship between goals and strategy type.

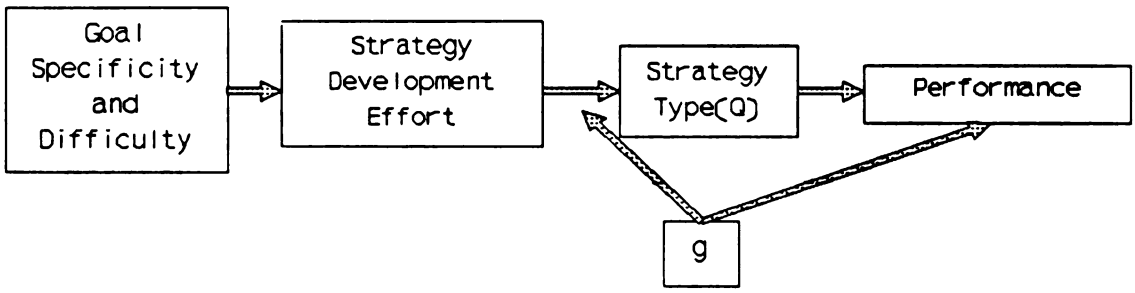


Figure 9. The expected mediating effect of strategy type and strategy development effort on the relationship between goals and performance.

the strategy on performance. A high quality strategy, while not the only predictor of performance, will account for alarge amount of the variance in performance compared to a low quality strategy. Hypothesis 8a proposes that specific and difficult goals, compared to easy to moderate, or general goals will lead to higher quality strategies. This is consistent with work by Smith, Locke, and Barry (in press), Earley, Lee, and Lituchy (1989), and Earley et al. (1990). Further, hypothesis 8b proposes that cognitive ability will moderate the relationship described in hypothesis 8a. The relationship between goal specificity and difficulty will be greater for individuals high on cognitive ability. This reiterates hypothesis 3b, but focuses more directly on the quality outcome of the choice of strategy. These relationships are shown in Figures 10 and 11.

Appendix A presents a summary of the hypotheses. Combining hypotheses 1 through 8 develops a model of goal setting for complex tasks that is pictured in Figure 12.

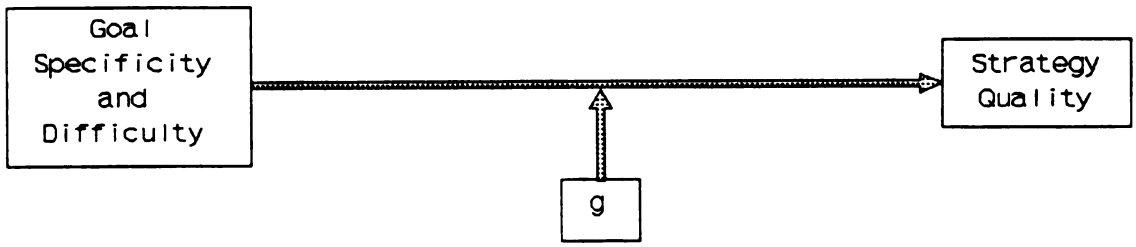


Figure 10. Expected relationships among goals, ability, and strategy quality.

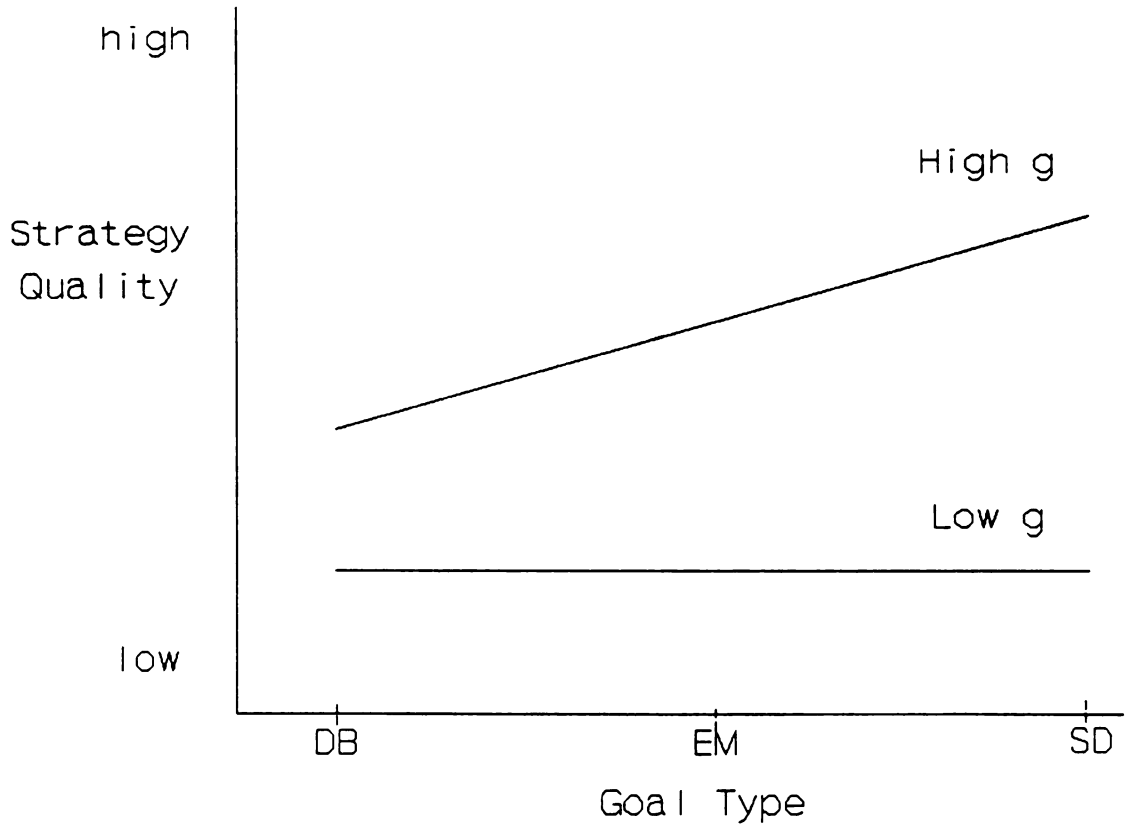


Figure 11. Expected interaction between ability and goals on strategy type.

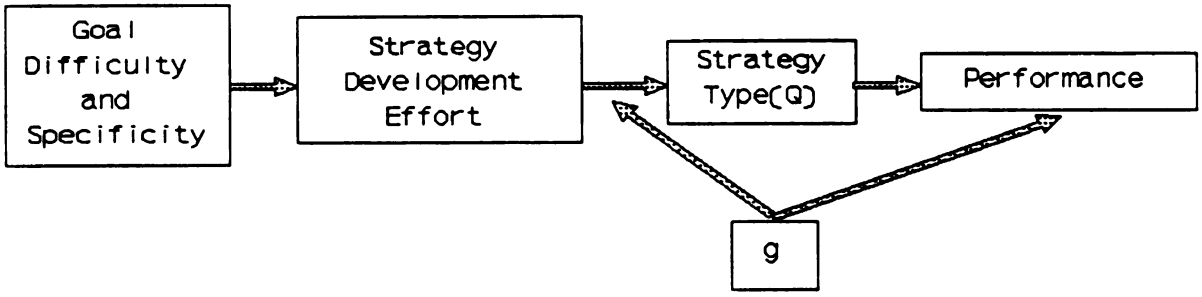


Figure 12. Model of goal setting and strategy on a complex task.[1]

METHOD

Subjects

Subjects were 253 undergraduate psychology students. Subjects received extra course credit for participating in this study.

Task

The task consisted of sets of crossword puzzles[2]. Each set contained 18 puzzles of varying levels of difficulty. There were six easy, six medium, and six difficult puzzles in each set. All subjects received identical sets of puzzles. Subjects had thirty minutes to work on the puzzles, in any order they chose. Subjects used different colored pens to work on the puzzles so that whether or not they did the puzzles in the order given them could be objectively assessed. They used a blue pen for the first ten minutes of task time, a red pen for the second ten minutes, and a green pen for the third ten minutes.

Goals were set in terms of total points to be attained. Points were earned by filling in correct answers. A word on an easy puzzle was worth 1 point. A word on a medium puzzle was worth 2 points. A word on a difficult puzzle was worth 3 points.

Design

The independent variables were goal difficulty and specificity and cognitive ability. There were two levels of goal difficulty and two of goal specificity. These were a 'do your best' (DB) goal, a low to moderate and specific (EM) goal, and a difficult, specific (SD) goal. The goals for each level of difficulty were determined in a pilot study. Thirty-four undergraduate psychology students participated in the pilot study. They were given the same set of puzzles that was used in this study. In the pilot study subjects were told to do their best on the puzzles. The mean performance of the group was 97 points with a standard deviation of 59.96. The goals assigned in this study were as follows. A vague goal was worded as "do your best to attain as many points as you can". The easy to moderate and specific goal was 70 points. The difficult and specific goal was 160 points. Therefore, the difficult goal is approximately at the 84th percentile and the easy to moderate goal is approximately at the 31st percentile of performance on the pilot study.

Dependent variables were the effort put towards developing strategies, type of strategy, quality of strategies, and performance.

Procedure

Participants were given a brief and very general description of the study. Next they were asked to read and sign a consent form, indicating that they voluntarily agreed

to participate and that they were aware that they could leave the experiment at any time without loss of credit and that their performance and survey data would be kept anonymous (see Appendix B).

After consent forms were collected students were given the cognitive ability test. This took approximately 30-40 minutes to complete. Next, participants were given a brief questionnaire that assessed crossword puzzle experience and affinity (see Appendix C).

Subjects were then introduced to the task. They were given a packet of puzzles with brief written instructions that included their goal. They were told not to look at the puzzles until they heard the instructions. After subjects read the instructions they were repeated orally by the experimenter. Questions regarding instructions were answered. Subjects were told to take out their puzzles. After this, the experimenter told the subjects that they needed to wait two minutes before they could begin writing answers. This period gave students time to begin planning, if they chose to do so.

At the end of the task time (30 minutes) students were given a survey to assess the effort they put towards strategy development, the strategies they used, and a manipulation check of goal difficulty and specificity.

After subjects completed these questionnaires they were given a debriefing form describing the study. When they

finished reading this and listened to a five minute oral debriefing they were dismissed.

Measures

Cognitive Ability

Selected parts of the Employee Aptitude Survey developed by Grimsley, Ruch, Warren, and Ford were used. They were the verbal comprehension, verbal reasoning, word fluency, and symbolic reasoning sections.

The verbal comprehension test, according to Ruch and Ruch (1980) was designed to "measure ability to use words in oral and written communication and in planning". The test consists of thirty items and takes five minutes to complete. Essentially, the test involves identifying synonyms. This test has an alternate forms reliability of 0.85. Ruch and Ruch (1980) report that it correlated 0.85 with the verbal subtest of the Primary Mental Abilities Test and 0.75 with the verbal subtest of the Cooperative School and College Ability Test. In a sample similar to the one to be used in this study Whitener (1988) found a coefficient alpha reliability of 0.75.

The verbal reasoning test assesses an ability to draw conclusions from given statements. It has thirty items and requires five minutes to complete. Ruch and Ruch (1980) report that it has an alternate form reliability of 0.82. Further, it has a correlation of 0.74 with the reasoning subtest of the Primary Mental Abilities Test, correlations of 0.51 and 0.53 with the verbal and quantitative subtests

of the Cooperative School and College Ability Tests, and a correlation of 0.56 with the Otis Employment Test.

The word fluency test is a five minute test that requires individuals to list as many words as possible beginning with a given letter in five minutes. It is standardized for the letters C, M, and S. It has an alternate form reliability (i.e., using a different letter as an alternate form) of 0.76. Ruch and Ruch (1980) reported a correlation of 0.64 with the word fluency subtest of the Primary Mental Abilities Tests. In this study the letter C was used.

The symbolic reasoning test was designed to assess an individual's ability to understand symbolic relationships. It is also a five minute, thirty item test. It requires test takers to draw conclusions based on given relationships among symbols. According to Ruch and Ruch (1980) it has an alternate forms reliability of 0.82. Further, it correlated 0.52 with the reasoning subtest of the Primary Mental Abilities Test and 0.41 with the quantitative portion of the Cooperative School and College Ability Tests.

Manipulation Check

A manipulation check questionnaire was used to determine if subjects knew their goal and if they used the goal given them or chose a goal of their own. Subjects were asked what the goal assigned to them was, if they had a goal of their own other than the assigned one, and if so, what was the goal. Although these questions could be used to

eliminate students who had a specific numerical goal that was different from the goal assigned to them, it is unclear whether the students understood the questions. While some students were able to state their goal (about 78 percent) and whether they used it or chose another, many other students responded by describing strategies, rather than goals and other students responded in a very general way. For example, some responses to the item "What was the goal assigned to you?" included answers such as "word orientation", "to get extra-credit points", and "to complete certain tasks in a given amount of time". When asked if they had a goal other than the assigned goal, subjects often responded with strategies, such as "get as many of the 'hard' answers as possible", "to do as many of the 'easy' words as possible", and "to finish one whole puzzle". However, since the goal was repeated twice by the experimenter and was presented in writing to each student, it seems reasonable to assume that the goal condition was effectively manipulated.

Effort Towards Strategy Development

Effort was determined by a post task questionnaire. Participants were given a questionnaire assessing the time they spent developing their strategies, the amount of concentration that went into strategy development, and other relevant items. Items 3 through 7 were adapted from Earley et al. (1987).

Strategies Used

In order to determine what strategies were used students answered a survey describing their strategies. A list of potential strategies was developed from a pilot study of 34 students (see appendix F). Participants rated the extent to which they used various possible strategies. The strategies are not, for the most part, mutually exclusive. Therefore, subjects may have used varying combinations of strategies. The list of strategies was factor analyzed to determine underlying, general strategies. Additionally, the colored pens used by the students as well as a count of the actual numbers of the puzzles worked on provided an objective measure of whether subjects did the puzzles in the order that they were in the packet. Since students used different colored pens at different times, it was possible to determine if subjects did not do the puzzles in the order that they were originally in the packet. Another objective measure of strategy was the percent of easy, medium, and hard puzzles that the students worked on. The total number of each type of puzzle worked on was counted. From this count, the percent of each type of puzzle worked on could be calculated.

Quality of Strategy

In this study, a high quality strategy is one that is associated with a high level of performance. Therefore, the quality of a strategy was determined by the frequency with which high performance was associated with that strategy.

Multiple regression, with performance as the dependent variable and strategy use (i.e., used exclusively, did not use at all, etc.) as the independent variable was used to describe strategy quality.

Analysis

The analyses were done on a sample size of 214. This excluded individuals who were classified as experts. Experts were those who reported having worked on seven or more crossword puzzles in the last month. This was approximately two standard deviations above the mean for this item. This sample also excluded eight subjects who reported having a numerical goal that was different from the one assigned to them. These eight students were excluded on the basis of their response to two manipulation check items. Specifically, these subjects responded to the item "What was the goal assigned to you?" with a numerical goal that was different from the assigned goal or responded with a specific numerical goal when asked what, if any, goal they set that was different from the assigned goal. Also excluded were eighteen other subjects who, for various reasons, could not complete the study (e.g., left for part of the study).

Hierarchical multiple regression was used to test the hypotheses. Goal specificity and difficulty were dummy coded such that the SD goal condition was the reference variable. Analysis of the specific hypotheses is discussed below.

Hypothesis 1a proposed that individuals with SD goals would perform better than individuals with general or less difficult goals. Specifically, it was asserted that individuals with SD goals would perform better than individuals with EM or DB goals. Further, hypothesis 1b proposed that this positive relationship between SD goals and performance would be moderated by cognitive ability on a complex task. Specifically, it was hypothesized that the positive relationship between SD goals and performance would be greater for high cognitive ability subjects as compared to low ability subjects. These hypotheses were tested with multiple regression, entering the dummy coded goal conditions first, cognitive ability second, and the interactions between cognitive ability and goal conditions third.

Hypothesis 2 proposed that SD goals would also be associated with the cognitive effort that individuals put toward strategy development. In this analysis, effort toward strategy development was the dependent variable and the goal conditions were entered in the first step.

Hypothesis 3a proposed a main effect of goal setting on choice of strategy type such that the difficulty and specificity of the goals that individuals were striving for would affect the type of strategy that they chose. Further, hypothesis 3b proposed that this relationship would be moderated by cognitive ability. In this equation, strategy type, as determined by the factor analysis of the strategy

questionnaire, was the dependent variable and goals, cognitive ability, and the interaction between goals and cognitive ability were entered in the first, second, and third steps respectively.

Hypothesis 4a proposed that the cognitive effort that individuals put towards strategy development would determine the type of strategy that they chose. Further, hypothesis 4b proposed that this relationship would be moderated by cognitive ability. For this analysis, strategy type was the dependent variable. Strategy development effort was entered in the first step, cognitive ability in the second, and the interaction between effort and ability in the third.

Hypothesis 5 proposed that hypothesis 4 would be a mediator of hypothesis 3 such that if the relationship in hypothesis 4 was controlled for, the effect of hypothesis 3 will go to zero. This would indicate that if the effects of strategy development effort are controlled for, the relationship between goals and strategy type will not be seen. For this analysis, strategy type was the dependent variable. Strategy development effort was entered in the first step, cognitive ability in the second, strategy development effort by ability interaction in the third, goals in the fourth, and the goal by ability interactions in the fifth step.

Hypothesis 6 proposed that the type of strategy that individuals chose would have a main effect on performance. Also, a positive main effect for g was proposed. For this

analysis, performance was the dependent variable and strategy type and g were entered in the first step and second steps respectively.

Hypothesis 7 proposed that hypothesis 6a and hypothesis 4 would mediate the relationships stated in hypothesis 1 such that the effects of goals on performance would not be seen if strategy type and effort towards strategy development are controlled. In this analysis, performance was the dependent variable strategy development effort was entered in the first step, cognitive ability in the second, strategy development effort by cognitive ability interaction in the third, strategy type in the fourth, goal conditions in the fifth, and goal by cognitive ability interactions in the fifth step.

Hypothesis 8a proposed that specific and difficult goals, compared to easy to moderate, or general goals would lead to higher quality strategies. Further, hypothesis 8b proposed that cognitive ability would moderate the relationship described in hypothesis 8a. The analysis for hypotheses used strategy quality as the dependent variable. Strategy quality was computed from a regression equation that entered score as the dependent variable and strategy type as the independent variable. For hypothesis 8, goals were entered in the first step, cognitive ability in the second step, and cognitive ability and goal interactions in the third step.

Further analyses included a path analysis of the model of strategy and goal setting on complex tasks. Additionally, exploratory analyses were done assessing the effects of specific cognitive abilities on performance and strategy. The cognitive ability tests fall into two categories. These are verbal abilities (verbal comprehension and word fluency) and analytic abilities (verbal and symbolic reasoning). Hierarchical multiple regression, with either strategy type or score as the dependent variable and verbal and analytic ability entering in separate steps were done to assess the possibility that verbal ability and analytic ability work in different ways to influence performance. Given the level of complexity and the verbal nature of this task, one might expect that verbal ability will have a positive main effect on performance, while analytic ability will be more highly related to strategy quality. Individuals high on verbal ability will have the cognitive resources to perform well on the task by filling in many words. Subjects with strong analytic skills will be able to use their reasoning skills to develop effective strategies.

RESULTS

The results are presented in the order of the experimental hypotheses. First, descriptive statistics of the measures are presented. Second, results of regression analyses of the hypotheses are described. Third an overall path model is shown. Finally, exploratory analyses describing the relationships of analytic and verbal abilities to the dependent variables are presented.

Descriptive Statistics

Table 1 presents the means, standard deviations, and reliabilities of the main variables of the study. Table 2 displays intercorrelations among the variables. All results are based on a sample size of 214 which included all subjects who were not crossword puzzle experts.

Factor Analysis of the Strategy Items

The factor analysis of the strategy items was done using principle factors with varimax rotation of factors with eigen values greater than 1. This resulted in the development of one six item scale that assessed the extent to which subjects worked on easy and medium as opposed to hard puzzles. The items included in this scale are numbers 2, 3, 6, 7, 8 and 9. The reliability of this scale is 0.75 (Cronbach's alpha).

Table 1

Means, Standard Deviations, and Reliabilities

Variable	Mean	S.D.	Reliability
Score (points)	103.68	47.40	
Strategy[1]			
Easy/Medium Puzzles	1.80	.54	.75
Scanning	1.86	.71	
g (general cognitive ability)[2]	.00	2.43	.79
Verbal ability[3]	.00	1.45	.58
Analytical ability[4]	.00	1.62	.78
Effort[5]	13.99	3.81	

[1] Based on a 3 point scale with 3 indicating a high degree of use.
[2] Based on the sum of the standardized scores of the four ability tests.
[3] Based on the sum of the standardized scores of the word fluency and verbal comprehension tests.
[4] Based on the sum of the standardized scores of the verbal reasoning and symbolic reasoning tests.
[5] Based on the sum of seven 5 point items, with 5 indicating high effort.

Table 2

Intercorrelations Among Variables

	1	2	3	4	5	6	7	8	9
1. Goal Dummy 1 (EM vs. SD)									
2. Goal Dummy 2 (DB vs. SD)	-.47***								
3. g	.04	-.13*							
4. Verbal Ability	-.02	-.08	.76***						
5. Analytic Ability	.08	-.13*	.82***	.25***					
6. Effort	-.08	.12*	.06	.04	.06				
7. Easy/Medium Strategy	-.05	.17**	-.06	-.06	-.04	.06			
8. Scanning Strategy	.04	-.04	-.14**	-.03	-.19***	.03	.16**		
9. Score	.08	-.09	.51***	.46***	.35***	.00	-.25***	.16**	

* p < .10
** p < .05
*** p < .01

Ability Tests

Reliabilities for the symbolic reasoning test and the verbal reasoning test were computed for the first half of the test and then adjusted using the Spearman-Brown formula for correction of test length. This was necessary since very few participants were able to finish these tests. Reliability for general cognitive ability (the sum of the four tests) was computed using only the verbal comprehension, verbal reasoning, and symbolic reasoning tests since the word fluency score is based only on a number of words generated. For the same reason, reliability of the verbal ability measure (the sum of verbal comprehension and word fluency) is the same as the reliability of the verbal comprehension test. Although standard scores were used for the analyses, reliabilities for g and for analytical ability were computed using raw scores. These reliabilities were calculated using Nunnally's (1978) formula for reliability of linear combinations.

Objective Measures of Strategy

The objective measure of whether subjects did the puzzles in the order that they were given in the packet was correlated with the self-report of this strategy. Specifically, the objective measure of whether students did puzzles in the order that they were in the packet was assessed in two ways. First by considering the numbers of the puzzles worked on (i.e., with respect to their position in the packet) with the order of color used (red, then blue,

then green). For example, if a student worked on puzzles 1, 2, and 3 and answered puzzle 1 in green, it is obvious that the puzzles were not done in order. Also, it could be assessed whether the puzzles were done in order by whether the numbers of the puzzles worked on were consecutively ordered. The correlation between the objective measure and the strategy item "I did the puzzles in the order that they were given" was 0.50 ($p < 0.01$), indicating that this self-report was reliable. Further, a comparison of an objective count of the number of easy and medium puzzles done with the subjective measure of this strategy indicated that the subjective measure is construct valid. Specifically, the correlation of the objective percentage puzzles that were worked on that were easy and medium with the strategy score for the Easy/Medium scale is 0.65 ($p < 0.01$).

The Hypotheses

The Overall Interaction of Goal Setting and Cognitive Ability on Performance

The first hypothesis addressed the relationships among performance, general cognitive ability, and goals. Hypothesis 1a posited that individuals with SD goals would perform better than individuals with DB or EM goals. Further, hypothesis 1b proposed that this positive relationship between goal specificity and difficulty and performance would be moderated by cognitive ability on a complex task. Specifically, the positive relationship between SD goals and performance would be greater for high

cognitive ability subjects as compared to low ability subjects. Table 3 shows the multiple regression results of the analysis of these relationships.

As can be seen from Table 3, there was no main effect for goals on performance and there was no interaction between goals and general cognitive ability. There was only a strong main effect of g on performance. Therefore, hypothesis 1 was rejected.

Goal Setting and Cognitive Effort

Hypothesis 2 proposed that as SD goals would lead to higher cognitive effort toward strategy development than DB or EM goals. Table 4 shows the results of the regression for this hypothesis. There was no significant main effect for goals on strategy development effort. Therefore, hypothesis 2 was rejected.

Overall Interaction of Goal Setting and Cognitive Ability on Strategic Choice

Hypothesis 3a proposed a main effect of goal setting on choice of strategy type such that SD goals, as compared to EM or DB goals would affect the type of strategy chosen. Further, hypothesis 3b proposed that this relationship would be moderated by cognitive ability. The results of this regression are shown in Table 5.

There was a significant main effect for goals on the use of the Easy/Medium puzzle strategy. This was an ineffective strategy, and subjects with SD goals were less likely to use it. Specifically, this goal effect is

Table 3

Regression Analysis with Performance (Score) as the Dependent Variable and Cognitive Ability and Goals Entering as Main and Interaction Effects

Step	Variables entered in the equation	R^2_{tot}	F	R^2 change	F of change
1	Goals Dummy 1 (EM vs. SD) & Dummy 2 (DB vs. SD)	.01	1.12		
2	g	.26	24.90***	.25	71.73***
3	Goals X g Dummy 1 X g & Dummy 2 X g	.26	14.94***	.00	.26

*** p < 0.01
** p < 0.05
* p < 0.10

Table 4

Regression Analysis with Effort Toward Strategy Development as the Dependent Variable and Goal Condition Entering as a Main Effect

Step	Variables entered in the equation	R^2_{tot}	F	R^2 change	F of change
1	Goals Dummy 1 (EM vs. SD) & Dummy 2 (DB vs. SD)	.01	1.56		

*** p < 0.01
** p < 0.05
* p < 0.10

Table 5

Regression Analysis with Strategy Type (Easy/Medium) as the Dependent Variable and Cognitive Ability and Goals Entering as Main and Interaction Effects

Step	Variables entered in the equation	R^2_{tot}	F	R^2 change	F of change
1	Goals Dummy 1 (EM vs. SD) & Dummy 2 (DB vs. SD)	.03	3.43**		
2	g	.03	2.38*	.00	.31
3	Goals X g Dummy 1 X g & Dummy 2 X g	.03	1.48	.00	.86

*** p < 0.01
** p < 0.05
* p < 0.10

accounted for by the DB versus SD condition. Therefore, subjects with DB goals were more likely to use this ineffective strategy than were subjects with SD goals. There was no interaction effect between goals and g on this dependent variable. Thus, this hypothesis was only partially supported.

The Strategic Choice Process

Hypothesis 4a proposed that the cognitive effort that individuals put towards strategy development would determine the type of strategy that they chose. Further, hypothesis 4b proposed that this relationship would be moderated by cognitive ability. The results of the analysis of these hypotheses are presented in Table 6. There were no main or interaction effects for either effort or g. The amount of cognitive effort that subjects put into strategy development did not determine the extent to which they used the Easy/Medium puzzle strategy. This decision was also unaffected by level of general cognitive ability. Therefore, hypothesis 4 was rejected.

Factors That Mediate the Relationship Between Goals and Strategic Choice

Hypothesis 5 proposed that the effects of goals on strategy choice occur through the influence of effort. Without the effects of effort, goals would not affect strategy choice. Since no effect of goals on effort or of effort on strategy type was demonstrated, testing of this hypothesis was obviated.

Table 6

Regression Analysis with Strategy Type (Easy/Medium) as the Dependent Variable and Strategy Development Effort and Cognitive Ability Entering as Main and Interaction Effects

Step	Variables entered in equation	R^2_{tot}	F	R^2 change	F of change
1	Effort	.00	.73		
2	g	.01	.82	.01	.34
3	Effort X g	.01	.57	.00	.06

*** p < 0.01
** p < 0.05
* p < 0.10

The Immediate Determinants of Performance

Hypothesis 6a proposed that the type of strategy that individuals chose would have a main effect on performance. Hypothesis 6b asserted that there would be a positive main effect for g on performance. As can be seen from Table 7, there was a main effect on performance for strategy as well as for general cognitive ability. Table 7 also shows an unanticipated interaction between strategy type and score. This interaction is illustrated in Figure 13 and reveals that the detrimental effect of working on easy and medium puzzles as opposed to difficult puzzles is greater for high ability subjects. High ability subjects have the most to gain from working on difficult puzzles since they are the ones most likely to get correct answers on these puzzles.

Factors that Mediate the Relationship Between Goals and Performance

Hypothesis 7 proposed that hypothesis 6a and hypothesis 4 would mediate the relationships stated in hypothesis 1 such that the effects of goals on performance would not be seen if strategy type and effort towards strategy development were controlled. Since there was no effect of goals on performance, or of effort on strategy type, this hypothesis was not tested.

The Determinants of Strategy Quality

Hypothesis 8a proposed that SD goals, compared to EM, or DB goals would lead to higher quality strategies. Further, hypothesis 8b proposed that cognitive ability would

Table 7

Regression Analysis with Performance (Score) as the Dependent Variable and Strategy Type (Easy/Medium) and Cognitive Ability Entering as Main Effects

Step	Variables entered in the equation	R^2_{tot}	F	R^2 change	F of change
1	Strategy Easy and Medium	.06	14.46***		
2	g	.31	46.97***	.25	74.48***
3	Easy/ Medium X g	.33	33.99***	.02	5.85**

*** $p < 0.01$
** $p < 0.05$
* $p < 0.10$

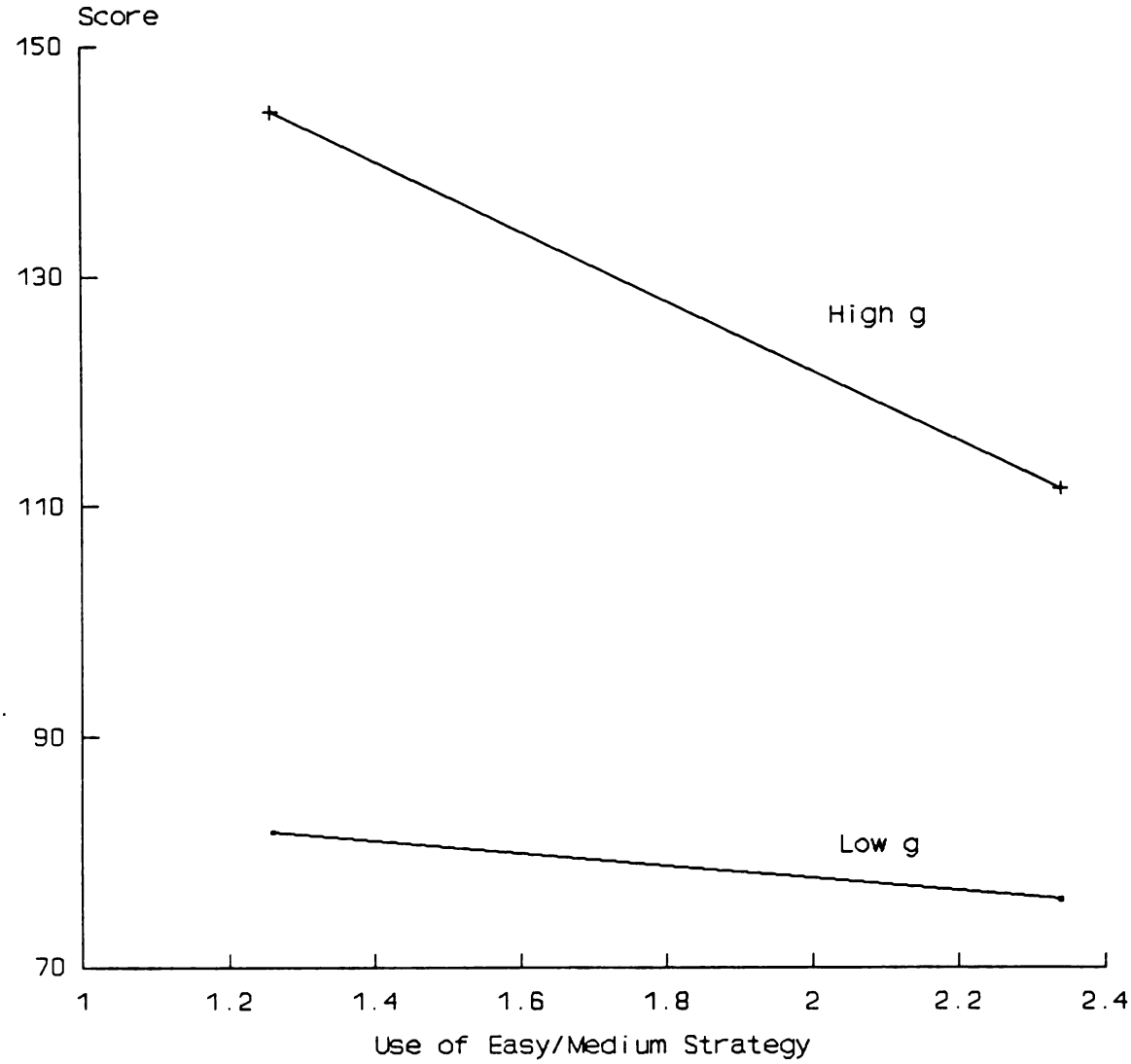


Figure 13. Interaction between general cognitive ability and strategy type on performance.

moderate the relationship described in hypothesis 8a. Since only one strategy type was analyzed and since this type was significantly correlated with performance, strategy type was, in essence, redefined as strategy quality. Therefore, this analysis was redundant with hypothesis 3 and is not presented. From hypothesis 3, it can be seen that there is a main effect for the DB goal condition on strategy quality.

Path Analysis of the Overall Model

Figure 14 illustrates the path model of the relationships examined in this study. It can be seen from the model that significant relationships exist between goals and strategy type, between strategy type and performance, and between general cognitive ability and performance. Also, there is a significant moderating effect of g on the relationship between strategy type and performance. A modified path model, including only these four significant relationships is shown in Figure 15. Since Easy/Medium is an ineffective strategy, its effect on performance is negative. It can be seen from the model that general cognitive ability has the greatest effect on performance.

Verbal and Analytic Ability

Exploratory analysis of the effects of verbal and analytic ability on performance and strategy did show that verbal ability has a stronger effect on performance. It can be seen from Table 8 that although both analytic and verbal ability had significant main effects on performance, the variance in score was primarily due to verbal ability. As

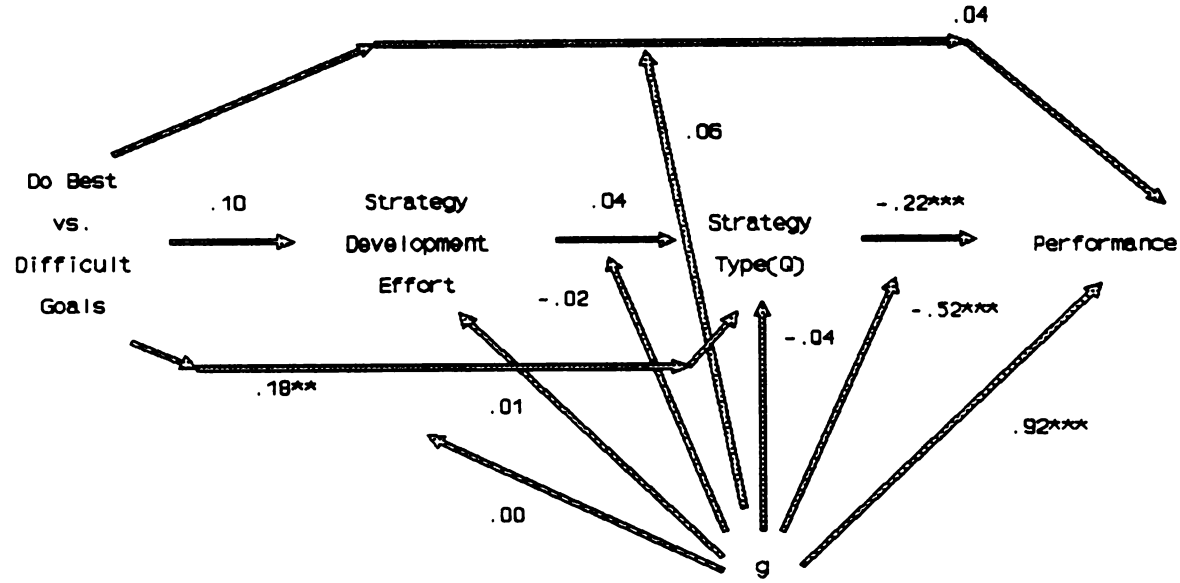


Figure 14. Path model.

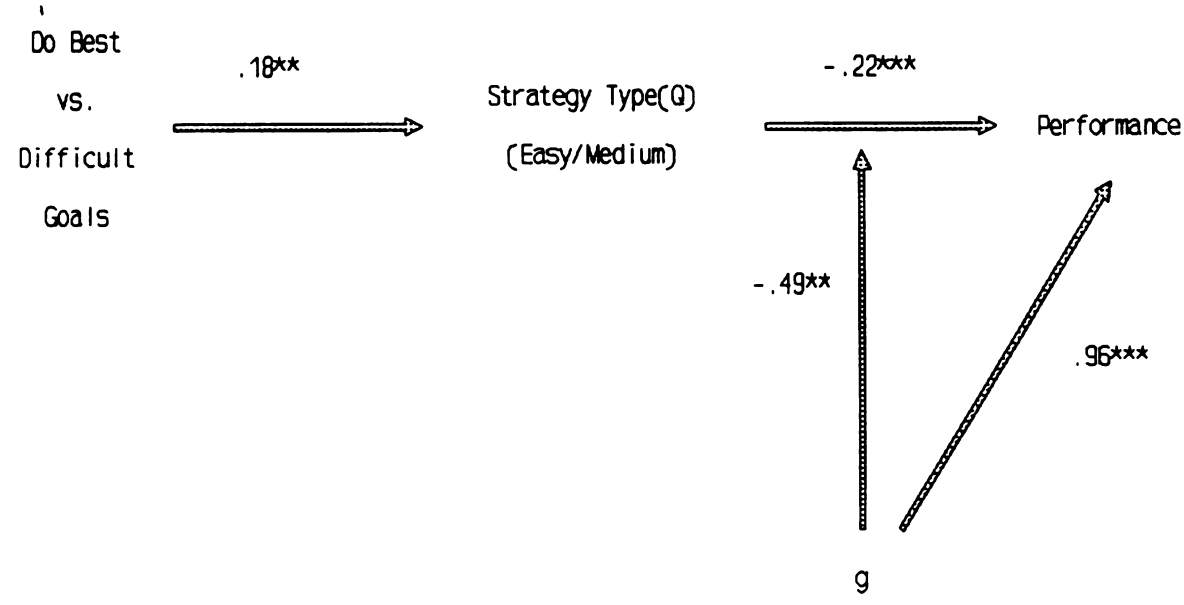


Figure 15. Modified path model.

Table 8

Regression Analysis with Score as the Dependent Variable and Verbal Ability and Analytic Ability Entering as Main Effects

Step	Variables entered in the equation	R^2_{tot}	F	R^2 change	F of change
1	Verbal Ability	.21	57.94***		
2	Analytic Ability	.27	38.48***	.06	16.73***

*** p < 0.01
** p < 0.05
* p < 0.10

shown in Table 9, neither verbal or analytic ability, like general cognitive ability had a significant main effect on the use of the Easy/Medium strategy.

Table 9

Regression Analysis with Strategy Type (Easy/Medium) as the Dependent Variable and Verbal Ability and Analytic Ability Entering as Main Effects

Step	Variables entered in the equation	R^2_{tot}	F	R^2 change	F of change
1	Analytic Ability	.00	.32		
2	Verbal Ability	.00	.44	.00	.56

*** p < 0.01
** p < 0.05
* p < 0.10

DISCUSSION

This section will discuss in detail the relationships among goals, strategy, cognitive ability, and performance. The first part will summarize and discuss the results described above. Then, additional post hoc analyses that further explore the model proposed here will be addressed. Next, the post hoc analyses will be integrated with the original results to develop conclusions consistent with both sets of analyses. Finally, suggestions for future research will be made.

Discussion of Results

The Overall Interaction of Goal Setting and Cognitive Ability on Performance

The results of this study did not find a positive main effect for goals on performance. This result is inconsistent with the Wood et al. (1986) meta-analysis of goal effects, which found that although positive goal effects were less pronounced on complex tasks, they were still present. However, other research has failed to find a positive link between goals and performance on complex tasks and has, in fact, reported a negative link. For example, Earley, Connoly and Ekegren (1989) found that increased goal difficulty resulted in performance decreases in three

studies that incorporated complex tasks. Similarly, Huber (1985) found that subjects with difficult goals working on a maze task had lower levels of performance than those with easy goals. In these studies, the decreased performance was attributed to ineffective strategy search or too much time spent on information gathering. Earley, Connoly and Ekegren (1989) describe four task conditions that may cause goals to negatively affect performance. These occur when (1) performance is more a function of task strategy than effort, (2) there are many possible strategies, (3) the best strategy is not obvious, and (4) there is little opportunity for testing the effectiveness of various strategies. The task incorporated in this study met all of these conditions.

Further, in this study, there was no interaction effect between goals and general cognitive ability on performance, indicating that there was no effect of goals on performance for individuals at all levels of general intelligence. If the absence of a main effect is attributed to the complexity of the task, then the absence of a moderating effect of g would indicate that the influence of complexity on goal effects for this task are not surmountable by increased intelligence.

This supports a complementary relationship between goal setting and general cognitive ability proposed by Wood et al. (1986). According to this proposition, there is a complementary relationship between goals and cognitive ability such that on tasks where goal setting works best,

general cognitive ability will have the least effect. Conversely, where the g-performance relationship is strongest, goal setting will have the least effect. Wood et al. based this idea on research by Hunter (1986) and Gutenberg et al. (1983) that examined the moderating effect of task complexity on the relationship between performance and general cognitive ability. This research found that this moderating effect is in the opposite direction of the moderating effect of task complexity on the relationship between goals and task performance. In this study, which focused on a complex task, there was a strong main effect of g on performance, but no significant main effect of goals on performance, thus illustrating one side of Wood et al.'s complementary proposition.

Goal Setting and Cognitive Effort

The second hypothesis dealt with the effects of goals on the effort that individuals put toward developing strategies. The results of this study demonstrated no main effect of goals on the amount of effort that subjects put forth. Theory and research by Locke et al. (1981), Earley, Lee, and Lituchy (1989) and Earley et al. (1987) indicate that a positive relationship could have been expected. The absence of a positive relationship in this study may be attributable to the nature of the goals. While people were putting effort towards strategy development, this was not the result of goals. Perhaps the goals were not of the type that would stimulate effort towards strategy development on

this task. Specifically, they did not provide any information relevant to strategy development.

A further explanation for failure to find support for this hypothesis could be attributed to the two minute time period that student's had prior to being permitted to fill in answers. Since student's had nothing else to do during this time period, they may have been able to do most or all of their strategy development during this time. Their incentive to plan may have been driven by boredom rather than by goals and they may have engaged in strategy development regardless of goal condition.

Overall Interaction of Goal Setting and Cognitive Ability on Strategic Choice

Hypothesis 3 addressed the relationships among ability, goals, and strategy type. For the Easy/Medium strategy there was a main effect of goals on strategy such that subjects in the DB condition, as opposed to the SD condition were more likely to work on easy and/or medium puzzles than hard puzzles. This was an ineffective strategy. There was no main effect of g on the use of this strategy and no interaction effect between goals and g.

The former result is comparable to outcomes found by Earley et al. (1990) and by Smith et al. (in press). Earley, et al. (1990) found that specific, difficult goals led to more effective work strategies than general goals and this strategy effectiveness resulted in better performance. Further, at the group level, Smith, Locke and Barry (in

press) found that specific and difficult goals were positively related to planning quality.

The Strategic Choice Process

Hypothesis 4 proposed a main effect of effort on strategy type and an interaction effect between effort and g on strategy type. Neither of these effects were found for the Easy/Medium strategy type. Subjects who put forth a high level of effort towards developing strategies did not use a more effective strategy than those who put forth little effort. This outcome is similar to results found by Smith et al. (in press) who found that there was no relation between formal (i.e., assigned) planning time and planning quality. Subjects in the Smith et al. study who were told to plan did not necessarily develop effective plans.

Also it is possible that this is an obvious strategy. In order to gain the most points it is beneficial to work on puzzles that are worth more points. Therefore, the decision to use this obvious strategy is not effort or intelligence dependent.

The Immediate Determinants of Performance

Hypothesis 6 asserted that both strategy type and general cognitive ability would have main effects on performance. Both these main effects were found. Individuals who possessed higher levels of general intelligence were able to perform better. This may be due to their greater information processing skills and knowledge base. Further, although both analytic ability and verbal

ability had main effects on score, this effect was much stronger for verbal ability, indicating, as expected, the verbal ability had its effect through increasing subjects' ability to answer questions.

Also, although it was not hypothesized, an interaction was found between the Easy/Medium strategy and g on score. While both high and low g individuals suffered decrements in score as a result of increased use of this strategy, this negative effect was more pronounced for high g individuals. In retrospect, this is a logical result since it is the high ability students who have the most to gain from working on difficult puzzles.

Additional Analyses

One limitation of this study is that the use of factor analysis to describe the strategies resulted in the omission of many strategies that were employed by students. Subjects used several strategies, but only one cohesive factor, the Easy/Medium strategy, emerged. The remaining eleven strategies may have had meaning with respect to the hypotheses. These effects were not addressed, however, since these strategies did not form any factors. Therefore, all strategies were explored and additional analyses were done to further investigate the hypotheses.

The seventeen possible strategies fell into two categories of strategy. These were 'between puzzle' strategies and 'within puzzle' strategies. The first twelve strategies were between puzzle strategies and reflected ways

in which students determined which puzzles to work on. The last five strategies were within puzzle strategies and represented ways in which students could work on a puzzle once that puzzle had been chosen. Therefore, individuals would necessarily use one or some of both types of strategies.

Nine out of the seventeen strategies had significant bivariate correlations ($p < .05$) with performance, but only three contributed unique variance on score. These were strategies 2, 9, and 17. Strategies 2 and 9 were between puzzle strategies and were included in the Easy/Medium strategy scale. Strategy 17 was a within puzzle strategy ("I answered the questions I knew first, then the ones I thought I knew, then I went back to fill in whatever was left") and was not included in the scale that resulted from the factor analysis of strategies. This strategy was an ineffective strategy, as indicated by a significant negative correlation with performance. This may have been an ineffective strategy because individuals using it may have spent too much time scanning the clues to find obvious answers and not enough time working toward solutions. In fact, this strategy correlated -0.24 ($p < 0.01$) with the total number of puzzles worked on. This approach also fails to maximize points by working off already filled in words. Further, this strategy parallels dysfunctional strategies incorporated by subjects with test anxiety. For example, Sarason (1978) found that individuals with test anxiety

spent too much time looking for a minority of obvious solutions and not enough time working towards solutions of non-obvious items.

In order to more thoroughly understand the relationships among goals, strategy, cognitive ability, and performance by exploring these relationships on a 'within puzzle' strategy, additional analyses were done using strategy 17 (Scanning). The analyses that were done using the Easy/Medium scale were repeated using the Scanning strategy. The results are discussed below.

Overall Interaction of Goal Setting and Cognitive Ability on Strategic Choice

Hypothesis 3 proposed a main effect of goals on strategy type and that this relationship would be moderated by general cognitive ability. The results of this analysis, using Scanning as the dependent variable are shown in Table 10. Although there was no main effect for goals, there was a significant main effect for general cognitive ability and a significant interaction between goals and ability. This latter effect primarily results from the interaction between the second dummy variable, which contrasted the DB condition with the SD condition, and g. The interaction is shown in Figure 16. Although individuals with DB goals used Scanning (an ineffective strategy) to a similar degree, individuals in the SD goal condition who were of low cognitive ability used this strategy to an especially high degree while individuals of high ability in the SD condition utilized

Table 10

Regression Analysis with Strategy Type (Scanning) as the Dependent Variable and Cognitive Ability and Goals Entering as Main and Interaction Effects

Step	Variables entered in the equation	R^2_{tot}	F	R^2 change	F of change
1	Goals Dummy 1 (EM vs. SD) & Dummy 2 (DB vs. SD)	.00	.28		
2	g	.03	1.85	.03	4.96**
3	Goals X g Dummy 1 X g & Dummy 2 X g	.05	2.43	.02	3.23**

*** p < 0.01
** p < 0.05
* p < 0.10

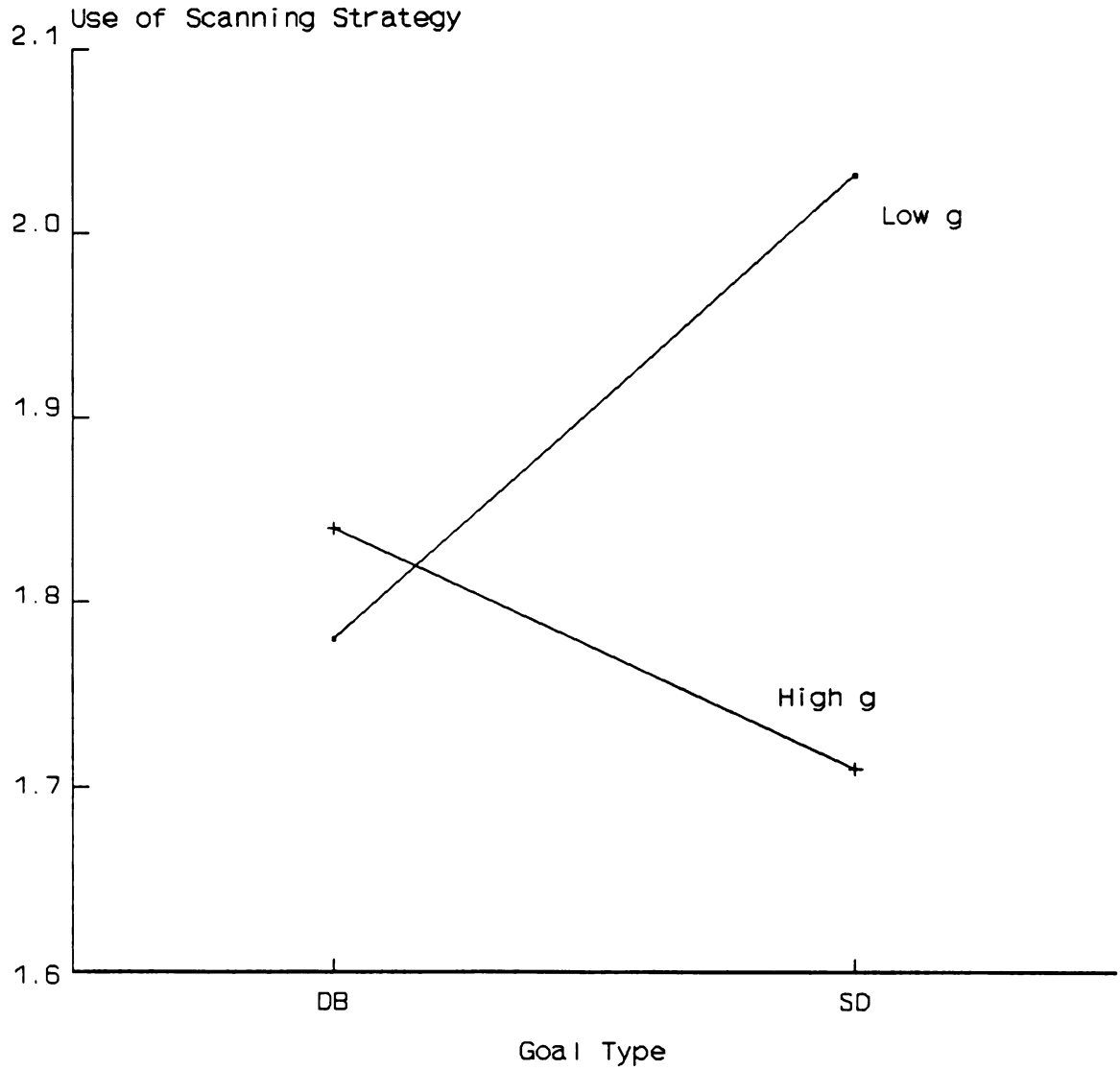


Figure 16. Interaction between general cognitive ability and goals on the use of the Scanning strategy.

this strategy significantly less. This is supportive of an interactive effect of ability which was not supported with the Easy/Medium strategy.

This moderating effect parallels training and experience effects found by Earley, Lee and Lituchy (1989) and by Earley et al. (1990). Earley, Lee and Lituchy (1989) found that subjects who received task training engaged in less strategy change throughout the task compared to subjects who received no training. Subjects who had a specific, challenging goal, but who did not receive training had difficulty finding a strategy that satisfied their criteria. Similarly, in a field study, Earley et al. (1990) found that job experience affected the relationships among goal setting, strategy, and performance. The authors concluded that, on a task with a number of independent acts and a variety of information cues, while goal setting stimulated strategy development, job experience was necessary for an individual to be able to judge the effectiveness of the strategy.

In this study general cognitive ability may have functioned in the same way as training and job experience did in the Earley et al. studies. Although subjects in this study did not receive training and did not have task experience, high ability subjects may have been able to draw conclusions about the task that gave them a performance advantage not experienced by the lower ability subjects.

This interactive effect is also supported by work on information processing and cognitive ability by Ackerman (1986) and Vernon (1983). The results of a study by Ackerman (1986) showed that on a task where controlled information processing was required, g accounted for a percent of the performance variance. This association between g and performance continued for hundreds of trials. Vernon (1983) also addressed the relationship of general cognitive ability and information processing. Vernon found that the speed with which individuals can perform various cognitive tasks was highly related to their intelligence. Further, Vernon proposed that individuals with a broader knowledge base and strategy base have acquired these over time as a result of faster and more efficient information-processing capabilities.

All individuals working on a complex task may engage in strategy search. However, only those individuals with high intelligence will be able to differentiate between high and low quality strategies.

The Strategic Choice Process

Hypothesis 4 proposed a main effect for effort towards strategy development and that this relationship would be moderated by cognitive ability. The results of this analysis with the Scanning strategy as the dependent variable are shown in Table 11. Although there were no main or interaction effects for either effort or g for the Easy/Medium strategy, there was both a main effect for g and

Table 11

Regression Analysis with Strategy Type (Scanning) as the Dependent Variable and Effort and Cognitive Ability Entering as Main and Interaction Effects

Step	Variables entered in the equation	R^2_{tot}	F	R^2 change	F of change
1	Effort	.00	.20		
2	g	.02	2.44*	.02	4.68**
3	Effort X g	.04	2.76	.02	3.35*

*** p < 0.01
** p < 0.05
* p < 0.10

an interaction effect between g and effort for Scanning. Subjects who put forth a relatively high level of effort towards strategy development who were high on g were less likely to use the Scanning strategy than those high ability subjects who contributed relatively little effort. However, subjects low on g who put forth a high level of effort used this strategy to a greater degree than low ability subjects who did not expend much effort. This interaction effect is shown in Figure 17.

This effect has some similarity to results found in a recent study by Earley and Perry (1987). In their study, Earley and Perry found that subjects with specific goals who were primed with plans engaged in more planning activities than those who were not primed. The effect of strategy on performance however, was a function of the applicability of the primed plan. The priming could cause a negative effect on performance if the primed plan was ineffective. In the present study, subjects low on g who engaged in a large amount of strategy development, like the subjects in Earley and Perry's study, increased their use of an obvious strategy, even though it was ineffective.

This moderating effect supports the assertion that on a complex task, increased effort alone does not result in the use of high quality strategies. In order for individuals to benefit from their increased effort, they must possess a level of general or analytic cognitive ability that will

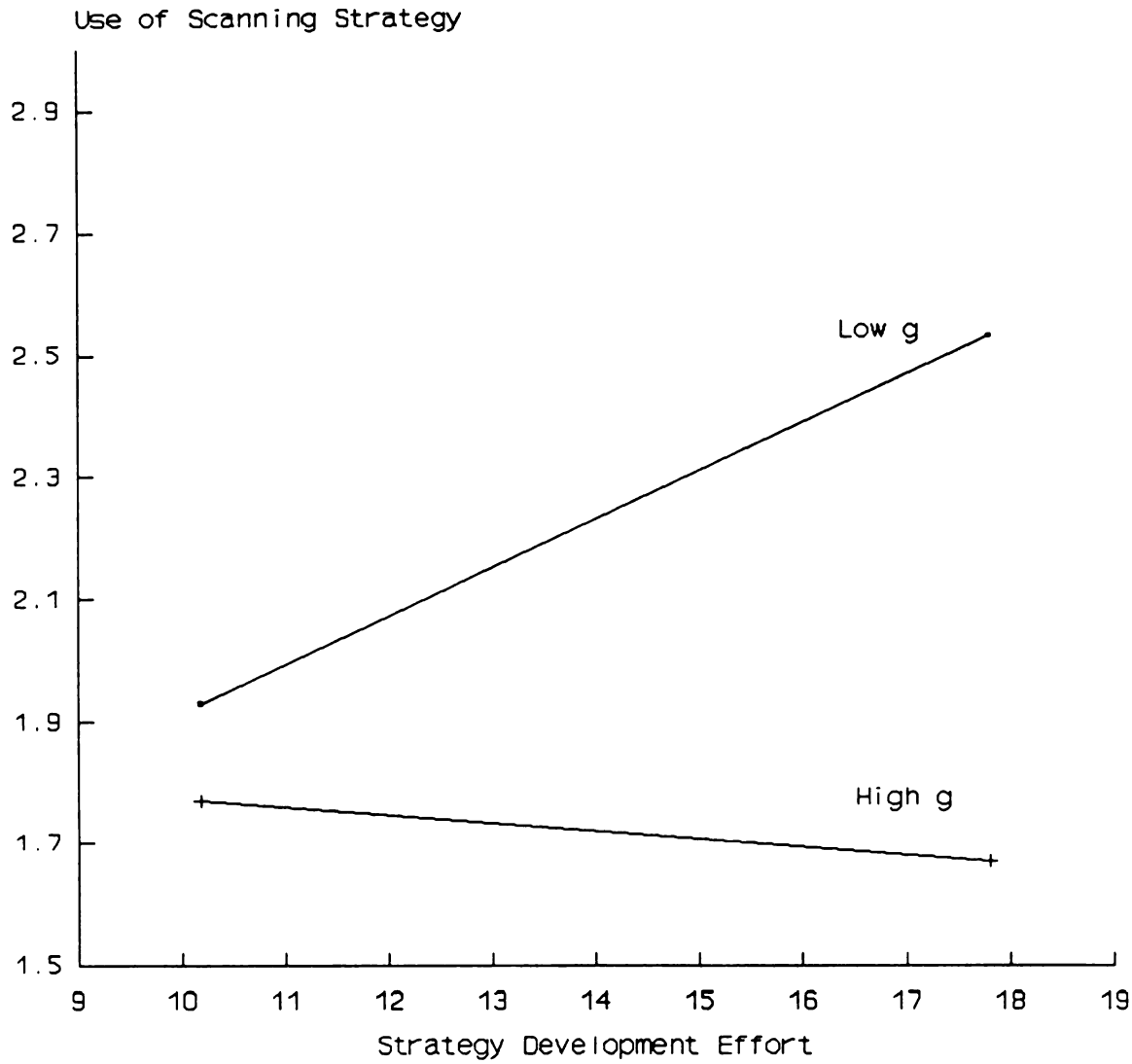


Figure 17. Interaction between general cognitive ability and strategy development effort on the use of the Scanning strategy.

permit them to differentiate between effective and ineffective strategies.

Factors That Mediate the Relationship Between Goals and Strategic Choice

Hypothesis 5 proposed that effort would mediate the relationship between goals and strategy choice. The results of this analysis are shown in Table 12. There was no mediating effect of effort on the interaction effect between goals and ability on the use of the Scanning strategy. Therefore, hypothesis 5 was rejected for this strategy.

The Immediate Determinants of Performance

Hypothesis 6a proposed that the type of strategy people choose would affect performance. As can be seen from Table 13, individuals who used Scanning to a large degree performed worse than subjects who used it to a lesser degree. There was no interaction between g and Scanning.

Factors that Mediate the Relationship Between Goals and Performance

Hypothesis 7 proposed a mediating effect of effort and strategy type on the relationship between goals and performance. Since the latter relationship was not found, this hypothesis was not tested.

The Determinants of Strategy Quality

Hypothesis 8 proposed that SD goals would lead to the use of higher quality strategies than EM or DB goals. For this analysis, strategy quality was the proportion of variance in performance due to the use of both Scanning and

Table 12

Regression Analysis with Strategy Type (Scanning) as the Dependent Variable and Effort Towards Strategy Development, Cognitive Ability and Goals Entering as Main and Interaction Effects

Step	Variables entered in the equation	R^2_{tot}	F	R^2 change	F of change
1	Effort	.00	.20		
2	g	.02	2.44*	.02	4.68**
3	Effort X g	.04	2.76**	.02	3.35*
4	Goals Dummy 1 (EM vs. SD) & Dummy 2 (DB vs. SD)	.04	1.92*	.00	.66
5	Goals X g Dummy 1 X g & Dummy 2 X g	.07	2.37**	.03	3.40**

*** p < 0.01
** p < 0.05
* p < 0.10

Table 13

Regression Analysis with Performance (Score) as the Dependent Variable and Strategy Type (Scanning) and Cognitive Ability Entering as Main Effects

Step	Variables entered in the equation	R^2_{tot}	F	R^2 change	F of change
1	Strategy Scanning	.03	5.69**		
2	g	.27	38.39***	.24	69.26***
3	Scanning X g	.27	25.48***	.00	.00

*** p < 0.01
** p < 0.05
* p < 0.10

the Easy/Medium strategy. As Table 14 shows, there was a significant main effect for goals which was largely due to the DB versus SD condition. Subjects in the DB condition did not use high quality strategies to the extent that subjects in the SD condition did. There were no main or interaction effects for general cognitive ability.

The effects of verbal and analytic ability on performance and strategy were also examined with respect to Scanning. It was expected that analytic ability would have its effect on strategy development while verbal ability would more directly influence performance. When Scanning was entered as the dependent variable and analytic and verbal ability entered as main effects it was shown that there were significant positive main effects for analytic but not for verbal ability. Subjects high on analytic ability were less likely to utilize the Scanning strategy than those high on analytic ability. These results are shown in Table 15.

When Scanning was entered as the dependent variable and goals and analytic ability or verbal ability entered as main and interaction effects, it was shown that there was a significant interaction effect between analytic ability and goals, but between verbal ability and goals. These results are shown in Tables 16 and 17. This interaction effect is of the same nature as that of the interaction between general cognitive ability and goals (as shown in Figure 16). This interaction is shown in Figure 18.

Table 14

Regression Analysis with Strategy Quality as the Dependent Variable and Cognitive Ability and Goals Entering as Main and Interaction Effects

Step	Variables entered in the equation	R^2_{tot}	F	R^2 change	F of change
1	Goals Dummy 1 (EM vs. SD) & Dummy 2 (DB vs. SD)	.02	1.84**		
2	g	.03	1.93	.01	2.10
3	Goals X g Dummy 1 X g & Dummy 2 X g	.03	1.27	.00	.30

*** p < 0.01
** p < 0.05
* p < 0.10

Table 15

Regression Analysis with Strategy Type (Scanning) as the Dependent Variable and Verbal Ability and Analytic Ability Entering as Main Effects

Step	Variables entered in the equation	R^2_{tot}	F	R^2 change	F of change
1	Analytic Ability	.03	7.74***		
2	Verbal Ability	.03	3.87**	.00	.04

*** p < 0.01
** p < 0.05
* p < 0.10

Table 16

Regression Analysis with Strategy Type (Scanning) as the Dependent Variable and Analytic Ability and Goals Entering as Main and Interaction Effects

Step	Variables entered in the equation	R^2_{tot}	F	R^2 change	F of change
1	Goals Dummy 1 (EM vs. SD) & Dummy 2 (DB vs. SD)	.00	.28		
2	Analytic Ability	.04	2.99	.04	8.39***
3	Goals X Analytic Dummy 1 X Analytic & Dummy 2 X Analytic	.09	3.9***	.05	5.19***

*** p < 0.01
** p < 0.05
* p < 0.10

Table 17

Regression Analysis with Strategy Type (Scanning) as the Dependent Variable and Verbal Ability and Goals Entering as Main and Interaction Effects

Step	Variables entered in the equation	R^2_{tot}	F	R^2 change	F of change
1	Goals Dummy 1 (EM vs. SD) & Dummy 2 (DB vs. SD)	.00	.28		
2	Verbal Ability	.00	.28	.00	.61
3	Goals X Verbal Dummy 1 X Verbal & Dummy 2 X Verbal	.01	.37	.01	.51

*** p < 0.01
** p < 0.05
* p < 0.10

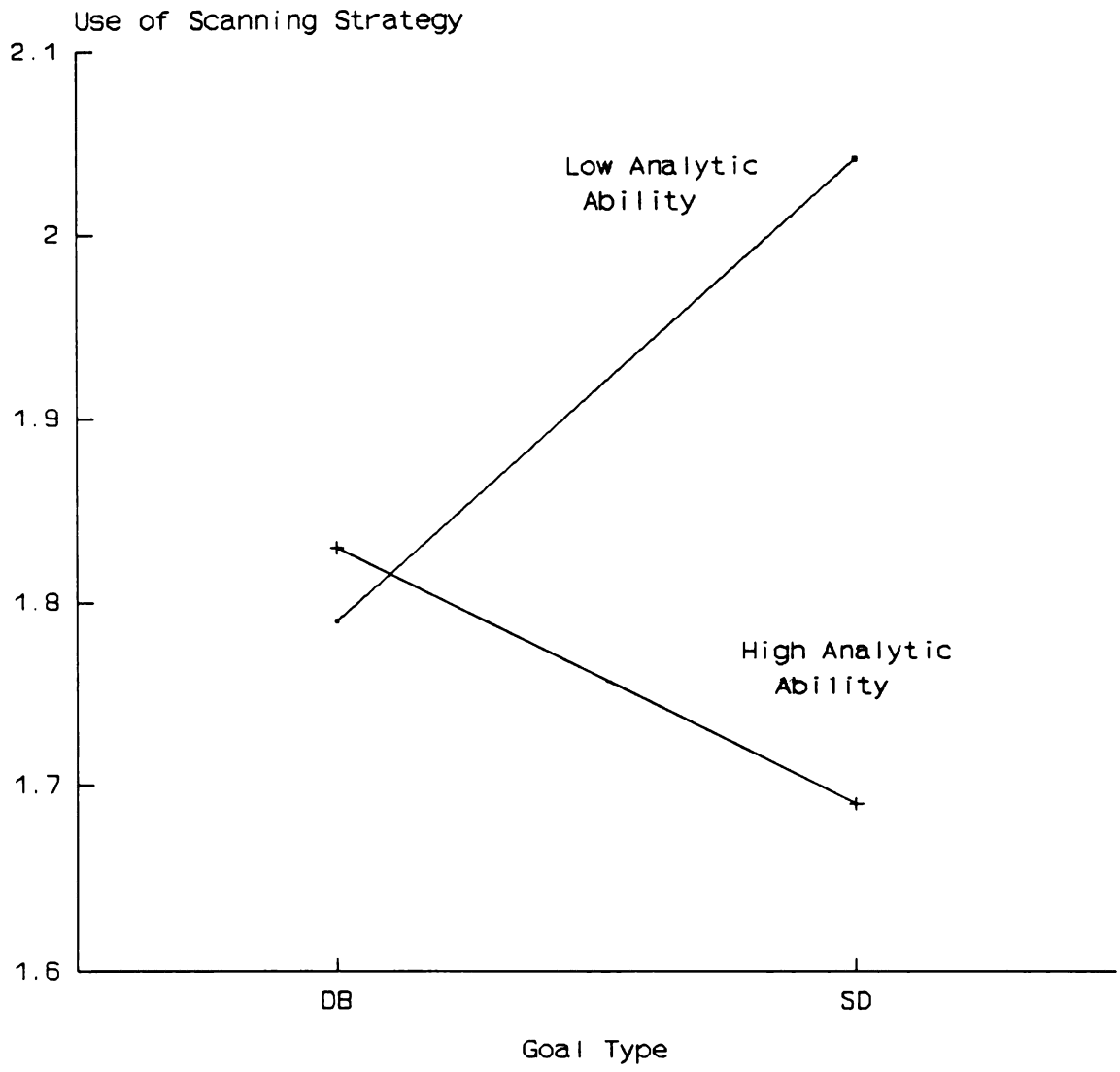


Figure 18. Interaction effect between analytic ability and goals on the use of the Scanning strategy.

Additionally, although verbal ability had no interaction effect with effort on the use of Scanning, analytic ability, like g, interacted with effort to influence strategy use. Tables 18 and 19 show these results. While subjects with low analytic ability increased their use of Scanning with increased strategy development effort, subjects low on analytic ability increased their use of this ineffective strategy with increased effort. This relationship is shown in Figure 19.

Table 20 summarizes the results of this study. The first column of the table indicates which hypothesis is being addressed. The second column briefly describes the proposed relationship. The next four columns deal with hypotheses for which specific strategies were not addressed. In these columns a 'Y' indicates that the relationship was found. A 'N' indicates it was not found. The first of these four columns focus on hypotheses for which ability was not involved. The last three of these columns address hypotheses for which general cognitive ability, analytic ability, or verbal ability, respectively, were of interest. The remainder of the columns indicate results for hypotheses which focused on a particular strategy, either Easy/Medium or Scanning.

Integration of Post Hoc Analyses

The results of this study were mixed. While some of the hypotheses were supported, others were not. Also, in many cases, the effects sizes were not as large as may have

Table 18

Regression Analysis with Strategy Type (Scanning) as the Dependent Variable and Strategy Development Effort and Analytic Ability Entering as Main and Interaction Effects

Step	Variables entered in the equation	R^2_{tot}	F	R^2 change	F of change
1	Effort	.00	.20		
2	Analytic Ability	.04	4.05**	.04	7.89***
3	Effort X Analytic Ability	.06	4.41***	.02	4.99***

*** $p < 0.01$
** $p < 0.05$
* $p < 0.10$

Table 19

Regression Analysis with Strategy Type (Scanning) as the Dependent Variable and Effort and Verbal Ability Entering as Main and Interaction Effects

Step	Variables entered in the equation	R^2_{tot}	F	R^2 change	F of change
1	Effort	.00	.20		
2	Verbal Ability	.00	.22	.00	.25
3	Effort X Verbal Ability	.00	.23	.00	.24

*** p < 0.01
** p < 0.05
* p < 0.10

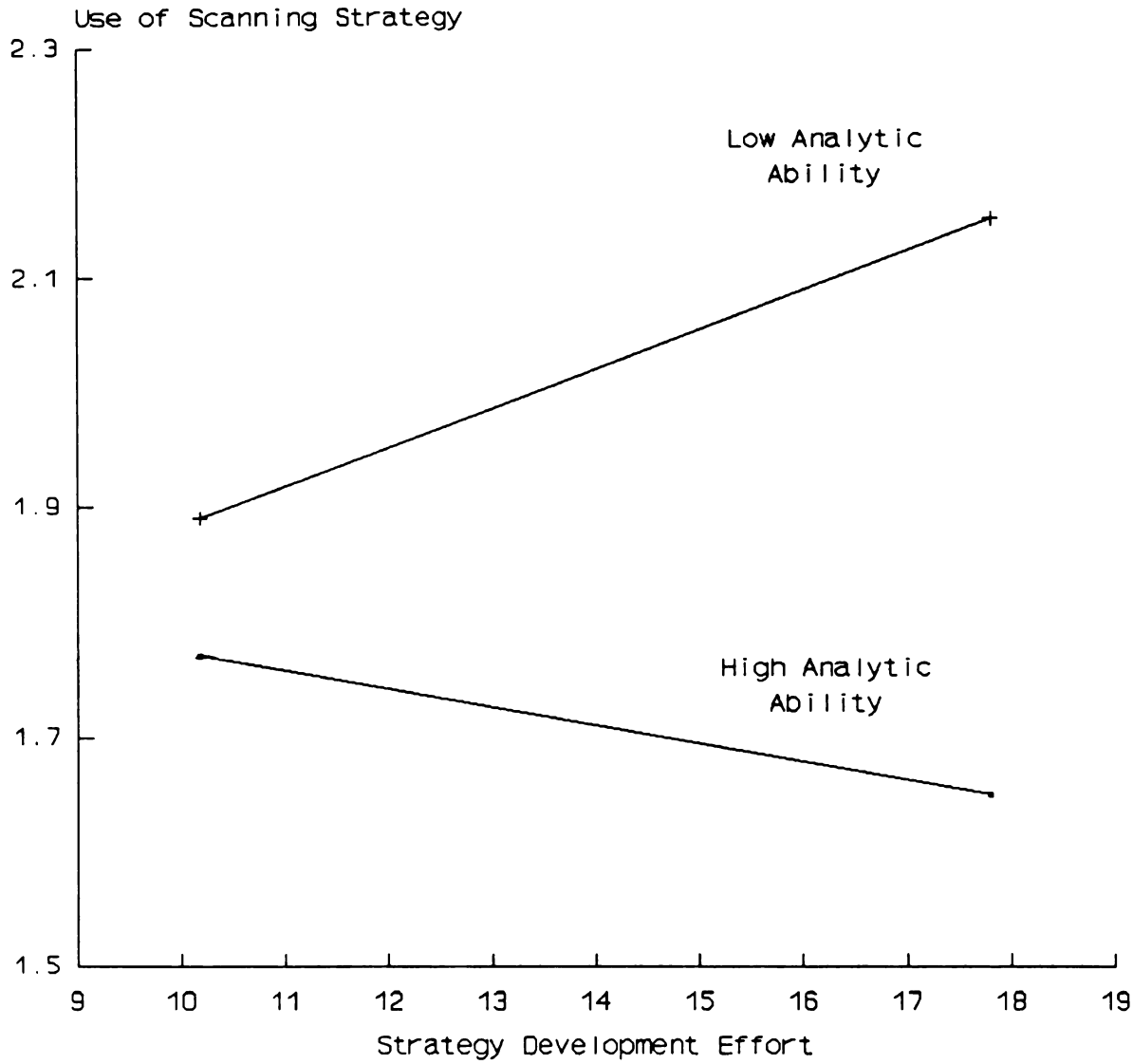


Figure 19. Interaction effect between analytic ability an strategy development effort on the use of the Scanning strategy.

Table 20

Summary of Results

Hypothesis	Proposed Relationship	Significant								
					Easy/ Medium			Scanning		
		g[1]	AA[2]	VA[3]	g	AA	VA	g	AA	VA
1a	Main effect of goals on performance	N[4]								
1b	H1a will be moderated by ability		N							
2	Main effect of goals on strategy development effort	N								
3a	Main effect of goals on strategy type				Y[5]			N		
3b	H3a will be moderated ability				N			N		
4a	Main effect of strategy development effort on strategy type by ability				N	N	N	Y	Y	N

[1] general cognitive ability
[2] analytic ability
[3] verbal ability
[4] there was no significant relationship
[5] there was a significant relationship

Table 20 (cont.)

Hypothesis	Proposed Relationship	Significant								
					Easy/ Medium			Scanning		
		g	AA	VA	g	AA	VA	g	AA	VA
4b	H4a will be moderated by ability				N			Y	Y	N
5	H4 will mediate H3							N		
6a	Main effect of strategy type on performance				Y			Y		
6b	Positive main effect of ability on performance	Y	Y	Y						
7	H6 and H4 will mediate H1									
8a	Main effect of goals on strategy quality				Y[6]			Y[7]		
8b	Moderating effect of ability on H8a				N			N		

[6] strategy quality is the proportion of variance in score attributable to the Easy/Medium strategy

[7] strategy quality is the proportion of variance in score attibutable to both the Easy/Medium strategy and Scanning

been expected. Further, the results with respect to the Easy/Medium strategy and Scanning were not always consistent. The sections below will attempt to summarize and explain the inconsistencies between the strategies.

Hypothesis 3 addressed the relationships among ability, goals, and strategy type. For the Easy/Medium strategy there was a main effect of goals on strategy such that subjects in the DB condition, as opposed to the SD condition were more likely to work on easy and/or medium puzzles than hard puzzles. This was an ineffective strategy. There was no main effect of g on the use of this strategy and no interaction effect between goals and g. In contrast, this result was not found with Scanning. For Scanning, however, there was a significant main effect for g as well as an interaction between goals and g on strategy type.

Hypothesis 4 proposed a main effect of effort on strategy type and an interaction effect between effort and g on strategy type. Although the former effect was not found for either strategy type, the latter effect was present for Scanning.

The difference in results between these two strategies may be due to the diverse nature of the strategies. The Easy/Medium strategy addressed 'between puzzle' plans, while Scanning was a 'within puzzle' strategy. Choosing the former type of strategy may be more likely to be a precursor to task activity while the latter strategy may be developed during task activity (or once the former decision has been

made). In this sense, since individuals must choose which puzzle to work on before they think about how to work on it, Easy/Medium may be considered a primary strategy. It is possible that goals have a stronger effect on strategic activities that occur first while cognitive ability plays a greater role on strategies developed later. Primary strategies are not subject to trial and error learning to the extent that secondary strategies are because they are developed prior to task activity. Therefore, cognitive ability is not as relevant on these types of strategies as it is on secondary strategies which may involve a greater amount of learning. Additionally, it may have been obvious to all subjects that in order to maximize points it would be beneficial to avoid easy puzzles and focus on difficult puzzles. The deleterious effects of using the Scanning strategy may not have been so obvious. Cognitive ability may have less of an effect on obvious, as opposed to nonobvious strategies.

Limitations of this Study

Several limitations of this study are worth noting. With the exception of the main effect of g on performance, the effect sizes were smaller than may have been expected. Further, several hypothesized relationships were not found.

It is possible that the goal manipulation was not completely effective. The manipulation check questions that assessed whether subjects knew or used the goal that was assigned to them was interpreted broadly by students and was

not useful as a manipulation check. Students in all goal conditions may have been trying to do their best rather than striving for their assigned goal. This may have occurred for two reasons. First, students were not instructed to stop when they achieved their goal. Therefore, the specific goals may have operated as 'do best' goals. Second, the students were not required to monitor their performance. While it would have been possible for them to get some idea of their performance by counting the number of words they completed and computing their points, it is unlikely that they did this because of the time limits on the task. Therefore, this lack of feedback may have influenced students to work as hard as they could, without actually knowing their progress with respect to their goal.

In addition to affecting the effectiveness of the goal itself, this lack of feedback may have affected the strategy development activities of the students. According to Lord and Hanges (1987), strategy development operates in a control systems framework. The way in which an individual develops strategies is dependent upon the amount of feedback received and the familiarity of the task. Since feedback on this task was slow, testing of alternate strategies would be limited. This may have limited the positive effects of high ability by restricting the opportunity for high g individuals to learn.

Recommendations for Future Research

To date, research linking goals to performance on a complex task has found inconsistent results. Although this study found no direct relationship between goals and performance on a complex task, both detrimental (e.g., Earley, Connoly & Ekegren, 1989) and beneficial (Wood et al., 1986) effects have been reported. This lack of congruity points to a need for research to address this issue more completely. Issues that need to be further explored include aspects of the task, types of ability, and characteristics of the strategy and the strategy development process.

It is generally accepted that strategy issues influence the effect of goals on performance on a complex task. Future research should continue to address the specific aspects of strategy that affect this relationship so that some of the inconsistencies of existing research can be resolved. These aspects fall into two categories. The first, strategy development, focuses on the processes by which individuals formulate and choose strategies. Wood and Locke (1990) and Lord and Hanges (1987) have developed models of strategy development that can be used to assess or manipulate the way in which individuals develop strategies. Other aspects of strategy development, such as amount of strategy change, time spent on generating and refining strategies, and effort towards strategy development can also be used to better understand the goal-performance

relationship. While this study did not find a link between goals and one aspect of the strategy development process (i.e., effort), other studies have found a relationship (e.g., Earley, Lee & Lituchy, 1989; Earley et al., 1987). Therefore, future research should address the circumstances under which this relationship will occur as well as other aspects of the strategy development process (such as the type of process used).

A second important issue in the area of strategy is the strategy itself. Research has addressed characteristics of strategy such as quality and detail. This study was able to draw a link between goals and strategy quality, but not between the strategy development process and strategy quality. Therefore, in addition to continuing to address linkages between aspects of strategy development such as time and effort and strategy type or quality, future research would benefit by exploring other aspects of the strategy development process, such as the type of process used and its relationship to strategy type.

An additional issue that could be addressed by research is the differentiation between primary and secondary strategies and obvious and nonobvious strategies and the varying effects that goals, effort, and g have upon these different types of strategy. Although this study was able to provide some post hoc explanations for differences in the effects for g upon these different strategies, more thorough

investigation of these dissimilarities may shed light on the role of g on strategy development.

Research should also more thoroughly address other issues of ability as they relate to strategy and goal setting. The primary focus of this study was general cognitive ability, although the separate contributions of facets of ability on performance and strategy were also touched upon. Additional research is needed to better understand the role general cognitive ability as well as of facets of cognitive ability on the relationships among goals, strategy, and performance. Also, future research may find that some of the relationships that hold true for general cognitive ability (such as the moderating effect of g on the relationship between goals and strategy choice) may be negated by task specific skills.

Also, if the role of goal setting on complex tasks is to be thoroughly understood, it may be helpful to design studies that vary task complexity and make direct comparisons of goal effects among various levels of complexity.

Final Comments

This study provided limited support for a model of goal setting on complex tasks that describes the influence of goals on performance as occurring through their effects on strategy. In some cases, subjects with difficult, as opposed to 'do best' goals were more likely to incorporate a

strategy that positively affected performance. Further, this relationship may be moderated by cognitive ability.

Other results of this study linked effort and general cognitive ability to choice of strategy such that individuals with high ability decreased their use of an ineffective strategy with increased effort while low ability subjects increase the use of an ineffective strategy with increased effort.

This study also compared the relationships between verbal ability and performance and strategy and analytic ability and performance and strategy. It was found that verbal ability had a stronger effect on performance, while analytic ability had a stronger effect on strategy for one strategy type.

This research takes a step towards defining the process through which goal setting affects performance. It extends current research by incorporating the role of cognitive ability in a goal setting model for complex tasks. Further, this study assesses the function of strategy in the goal process.

Increased incorporation of technology in organizations is driving up the level of complexity of many tasks. Therefore, it is imperative that researchers address motivational issues on complex tasks. Research needs to more thoroughly assess the role of cognitive ability and strategy development on complex tasks so that the beneficial aspects of goals so frequently found on simple tasks can be extended to complex tasks.

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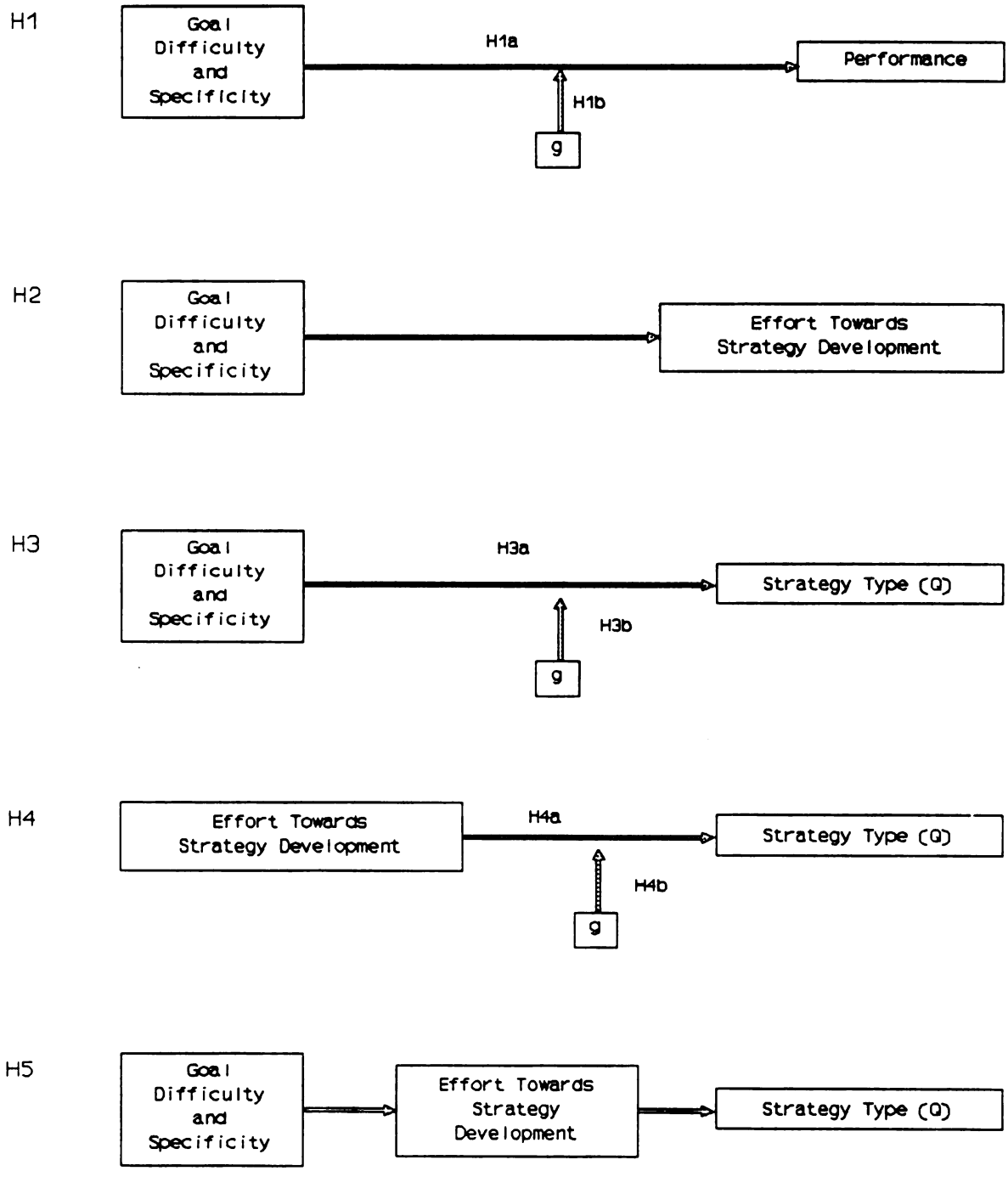
Appendix A

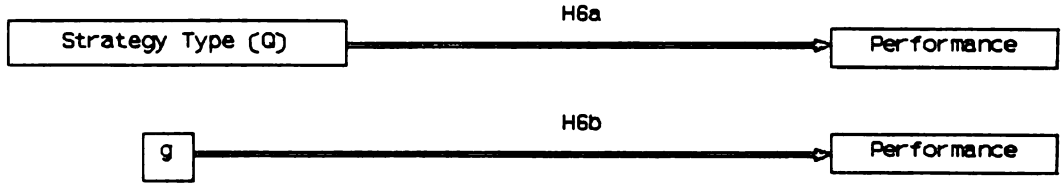
Summary of Hypotheses

Hypothesis **Model**

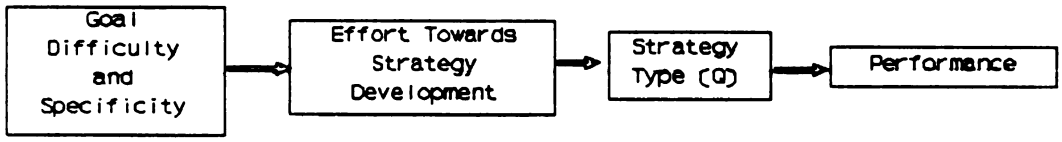


Hypothesis **Model**

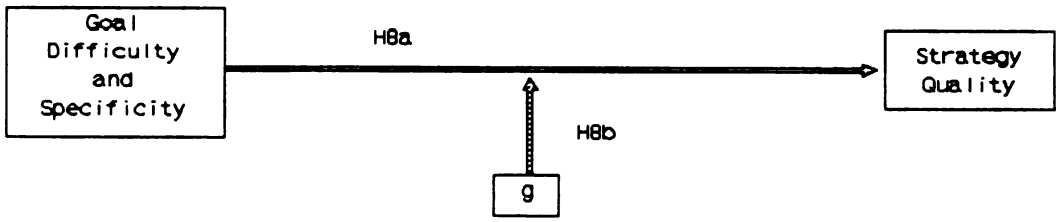
H6



H7



H8



Appendix B

Consent Form

CONSENT FORM

For this research project you will be asked to work on a set of crossword puzzles for 30 minutes. Before beginning work on the puzzles you will be asked to take an ability test and to answer several questions regarding your crossword puzzle skills. After working on the puzzles, you will be asked to provide answers to several questions about the task.

The experiment requires approximately an hour and a half to two hours to complete and participation in the experiment is voluntary. While your participation will provide you with extra class credit, a decision not to participate will not negatively affect your course grade. Additionally, there are alternative options for achieving extra credit in your class other than participation in the experiment. You also have the right to discontinue your participation in the experiment at any time for any reason. If you do not believe you are willing to invest sincere effort in achieving the goals of the experiment, please notify the experimenter so that you may be dismissed. Otherwise, your participation will contaminate the results of the study.

All results from your participation will be treated with strict confidence. Within this restriction, the final results of the experiment will be made available to you upon written request.
You will also be fully debriefed at the conclusion of the experiment. Any questions that you have regarding the experiment will be answered at that time. If at any time you have questions or concerns regarding this study or if you wish to know the results of the study at a future date please contact J. Shapiro through the graduate student mailboxes in room 135 Snyder Hall (Psychology office).

I have read and understand the above statement. I will consent to participate in this experiment without waiving my right to discontinue my participation in the experiment at any time without recrimination.

_____

signature of student

_____

print your name here

Appendix C

Experience With Crossword Puzzles

Please answer the following questions as accurately as you can.

1. How much do you enjoy working on crossword puzzles? (circle the number of the appropriate response)

1	2	3	4	5
like very much	like somewhat	indifferent	dislike somewhat	dislike very much

2. How do you rate your ability to answer crossword puzzles correctly?
(circle the number of the correct response)

1	2	3	4	5
outstanding	above average	average	below average	very poor

3. In the last month, about how many crossword puzzles have you worked on?

APPENDIX D

Manipulation Check on Goal Difficulty and Goal Specificity

Please answer the following questions as accurately as you can.

1. What was the goal assigned to you?

2. Did you set any specific goals for this task, other than the instructed goal? (circle the number of the appropriate response)

1. yes

2. no

3. If the answer to question 2 was yes, what was the goal(s) (e.g., " fill in 20 words", "fill in 10 to 20 words", "earn 30 points", or any others)?

4. If you had a goal, did you change it over time or did it remain the same throughout the task? (circle the number of the appropriate response or responses)

1. Changed over time
   a. raised
   b. lowered
   c. raised and lowered

2. remained the same throughout the task.

5. How specific was your goal? In other words, to what extent was it clear to you how many points you were supposed to obtain?

1	2	3	4	5
It was very ambiguous	It was somewhat ambiguous	It was neither clear or ambiguous	It was somewhat clear	It was very clear

6. How difficult was your goal?

1	2	3	4	5
It was very easy	It was somewhat easy	It was moderate	It was somewhat difficult	It was very difficult

APPENDIX E

Effort Towards Developing Strategies

The following items refer to the strategy, or method that you used to work on the task that you just completed. A strategy refers to the plan or steps that you followed to perform your task. For example, if you had a task of writing a term paper, one possible strategy may have been to 1) pick a topic, 2) go to the library and get books and articles, 3) write an outline, 4) write the paper, and 5) type the paper. If you had never written a paper before, you may have had to spend time thinking up these steps and deciding the order in which to do them. This process is called strategy development. The following questionnaires refer to the strategy and strategy development processes that you used to attain your goal for the task that you just completed. Please answer all questions as accurately as you can.

1. Compared to the entire task time (1/2 hour) how much time did you spend thinking about ways in which to achieve your goal? This does not include the time you spent working on the puzzles or looking for words to fill in.

1	2	3	4	5
none	a little	a moderate amount	quite a bit	very much

2. About how much time, in minutes, did you spend thinking about ways in which to achieve your goal?

3. Developing a strategy for this task was _____ for accomplishing as much as I did.

1	2	3	4	5
not at all important	somewhat important	moderately important	very important	extremely important

4. To work on the task I _____ . (circle one)

1= just started working
2= thought about one or two methods to work toward my goal then settled on one
3= took a moment to think about several possible methods
4= thought about several ways to work toward my goal and how to try each one
5= carefully planned how to work toward my goal by considering time pressures and other elements.

5. To accomplish the goal assigned to me I was _____ about the manner in which I tried to finish the whole task.

1	2	3	4	5
not at all deliberate	somewhat deliberate	moderately deliberate	very deliberate	extremely deliberate

6. How much effort did you expend to develop a strategy for this task.

1	2	3	4	5
no effort	a little effort	a moderate amount of effort	a lot of effort	an extreme amount of effort

7. While working on developing a strategy I found myself concentrating _____.

1	2	3	4	5
not hard at all	a little bit hard	moderately hard	very hard	extremely hard

APPENDIX F

Strategies Used

The following items refer to the specific strategies that you used while working on the task. Please mark to what extent you used each strategy listed. Please respond to every item. If you do not remember exactly what is meant by the term strategy, as it is used in this study, refer to the instructions at the beginning of the questionnaire that you completed prior to this one.

Please use the computer scored answer sheet (bubble sheet) that you used for the ability test to respond to these questions. Start with number 91 on the answer sheet and answer all questions consecutively. The number in parentheses refers to the number on the answer sheet that corresponds to that response.

1. I compared the three different types of puzzles to see which I could do best.

1	2	3
I did this very little or not at all	I did this a moderate amount	I did this mostly or exclusively

2. I sorted the puzzles into those I could do and those I couldn't do.

1	2	3
I did this very little or not at all	I did this a moderate amount	I did this mostly or exclusively

3. I 'warmed up' on an easy puzzle(s), then worked on the medium puzzles.

1	2	3
I did this very little or not at all	I did this a moderate amount	I did this mostly or exclusively

4. I did as many as possible on the easy puzzles, then did as many as possible on the medium, then did as many as possible on the hard puzzles.

1	2	3
I did this very little or not at all	I did this a moderate amount	I did this mostly or exclusively

5. I did as many as possible on the medium puzzles then did as many as possible on the hard puzzles.

1----------2----------3
I did this very little or not at all | I did this a moderate amount | I did this mostly or exclusively

6. I did some hard, some medium, and some easy puzzles, in no particular order.

1----------2----------3
I did this very little or not at all | I did this a moderate amount | I did this mostly or exclusively

7. I did only easy and medium puzzles.

1----------2----------3
I did this very little or not at all | I did this a moderate amount | I did this mostly or exclusively

8. I did the puzzles in the order in which they were given.

1----------2----------3
I did this very little or not at all | I did this a moderate amount | I did this mostly or exclusively

9. I worked on only easy puzzles.

1----------2----------3
I did this very little or not at all | I did this a moderate amount | I did this mostly or exclusively

10. I worked on only medium puzzles.

1----------2----------3
I did this very little or not at all | I did this a moderate amount | I did this mostly or exclusively

11. I worked on only hard puzzles.

1	2	3
I did this very little or not at all	I did this a moderate amount	I did this mostly or exclusively

12. I tried to complete a puzzle, before going on to others.

1	2	3
I did this very little or not at all	I did this a moderate amount	I did this mostly or exclusively

13. For each puzzle that I worked on, I scanned the clues, then filled in words mostly at random.

1	2	3
I did this very little or not at all	I did this a moderate amount	I did this mostly or exclusively

14. I worked on the 'across' words, then the 'down' words, then went back to the 'across'.

1	2	3
I did this very little or not at all	I did this a moderate amount	I did this mostly or exclusively

15. I did one or a few 'across' words and one or a few 'down' and then used those words to find others.

1	2	3
I did this very little or not at all	I did this a moderate amount	I did this mostly or exclusively

16. I did all the 'across' words that I could, then all the 'down' that I could, then moved onto another puzzle without going back.

1	2	3
I did this very little or not at all	I did this a moderate amount	I did this mostly or exclusively

17. I answered the questions I knew first, then the ones I thought I knew, then I went back to fill in whatever was left.

1	2	3
I did this very little or not at all	I did this a moderate amount	I did this mostly or exclusively

18. Other (please use the space below to fill in any additional strategies that you used and rate it (them) on a 1 to 3 scale as above).

ENDNOTES

1. Task specific skills, unlike cognitive processes, are directed only at a specific task or set of tasks and therefore may have effects on strategy development that are different from those of general or specific cognitive abilities. Increased knowledge along with chunking, hierarchically arranged cognitive structures, and problem specific cognitive schema may enable expert performers to bypass some if not all of the strategy development that novices must proceed to.

Further, Schmidt, Hunter, Outerbridge, and Goff (1988) researched the relationship between job experience and cognitive ability with respect to performance for several military jobs and found that for some jobs as job experience increased, performance was determined to a lesser degree by initial ability. While Hunter et al. (1988) found that for some job criteria the validity of general cognitive ability tests for job performance neither increased or decreased with increased job experience other jobs, when the job criteria used was supervisory ratings, the performance level of both high and low ability individuals converged over time as job experience increased. This convergence may indicate that experience, in some sense, replaces ability for some jobs.

According to this research, if task specific skills were considered in Figure 12, it may be found that the effects of skill level (expertise) directly affect performance (positively) and moderate the relationship between strategy development effort and goal setting such that as goal specificity and difficulty increase, individuals low on task specific skills will engage in strategy development increasingly while individuals with expert skills will not engage in strategy development.

While this will not be empirically addressed in this study, future research may be aimed at examining these issues more closely.

2. Copied with permission from <u>The Dell Big Book of Crosswords & Pencil Puzzles #6</u> (New York: The Dell Publishing Company, Inc.).