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Bradford S. Bell

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THE EFFECTS OF GUIDANCE ON LEARNING AND TRAINING PERFORMANCE IN A COMPLEX TRAINING SIMULATION

By

Bradford S. Bell

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ABSTRACT

THE EFFECTS OF GUIDANCE ON LEARNING AND TRAINING PERFORMANCE IN A COMPLEX TRAINING SIMULATION

By

Bradford S. Bell

Over the past two decades, a considerable amount of research has examined the effects of giving trainees control (i.e., sequence, content, pace) over their learning (Steinberg, 1977, 1989; Williams, 1993). The most consistent finding of this research has been that trainees are not good judges of what or how much they need to practice and they do not make good use of the control they are given. The current study examined the effects of two forms of guidance, behavioral\cognitive and affective, on learning and performance in a complex training environment (Kozlowski, Weissbein, Brown, Toney, & Mullins, 1997). Overall, it was found that behavioral\cognitive guidance had a substantial effect on trainees' study and practice sequence and also several self-regulation variables. Affective guidance had a direct effect on the amount of effort trainees put forth on the task. The process by which guidance influenced various training outcomes is discussed as are the implications and limitations of the present study.

Dedicated to Robert Bell and Edward Harvey

One Taught Others and One Taught Himself
But Both Showed Me that there are Many Different Paths to Knowledge

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complaints and discontents. There is no doubt in my mind that I would not be where I am today if I did not have you by my side. The future that I imagine and desire for us is one my greatest sources of motivation. Looking forward to seeing you each evening also makes it a little easier to get my work done each day. You encourage me to work hard and be the best that I can be, while at the same time helping me to keep it all in perspective. I love you and thank you for everything.

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INTRODUCTION

As technology becomes an increasingly more important part of today's work environment, the nature of work in today's organizations is changing (Turnage, 1990). Technology has taken over more of the mundane vigilance and information processing tasks, often requiring fewer people on the job (Kozlowski et al., 1997). In addition, technology has created jobs that are more cognitively complex and demanding (Smith, Ford, & Kozlowski, 1997). The work itself is increasingly dynamic, requiring that employees adapt their knowledge and skills to new situations and problems (Kozlowski, in press; Smith et al., 1997). As a result of these changes, the skills of individuals will become more, rather than less, important, and training will play a critical role in providing individuals with these skills (Kozlowski et. al, 1997).

Although training requirements have increased, the time and resources allocated to training, in many instances, have not increased proportionately. This has led researchers to search for new ways to train people on complex tasks. The result has been research in areas such as computer-based training (CBT), simulations, and distance learning. These are all relatively new methods of using today's advanced technology in an attempt to more effectively and efficiently train individuals. These training methods have been shown to lead to several positive training outcomes, including improved test performance and attitudes (Duncan, 1991; Goolkasian, 1989; Marcoulides, 1990; Worthington, Welsh, Archer, Mindes, & Forsyth, 1996). However, the greatest benefit of these new methods is often their cost. Using CBT or simulations, the overall training time and student-instructor contact time can usually be lessened considerably with little or no performance decrements (Dossett & Hulvershorn, 1984; Wexley, 1984).

Another advantage of computer-based training and instruction is that these applications often allow the trainee to have some control (e.g., speed, content, sequence) over his or her learning process. Over the past two decades, a considerable amount of research has examined the effects of giving individuals control over their learning (for reviews see Steinberg, 1977, 1989; Williams, 1993). Although there has been several problems with this research, ranging from mixed and equivocal findings (Kinzie, Sullivan, & Berdel, 1988; Steinberg, 1989) to theoretical, definitional, methodological, and analytical deficiencies (Reeves, 1993), one of the most consistent findings is that individuals are not good judges of what or how much they need to practice (Tennyson & Rothen, 1979; Tennyson, 1980; Williams, 1993). When given control over their learning, most individuals will either exit instruction before they have mastered the task (Tennyson, Tennyson, & Rothen, 1980; Ross & Rakow, 1981) or practice well beyond the point at which concepts have been acquired (Tennyson 1980, 1981). These findings led researchers to conclude that it is necessary to supplement learner control with some form of advisement or guidance which will provide information needed for making learning decisions, such as how much to practice (Tennyson, 1980, 1981; Tennyson & Buttrey, 1980; Tennyson & Rothen, 1979).

The interest in combining learner control with advisement has led to a great deal of research on computer aided instruction (CAI), computer based instruction (CBI), and intelligent tutors. These computer systems and other adaptive algorithms attempt to monitor trainee development and guide the trainee on what he or she should be studying or practicing. Although learner control combined with advisement has generally proved to be more effective than learner control alone (e.g., Tennyson, 1980; Steinberg, 1989), this research has been limited by its focus on simple tasks. In his comprehensive review of the learner control literature, Williams (1993) noted that most of the research on learner control has been conducted using drill and practice or tutorial programs with little research being conducted with simulation, hypermedia, or tool software.

In this study, I focused on an advisement strategy referred to as guidance. A great deal of research has focused on feedback as a means of providing trainees with information about their performance (for a review see Kluger & DeNisi, 1996); however, feedback focuses on past behavior and is not diagnostic about what trainees should do, think, or feel next. Whereas feedback is past oriented, guidance is future oriented and provides an interpretation of "what next" (Kozlowski et al., 1997).

In this study, I examined two forms of guidance, behavioral\cognitive and affective, and how they operated in a complex training situation. Behavioral guidance directs the trainee about what actions to do next. Cognitive guidance directs the trainee about what to think, such as concentrating on particular practice strategies. Affective guidance directs the trainee to exercise emotional control with respect to his or her reactions to practice feedback and provides strategies to help the trainee control his or her emotions. These three forms of guidance should help the trainee to better judge his or her progress and determine the cognitive, behavioral, and affective strategies that aid improvement (Kozlowski et al., 1997). Thus, guidance should act to enhance self-regulation, learning, and performance.

REVIEW OF THE LITERATURE

Learner Control

The idea of providing individuals with control over their learning was borne out of research designed to improve the quality of education as well as to find methods to educate a broader segment of society (Steinberg, 1977). The application of computers to education made individualization even more feasible, and led to the development of computer-managed (CMI) and computer-assisted (CAI) instruction. Computers enabled researchers to go beyond programmed instruction and to individualize instruction (Bunderson, 1970). The result has been a great deal of research on the effects of leaving decisions on instructional management, either in part or in entirety, to the student (Steinberg, 1977).

Learner control vs. program control. In one of the first studies on learner control, Judd, Bunderson, and Bessent (1970) examined the effects of four levels of student control over course flow in a remedial mathematics course for college students. The four levels of student control were (1) total computer management; (2) student control over the sequence of topics from a table of contents; (3) additional student control of the amount of practice; and (4) total learner control (Judd et al., 1970). The researchers found that students under learner control did worse than those under computer control and that learner control did not improve student attitudes. Also, contrary to expectations, students were good judges of how much to practice. However, they didn't practice the appropriate material. In other words, they displayed ineffective learning strategies (Judd et al., 1970).

Additional studies examining the differences between learner control and program control were conducted using two major CAI systems, TICCIT (Faust, 1974) and PLATO (Alpert & Bitzer, 1970). Whereas a basic premise of the TICCIT system was that students should control course flow, the PLATO system gave lesson authors complete control over educational decisions. Studies conducted using these two systems provide useful information about learner control.

The TICCIT system was developed specifically to teach concepts and principles. The student chose his or her own learning strategy, using special keys on the terminal that accessed examples, rules, practice, help, advice, and difficulty level. Using the TICCIT system, Bunderson (1976) conducted a study in a college mathematics course. Overall, students using the TICCIT system did no worse in achievement than regular classroom students although they had not completed all the lessons. However, those students who did not do well exhibited inefficient learning strategies. Bunderson (1976) concluded that students needed advice on management of time and review strategies.

In a Navy setting, Lahey, Crawford, and Hurlock (1975) used the PLATO CAI system as a means for applying the TICCIT instructional paradigm. Control students used standard booklets, while experimental students used PLATO. Both groups were self-paced, but the PLATO students also controlled their own instructional strategies. There were no significant post-test performance differences between the groups, but the PLATO students took longer to complete the lessons. The authors attributed the time difference to overlearning on the part of the students using PLATO (Lahey et al., 1975).

Since these first studies comparing learner control to program control, a significant amount of research has continued to explore the differences between these two instructional strategies (for reviews see Steinberg, 1977, 1989; Williams, 1993). Much of this research has examined the effects of giving the learner control over different aspects of his or her instruction, such as sequence, content, or pace. This research has resulted in not only mixed and inconsistent findings but also methodological criticisms (see Reeves, 1993, for a thorough critique). For example, much of the past research on learner control has failed to control for various individual difference variables, such as cognitive ability, that may influence training outcomes. The result is that it is difficult to determine the actual effects of giving individuals control over their learning. In the next section, I provide a brief review of these mixed findings and discuss the implications of this research (see Williams, 1993, for a complete review).

A few studies have supported the use of learner control of at least some instructional events (e.g., Avner, Moore, & Smith, 1980; Kinzie, Sullivan, & Berdel, 1988; Shyu & Brown, 1992). Most of these studies support Hannafin's (1984) suggestion that learner control results in a deeper or more long-lasting effect on memory. For example, Mayer (1976) found that more complex outcomes were learned better when learners had control over the order of presentation, but simple outcomes were learned better under experimenter-controlled instruction.

In contrast, numerous studies (e.g., Morrison, Ross, & Baldwin, 1992; Tennyson & Buttrey, 1980; Tennyson, Park, & Christiansen, 1985; Tennyson, Tennyson, & Rothen, 1980) have found various types or degrees of program control superior to learner control over the same instructional elements for posttest achievement. Most of these researchers have concluded that learners do not have or do not know how to utilize appropriate strategies when they are left to themselves to manage their own learning. In a meta-analysis of 10 years of interactive video instruction, McNeil and Nelson (1991) concluded generally that program-controlled conditions are superior to learner-controlled conditions. They suggest, however, that partial or "guided" learner control over review and practice activities might be better for learning than program control over these activities (McNeil & Nelson, 1991).

Most studies, however, have found no overall differences between learner-controlled and program-controlled treatments (e.g., Balson, Manning, Ebner, & Brooks, 1984/1985; Carrier, Davidson, & Williams, 1985; Goetzfried & Hannafin, 1985; Gray, 1987; Judd et al., 1970; Lahey et al., 1976; Pridemore & Klein, 1990). Various conclusions have been drawn from these "no difference" findings. Some researchers have used this finding to support the use of learner control, stating that programming the computer to handle "branching" tasks is far too difficult. They believe, therefore, that it is easier to just allow students to handle their own branching (Williams, 1993). Other researchers use these findings to support the use of program control, stating that other effects of learner control, such as increased time due to overlearning, make program control more efficient.

It is obvious that the above findings do not clearly support or reject the use of learner control as an instructional approach. In his review, Williams (1993) concludes that there are good reasons to believe that learner control is a desirable instructional approach, but also notes that the majority of studies have found that students left on their own do not make good use of strategies or time. In general, it has been found that many students are just not capable of making good use of the control they are given (Williams, 1993). This finding led researchers to examine whether supplementing learner control with some form of adaptive advisement would be more beneficial than total learner control. The findings of this research are the focus of the next section.

Adaptive Advisement

Learner control with advisement is an attempt to take advantage of the best features of both adaptive computer control and learner control. Adaptive control individualizes instruction by using a mathematical or statistical algorithm to determine a learner's understanding and to prescribe a sequence of instruction. It has been shown that students do not perform as well under learner control as under adaptive computer control (e.g., Tennyson, Tennyson, & Rothen, 1980). This is due in part to the fact that when given control of their learning students often exit the lesson too soon. Under learner control, students view significantly fewer examples and complete the lesson in significantly less time (Tennyson, Tennyson, & Rothen, 1980; Ross & Rakow, 1981).

Although adaptive control has advantages over learner control, it has some disadvantages too (Park & Tennyson, 1983). Most important is that adaptive control assumes all the responsibility for learning, rather than giving it, or at least some of it, to the student (Tennyson & Buttrey, 1980). This led researchers to suggest that if students are to be responsible for their learning, they need information for making learning decisions, such as what and how much to practice (Tennyson & Rothen, 1979).

To examine this idea, Tennyson (1980) conducted a study to test the hypothesis that learner control with adaptive advisement is more effective than either adaptive computer control or learner control without advisement. In the adaptive control condition, all decisions about sequence and amount of instruction were made by the adaptive instructional program. Under adaptive learner control, students received diagnostic and prescriptive information but controlled the decision to make use of it. In the third condition, students were under the learner control condition but received no advisement. Performance was about the same in the adaptive computer and adaptive learner control conditions, but both conditions were better than learner control without advisement. Tennyson (1980, p. 531) concluded that advisement was "highly significant in providing students in the learner-adaptive control condition with meaningful information with which to make appropriate decisions about acquisition of the coordinate concepts." Students in the learner control condition took less time to complete the lesson, indicating that they exited instruction before they had mastered the task. Similar results were obtained by Tennyson and Buttrey (1980) in a study on high school seniors' acquisition of concepts in psychology.

In a more recent study, Santiago and Okey (1992) compared three types of advisement. One group received adaptive advisement, which was advice on current learning needs in terms of amount and sequence of instruction needed for the task at hand. Another group received evaluative advisement, which provided learners with information about their current states of knowledge. A third group received a combination of these two forms of advisement. Although there were no significant differences between the achievement of students in the adaptive and combined groups and in the evaluative and combined groups, adaptive advisement resulted in significantly higher post-test scores than the evaluative advisement (Santiago & Okey, 1992). In addition, students in the adaptive advisement group found it much easier to make decisions about their instruction than did students in the evaluative advisement group. The authors concluded that "These findings indicate that providing specific information adapted to learners' needs results in better performance than information on learners' current states of knowledge" (Santiago & Okey, 1992, p. 50).

These findings form the basis for the training strategy, referred to as guidance, which was examined in the present study. However, the current study built on past research in several ways. First, most of the research on both learner control and advisement has focused on one main dependent variable, posttest performance (i.e., declarative knowledge). Little attention has been focused on process variables, such as self-efficacy, motivation, and attributions, that might mediate the effects of guiding individuals through the learning process. The present study examined how guidance effected these process variables, and how, in turn, different levels of these variables influenced performance. Second, research on advisement has not examined the use of this strategy for influencing individuals' affect. In the present study, one form of guidance, affective, was aimed at controlling trainees' reactions to their feedback. Finally, most of the research on learner control and advisement has been conducted using simple learning tasks. In the present study, guidance was applied to a complex and difficult training simulation.

Guidance

Guidance involves giving a trainee information regarding future directions that should be taken for improvement. Guidance can be thought of as "feedforward," more than "feedback" (Kozlowski et al., 1998). Guided information can describe the behaviors a trainee should next engage in (Earley, Connolly, & Ekegren, 1990), what a trainee should think about and how to think about it (e.g., metacognitive strategies; Nelson, Dunlosky, Graf, & Narens, 1994), and what emotions the trainees might next encounter and how to handle that affect in a constructive way. Thus, guidance should be considered future oriented, and can be defined as any information that directs future cognition, behavior, and/or affect (Kozlowski et al., 1997, 1998). Guidance provides an interpretation of what next.

By enhancing trainee self-regulation, guidance can help the trainee to better calibrate progress and determine the cognitive, behavioral, and affective strategies that aid improvement (Kozlowski et al., 1997). Guidance helps the trainee to recognize areas of needed improvement, and directs the trainee on what can be done to achieve desired levels of performance. In addition, guidance acts to sequence the learning of trainees, so that they build fundamental skills before learning more strategic aspects of the domain.

The model shown in Figure 1 depicts the processes by which both behavioral\cognitive guidance and affective guidance were predicted to affect learning and training performance. There are five distinct sets of variables that make up the model: (1) independent variables; (2) process variables; (3) effort variables; (4) relevance of effort variables; and (5) outcome variables. There are two independent variables, behavioral\cognitive guidance and affective guidance. Behavioral\cognitive guidance and affective guidance were both hypothesized to effect several process variables. Specifically, behavioral\cognitive guidance was predicted to influence trainees' self-efficacy and self-satisfaction. Affective guidance was predicted to effect trainees' self-efficacy, on-task cognition, and attributions. In addition, behavioral\cognitive guidance was hypothesized to have a direct effect on two relevance of effort variables, practice sequence and content and study sequence and content. The process variables were predicted to mediate the effect of the two forms of guidance on two main effort variables, time spent studying and time spent on feedback. These effort variables and the sequence and content of trainees' study and practice were expected to affect two main outcome variables, trainees' knowledge and performance on the task, although to differing degrees. Finally, trainees' knowledge and performance on the task during practice was hypothesized to influence performance on the final, more complex generalization trial. I will now present each of these constructs, followed by specific hypotheses.

Independent Variable Constructs

Behavioral and cognitive guidance. Although behavioral and cognitive guidance are two separate constructs, they are complementary and work together. It is often difficult to provide one without the other, and thus were combined as an independent variable in the present study. Behavioral guidance directs trainees on what they should be doing next (Kozlowski et. al, 1997, 1998). As its name suggests, behavioral guidance focuses on the actions and behaviors that are necessary to reach a desired level of performance or knowledge on a task. For example, behavioral guidance may direct a trainee on what skills or strategies he or she needs to practice. Cognitive guidance directs trainees on what they should be thinking about or learning (Kozlowski et al., 1997, 1998). This form of guidance focuses on what trainees need to learn to achieve desired levels of performance. For example, cognitive guidance may instruct a trainee to focus on studying specific information which their past performance indicates they have not yet learned. Both behavioral and cognitive guidance provide the trainee with information necessary for judging his or her performance on specific aspects of a task (Kozlowski et al., 1997). These two forms of guidance should focus trainee self-regulation on task-relevant material and facilitate appropriate learning and practice strategies, resulting in increased knowledge and improved performance. In the present study, the guidance given focused on behavioral and cognitive aspects of learning, and was based on the trainee's own past practice sessions. In this way, the behavioral and cognitive guidance was adaptive to trainee progress.

Affective guidance. Affective guidance directs trainees to exercise emotional control with respect to their feedback (Kozlowski et al., 1997). It focuses on the emotions trainees are likely to encounter and provides trainees with information and strategies to help them handle their affect (Kozlowski et al., 1998). Affective guidance may, for example, instruct a trainee to expect poor performance in the beginning of a task because the task is difficult and takes time to learn. The affective guidance may also provide trainees with strategies and techniques, such as positive self-talk, imagery, and deep breathing, that they can use to control their emotions. In the present study, the affective guidance was not adaptive to individual trainee performance. However, the affective guidance was scripted so as to provide unique and novel guidance on each presentation and was designed to coincide with how most trainees should feel about their performance relative to where they are in the training session.

Process Constructs

Self-efficacy. Self-efficacy is an individual's belief about whether he or she can perform a task or behavior. In this way, self-efficacy can be thought of as competency beliefs one holds about oneself. It is partly on the basis of self-perceptions of efficacy that individuals choose what challenges to undertake, how much effort to expend in an endeavor, and how long to persevere in the face of difficulties (Bandura, 1982, 1986a). Self-efficacy is most often directly relevant to a particular task, but can also be generalized to other tasks and situations (Bandura, 1977). Past performance on a task is considered to be the best indicator of future performance (Gist & Mitchell, 1992; Silver, Mitchell, & Gist, 1995). Successful experiences typically lead to increases in self-efficacy; failures undermine it.

Whether perceived discrepancies between personal standards and attainments are motivating or discouraging is likely determined by the strength of people's perceived capabilities to attain the standards they are pursuing (Bandura & Cervone, 1983, 1986a). Those whose distrust their capabilities are easily discouraged by failure, whereas those who are highly assured of their efficacy for goal attainment will increase their efforts when their performances fall short and persevere until they succeed (Bandura & Cervone, 1983, 1986a; Brown & Inouye, 1978; Cervone & Peake, 1986; Schunk, 1984; Weinberg, Gould, & Jackson, 1979). Inherent within this conceptualization of self-efficacy is the idea that increased effort will lead to increased performance. Many of the studies that have examined self-efficacy (e.g., Bandura & Cervone, 1983, 1986a) have employed a physical task, for which the belief that one can complete the task translates quite easily into an intention, and subsequently, into successful performance. There is a relatively direct relationship between effort and performance. However, for complex tasks, like the one used in the present study, it was more appropriate to conceptualize self-efficacy as a more complex psychological construct that captures a broader self-perception of competence. Here the relationship between self-efficacy, effort, and performance is not as direct, it is a relationship mediated by numerous process variables.

Self-satisfaction. Self-satisfaction is an affective reaction to behavior that contributes to motivation. Satisfaction with oneself is a direct result of comparing one's performance with one's goal for that performance or some set standard of performance (Bandura & Cervone, 1983). When a goal is attained or surpassed, a person will experience the positive affect of satisfaction. When a goal is not attained, a person will experience the negative affect of dissatisfaction.

Findings have shown that the higher the self-dissatisfaction with substandard attainments, the greater is the subsequent intensification of effort (Bandura & Cervone, 1983; Locke, Cartledge, & Kerr, 1970). Research has also shown that when there is a simple and direct relation between effort and performance, self-dissatisfaction that enhances effort will positively affect performance (Bandura & Cervone, 1983, 1986b). However, on complex tasks, the negative affect due to self-evaluations can undermine performance by interfering with cognitive processes critical to success (Cervone, 1993). In a study employing a complex decision-making task, Cervone, Jiwani, and Wood (1991) found that individuals who became dissatisfied with their performance exerted a great deal of effort in an attempt to improve; however, in doing so, they applied a number of conflicting strategies which inhibited their performance. These findings suggest that individuals learning complex tasks must be given proper guidance on what they should do to improve their performance and eliminate self-dissatisfaction, or their effort may be misguided or counterproductive.

Self-satisfaction or self-dissatisfaction can be either motivating or demotivating (Bandura, 1991; Carver & Scheier, 1990). Performance that falls considerably short of standards is likely to give rise to discouragement and goal abandonment (Bandura &

Cervone, 1983). Moderately discrepant performances, which make the standard appear attainable (Atkinson, 1964; Locke, 1968), are likely to activate self-dissatisfactions that spur efforts to bring performance in line with valued standards. Attainments that meet or surpass personal standards create self-satisfactions that serve as motivation for further pursuits (Bandura & Cervone, 1983).

Attributions. Attributions are the causes to which behavior is ascribed. The attributed causes may or may not be the actual cause of the behavior, but rather are what the individual believes caused the behavior. Research indicates that trainee attributions of causality can have impacts on their affective states, future expectations, and the behaviors they engage in during training (Forsterling, 11985; Curtis, 1992). Attributions are generally classified as one of three types: locus, stability, and controllability (Weiner, 1985). Stability refers to whether the attributed cause is stable or unstable. For example, a difficult task may be considered a stable cause for performance, but the effort one puts into the task is unstable and changing. Controllability refers to whether the trainee perceives the attributed cause as being under his or her control. Luck, for example, is likely to be perceived as an uncontrollable cause of behavior, whereas effort would likely be perceived as a controllable cause. The locus of attributions refers to whether the cause is perceived as being a factor within the person (internal), or a factor within the environment (external).

In the present study, I focused on the internal/external locus of attributions. Typically, when good performance is attributed to one's self, motivation, learning, and performance increase over time. When bad performance is attributed to one's self, the effects are negative (Kozlowski et al., 1997). Typically, in order to protect the self, bad performance is more often attributed to external factors, justifying withdraw from the task. Attributional interpretations occur naturally. Because complex tasks often involve many trainee errors, particularly during early skill acquisition, uncontrolled attributional processes have the potential to undermine self-regulation, learning, and performance (Kozlowski et al., 1997). If trainees attribute their performance to external causes they will be more likely to feel detached from the task and less likely to put forth effort to improve their performance. Thus, it is important, especially in the beginning of training, to control the locus of trainee's attributions. Attributions should be internally focused in order to give trainees a sense of control over their learning (Kozlowski et al., 1997).

On-task cognition. In most training situations there exists some sort of positive relation between persistence and performance success, and most people believe that greater effort will result in improved performance (Sandelands, Brockner, & Glynn, 1988). Although persistence is usually adaptive, a number of different factors, including the nature of the task and available opportunities for success, can influence individuals' perceptions of this persistence-performance relationship, and subsequently their decisions to put forth effort on a task. For example, during the early stages of learning a complex task, performance often involves many errors and the majority of feedback may be negative. In these situations, individuals may perceive future effort to be futile or may withdraw effort in an attempt to protect their "competence image" (Jones, 1989).

The general idea behind theories of persistence is that individuals will be more likely to persist at a task if they believe they can achieve desired outcomes. However, research has also uncovered numerous individual and situational determinants of task persistence. Henry and Sniezek (1993) found that task persistence is increased when individuals perceive a high degree of internal control and when rewards are contingent on performance. Research has also found that feedback focusing on positive outcomes leads to greater persistence than feedback focusing on negative outcomes (Roney, Higgins, & Shah, 1995). Sandelands and colleagues (1988) found that task persistence was greater when individuals were informed that persistence was a wise strategy for task completion (e.g., persistence-performance relationship is continuous) than when individuals were told that the nature of the task was such that persistence was a less prudent strategy (e.g., persistence-performance relationship is discrete). Furthermore, Cervone (1989) found that individuals' self-efficacy judgments were positively related to their task persistence.

Many of the studies in this line of research (e.g., Cervone, 1989; Kroll, 1991; Roney et al., 1995; Sandelands et al., 1988) have measured task persistence by having participants work on unsolvable problems, usually anagrams. Task persistence is then measured by calculating the amount of time individuals spend on the unsolvable problems before quitting. In many situations, however, individuals may withdraw mentally from a task long before they actually quit physically performing the task or the nature of the task may prohibit such objective measures of time on task. This is especially true in training situations where individuals are required to spend a certain amount of time on a task. Under these circumstances, it is more appropriate to measure task persistence by assessing individuals' on and off-task cognition (e.g., Kanfer, Ackerman, Murtha, Dugdale, & Nelson, 1994).

Effort Constructs

Time spent studying. The present study focused on two variables to represent the effort construct. The first was the amount of time the trainee spent studying. In situations where learning is an important outcome, separate from performance, effort toward learning should be measured. For complex, difficult, and novel tasks, it is important for trainees to study task information and materials prior to opportunities to practice or perform the task. In these situations, many skills and strategies simply cannot be learned through repeated practice, rather trainees must study task materials, such as manuals, to acquire the task knowledge necessary for developing skills and strategies. Thus, the amount of time learners spend studying these task materials constitutes an indication of their effort to learn the task.

Time spent on feedback. Feedback allows trainees to measure their performance against either some personal or set standard and/or their previous performance (Kluger & DeNisi, 1996). In addition, feedback allows trainees to judge their performance and progress and make appropriate decisions about future behaviors and levels of effort. Thus, the amount of time a trainee spends reviewing and interpreting feedback is an indication of their effort to achieve some standard of performance. The more time a trainee spends on feedback the more effort they are putting forth in an attempt to learn and perform well on the task.

Relevance of Effort Constructs

Practice sequence. Effort alone is often not enough to perform well on difficult and complex tasks. Individuals must also focus their effort on relevant aspects of the task. In the present study, the relevance of a trainee's practice was measured by the sequence in which they practiced the relevant training material. Trainees must first learn the fundamental skills of the task. Once these skills are developed, the trainee can then proceed to learn the more strategic aspects of the task, which are critical to performing well on the task. Without the fundamental skills, a trainee will be unable to correctly learn or utilize the strategic skills and will not perform well at the task. If a trainee is not proficient at performing particular operations or applying certain strategies, he or she will not perform well at the task.

Study sequence and content. The relevance of a trainee's study can also be determined by the order in which they study the relevant training material. Trainees must study the training material in a particular sequence to completely and appropriately learn the skills and strategies of the simulation. As with practice, trainees must first concentrate on learning the fundamental aspects of the task. Once these basic skills have been learned, trainees can then progress to learning the strategic aspects of the simulation. Both forms of knowledge are necessary to perform well at the task. The appropriate sequence of trainees' practice and study is presented in Figure 2.

Outcome Constructs

Basic and strategic performance. The outcome variable which is most salient in training studies is training performance. Training performance can be construed as a skill, or what the trainee does with respect to the task. The present study focused on two types of performance, basic and strategic. Basic performance refers to trainees' ability to perform fundamental task features and operations, which must be learned in order for participants to develop more advanced skills. Strategic performance refers to a trainee's ability to perform more complex and difficult operations, which are based on an understanding of the deeper elements of the task. Both of these outcome constructs are important measures of how performance varies as a result of manipulating guidance and the associated changes in other process variables.

Basic and strategic task knowledge. An outcome variable often forgotten in training studies is learning (Kozlowski et al., 1998). In situations involving complex and difficult tasks, learning can often be broken down into two components. The first is basic task knowledge. Basic task knowledge refers to the extent to which a trainee has learned the fundamental principles of a task. The second component is strategic task knowledge. Strategic task knowledge refers to the extent to which a trainee has learned the underlying or deeper elements of a task. Both types of task knowledge are appropriate outcome variables for measuring the effects of the guidance manipulation and the related changes in process variables on learning.

Generalization performance. Researchers are beginning to realize that the environments in which trainees apply their knowledge and skills are dynamic and changing rather than static and constant. As a result, research is beginning to examine how different training strategies effect performance in not only the training situation but also in more complex and difficult situations (Kozlowski et al., 1997). The goal is to measure the extent to which trainees can adapt what they have learned to a variety of task situations, often involving an increased workload and new challenges. In the present study, trainees' ability to adapt what they had learned was measured by their performance on a more complex and challenging generalization trial. Performance on this generalization trial is an indication of the degree to which trainees have learned both fundamental task features and, more importantly, the strategic and deeper elements of the task.

HYPOTHESES

The hypotheses which were examined in the present study are outlined in Figure 1. The behavioral and cognitive guidance was designed to assess each trainee's performance, recognize deficiencies, and provide recommendations on what the trainee should be doing and thinking. Focusing on the behavioral component, this form of guidance directs trainees on what material they should be practicing and the order in which they should practice the material (Kozlowski et al., 1997). As a result, trainees receiving behavioral and cognitive guidance should be more likely to not only practice all the relevant TAG procedures and skills but also to follow the suggested sequence of practice (basic --> strategic). All trainees should spend a significant amount of time practicing the basic aspects of the game; however, trainees receiving behavioral and cognitive guidance should spend significantly more time practicing the strategic components of the game than trainees not receiving this guidance.

Hypothesis 1: Trainees receiving behavioral and guidance will be more likely to follow the suggested sequence of practice, basic to strategic, than trainees not receiving this guidance.

In addition to recommending future courses of practice, behavioral and cognitive guidance also directs trainees on what they should be studying (Kozlowski et al., 1997). The behavioral and cognitive guidance assesses trainees' past performance, recognizes areas of deficiency, and recommends the material trainees should be studying in order to overcome these deficiencies. In addition, the guidance sequences trainees' learning so that they focus on the more basic aspects of the task in the beginning of training, and progress to learning strategic skills later in the task. As a result, trainees receiving behavioral and cognitive guidance should not only study more of the relevant TAG procedures and strategies but also should study the material in the proper sequence. All trainees should spend a significant amount of time studying the basic aspects of the game; however, trainees receiving behavioral and cognitive guidance should spend significantly more time studying the strategic components of the game than subjects not receiving this guidance.

Hypothesis 2: Trainees receiving behavioral and cognitive guidance will display a more appropriate sequencing of study, basic to strategic, than trainees not receiving this guidance.

For individuals to develop feelings of self-satisfaction or self-dissatisfaction, they need to be able to compare their past performance to some standard of performance (Bandura & Cervone, 1983). Behavioral and cognitive guidance provides trainees with specific information about how their performance on particular skills or strategies compares to a set standard. In this way, the behavioral and cognitive guidance allows trainees to compare their performance to a reference point or desired level of performance. As trainees attempt to learn a new skill or strategy, their performance will initially fall below the set standard of performance. This failure to meet the standard should result in increased self-dissatisfaction (Bandura & Cervone, 1983).

Hypothesis 3a: Behavioral and cognitive guidance provides trainees with an opportunity to compare their performance to a clear set standard of performance, resulting in increased self-dissatisfaction for trainees not achieving the standard.

When a person fails to achieve a personal or set standard of performance, they experience self-dissatisfaction (Bandura & Cervone, 1983, 1986a). As long as the standard appears attainable, self-dissatisfaction leads to an intensification of effort to achieve the standard (Bandura & Cervone, 1983, 1986a). Thus, increased self-dissatisfaction with performance should lead to increased effort on the task.

Hypothesis 3b: Higher levels of self-dissatisfaction will lead to higher levels of effort on the task, such as more time spent studying and more time spent reviewing feedback.

As discussed earlier, whether perceived discrepancies between personal standards and attainments are motivating or discouraging is determined in part by the degree to which people believe they can attain the standards they are pursuing (Bandura & Cervone, 1983, 1986a). Individuals who receive behavioral and cognitive guidance are told that they will be guided through the training process. They also receive guidance, which, if followed, will help them succeed on the task. They are given information about their performance deficiencies and are told exactly what they need to do in order to meet the set performance standards. Trainees receiving behavioral and cognitive guidance should feel as though they are being given an excellent opportunity to succeed at the task, and that they can overcome performance decrements and perform well. As a result, trainees receiving behavioral and cognitive guidance should display higher levels of self-efficacy than individuals not receiving this guidance.

Hypothesis 4: Trainees who receive behavioral and cognitive guidance will exhibit higher levels of self-efficacy than trainees not receiving this guidance.

An individual's self-efficacy effects his or her decisions concerning what challenges to undertake, how much effort to expend on a task, and how long to persevere in the face of difficulties (Bandura, 1982, 1986a). Individuals with low self-efficacy are easily discouraged by failure, whereas those with high self-efficacy will increase their effort when their performance falls short and persevere until they succeed (Bandura & Cervone, 1983, 1986a; Brown & Inouye, 1978; Cervone & Peake, 1986; Schunk, 1984; Weinberg, Gould, & Jackson, 1979). Thus, trainees with high self-efficacy should expend more effort on the task than trainees with lower levels of self-efficacy.

Hypothesis 5: The higher a trainee's self-efficacy, the more effort, in terms of amount of time spent studying and reviewing feedback, he or she will expend on the task.

Affective guidance is designed to help trainees control their reactions to their feedback. This guidance tells trainees that the task is difficult and that poor performance, especially in the beginning of training, is to be expected. It makes trainees aware of the emotions they may face during training, such an anxiety or anger, and provides strategies and techniques for helping them handle these emotions. Receiving negative feedback or being told often that past performance is below a set standard can have a negative affect on trainees' motivation. However, affective guidance should act to control trainees' negative affect and convince them that they can attain the desired level of performance. As a result, trainees receiving affective guidance should possess higher levels of self-efficacy than trainees not receiving this guidance.

Hypothesis 6: Trainees receiving affective guidance should display higher levels of self-efficacy than trainees not receiving affective guidance.

Sandelands and colleagues (1988) showed that individuals persisted longer on a task when they were advised that persistence was a wise strategy for task completion. In the present study, affective guidance tells trainees that although they may do poorly at times, if they continue to work hard they will do well. This guidance is telling trainees that the relationship between persistence and performance is continuous, or that success is the result of gradual, continuous effort devoted to the task (Sandelands et al., 1988). Trainees who receive affective guidance should be more apt to believe that continued effort will result in success, and thus be less likely to withdraw from the task. These trainees should display more on-task thoughts and less off-task thoughts than trainees not receiving the affective guidance.

Hypothesis 7a: Trainees who receive affective guidance will be less likely to withdraw from the task and will display higher levels of on-task cognition than trainees not receiving affective guidance.

Trainees may withdraw from a task for several different reasons, including protecting their self-concept and believing that future effort is futile (Jones, 1989). Whatever the reason, when trainees withdraw from a task, or plan to withdraw, they display less effort than trainees who persist at the task. Thus, there should be a direct relationship between the degree to which trainees have withdrawn from the task and the amount of effort they put forth on the task.

Hypothesis 7b: Trainees with higher levels of on-task cognition will display more effort, in terms of time spent studying and reviewing feedback, than trainees who indicate they have withdrawn from the task.

Affective guidance also focuses on controlling trainees' attributions. Poor performance and a high rate of errors are to be expected during early skill acquisition on complex and difficult tasks. However, negative feedback can have detrimental effects on trainee's motivation, especially if they perceive their failure as resulting solely from external causes. During the early stages of training the affective guidance is designed to inform the trainees that the task is difficult and poor performance is to be expected. However, it also provides trainees with techniques and strategies to help them handle their reactions to feedback, thus creating an internal locus of control. Trainees receiving affective guidance, therefore, should display a more internal locus of attributions throughout the course of training.

Hypothesis 8a: Trainees receiving affective guidance should display a more internal locus of attributions than other trainees.

Uncontrolled attributions have the potential to undermine trainee motivation, self-regulation, performance, and learning (Kozlowski et al., 1997). It is important to encourage trainees to focus their attributions on internal causes so that they develop a sense of control over their learning (Kozlowski et al., 1997). This internal focus will help trainees to persist in the face of difficulties and will help to boost motivation and effort (Kozlowski et al., 1997).

Hypothesis 8b: An internal locus of attributions during training will result in increased trainee effort, in terms of amount of time spent studying and reviewing feedback..

An individual's self-efficacy judgements should influence his or her task persistence. Self-efficacy theory proposes that when individuals are faced with obstacles or difficulties, efficacy judgements influence the persistence of effort on an activity (Bandura 1986a; 1988). As Sherman and colleagues (1981, p. 145) stated, "expectations of success or failure are likely to affect the amount of effort and concentration exerted." In an experiment designed to test this proposition, Cervone (1989) found that individuals' perceived self-efficacy was positively related to task persistence. Thus, in this study, we would expect a positive correlation between trainees' self-efficacy judgments and their task persistence.

Hypothesis 9a: Higher levels of self-efficacy will result in greater on-task cognition and less off-task cognition.

Trainee attributions should also influence task persistence. Henry and Sniezek (1993) found that task persistence was increased when people perceived a higher degree of internal control. It makes sense that if trainees feel a sense of control over their learning, they will be more likely to expend effort on the task and less likely to withdraw effort when faced with poor performance or difficulties. Trainees who develop internal attributions should feel increased control over their learning and display higher levels of task persistence.

Hypothesis 9b: Internal attributions throughout training will result in greater on-task cognition and less off-task cognition.

The effort trainees expend on the task, in terms of time spent studying and reviewing feedback, and the relevance of this effort, in terms of the sequence and content of practice and study, will effect several dependent variables. The first is basic task knowledge. Trainees who spend considerable time studying task materials and reviewing feedback should learn more about the basic aspects of the task than individuals who do not spend as much time performing these activities. In addition, trainees who study and practice the relevant task skills and strategies, and do so in the appropriate sequence, should display greater basic task knowledge than other trainees. It is important to note that basic task knowledge will be acquired by all trainees through repeated practice and exposure to the task; therefore, overall differences expected between groups on this variable are minimal. However, individuals who follow the appropriate plan of study and practice will probably acquire this knowledge quicker than other trainees. Thus, the greatest differences on basic task knowledge should be found early in training.

Hypothesis 10a: The effort trainees expend on the task and the relevance of this effort will be significantly and positively correlated to basic task knowledge.

The effort trainees put forth on the task and the relevance of this effort will also affect strategic task knowledge. Trainees who spend more time studying task materials and reviewing practice feedback will develop a better understanding of the strategic aspects of the game than those trainees who do not spend as much time at these activities. More importantly, the sequence and content of trainees' study and practice will have a large effect on their strategic task knowledge. Trainees who follow the desired plan of study and practice should be more likely than other trainees to spend time learning the deeper elements of the game. The greatest differences in strategic knowledge should be found during the later stages of training when trainees have had an opportunity to learn the strategic elements of the game and when the guidance directs trainees' attention to these aspects of the task.

Hypothesis 10b: Trainee effort on the task and the relevance of this effort to important aspects of the task will be significantly and positively correlated with strategic task knowledge.

All trainees will achieve a minimum level of basic performance through repeated exposure to and practice on the task. However, trainees who spend more time studying task materials and reviewing practice feedback will perform better at the basic aspects of the task than trainees who spend less time performing these activities. In addition, trainees who study and practice relevant task content and do so in the desired sequence will display higher levels of basic performance than other trainees. Trainees who put forth more effort and focus this effort on relevant aspects of the task should be able to perform well at the basic components of the task quicker than other trainees. Thus, the largest differences on this variable should be found during the early stages of training.

Hypothesis 10c: Basic performance will be significantly and positively correlated to the amount of effort trainees expend on the task and the relevance of this effort.

Strategic performance is an important aspect of complex and difficult training situations. In the present study, a trainee's strategic performance will be affected by both the effort he or she expends on the task and the relevance of this effort to important aspects of the task. Trainees who spend more time studying task materials and reviewing practice feedback should be better equipped with the information necessary to perform well on the strategic aspects of the task. In addition, studying and practicing appropriate task content and doing so in the proper sequence will enable trainees to develop the strategic skills necessary to perform well at the task. The greatest differences on strategic performance should be found in the later stages of training when trainees have had an opportunity to develop these skills.

Hypothesis 10d: Strategic performance will be significantly and positively correlated with the amount of effort trainees expend on the task and the relevance of this effort to important aspects of the task.

Trainees who perform well on the basic and strategic aspects of the task and display high levels of basic and strategic knowledge should perform well on the generalization trial. Although each of these variables will be positively correlated to performance on the generalization trial, the size of their respective effects will not be equal. In the generalization trial, the workload is increased dramatically and the rules of the game are modified. To handle this complex and difficult situation, trainees must be able to effectively and efficiently apply the strategic knowledge and skills they have learned during practice. Basic skills and knowledge are still critical in the generalization trial, but they alone will not allow the trainee to perform well. As a result, trainees' performance on and knowledge of the strategic aspects of the task will have the greatest impact on performance in the generalization trial.

Hypothesis 11: Performance on the generalization trial will be significantly and positively correlated with trainees' basic and strategic performance on the task during practice and their basic and strategic knowledge.

METHOD

Design

Overview. The present study employed a 2 (behavioral\cognitive guidance vs. no behavioral\cognitive guidance) by 2 (affective guidance vs. no affective guidance) fully crossed between-subjects design. The experiment took place in a single session consisting of three blocks, each block consisting of three trials, for a total of nine training trials. Blocks (3) and trials (9) both represent within subjects factors. Following the training blocks, trainees participated in a generalization trial in which the workload (e.g., more targets, length of the trial was doubled) and complexity (e.g., the principles and rules underlying task proficiency were modified) were increased. The purpose of the generalization trial was to measure the extent to which trainees are able to adapt their acquired skills.

Simulation. The PC-based decision making simulation TEAMS/TANDEM (see Kozlowski & Gully, 1996; Weaver, Bowers, Salas, & Cannon-Bowers, 1995; Weaver, Morgan, Hall, & Compton, 1993) was used as the experimental platform. This platform is a low physical fidelity simulation of a naval radar tracking task which provides a high psychological fidelity for complex and difficult decision making and information processing tasks. The task was originally developed by the Naval Air Warfare Center Training Systems Division (NAWCTSD) and the University of Central Florida. The original task has undergone extensive design modifications to create the current version of TEAMS/TANDEM (version 8.1f), which provides a dynamic, self-contained, and completely novel task environment. The current version of TEAMS/TANDEM allows researchers to examine the process of training individuals on a complex task and developing adaptive expertise. The simulation was designed to include events that unfold in real time that can be scripted by the researcher. In addition, the researcher has control over what performance information trainees are given, what decisions they need to make, and how the performance of these actions are scored.

The current version of TEAMS/TANDEM, which was used in this study, is referred to as the Tactical Action Game (TAG). During TAG, each participant is seated at a simulated radar console upon which multiple contacts are presented. The trainee must gather information about each contact by "hooking" the target, gathering information about its characteristic "cue values," and making a final decision about the target's disposition based on information gathered. Using this information, the trainee then makes a final decision about what action to take against the target (shoot or clear). Three cues are available for each of the component decisions (nine cues overall), which must be made in the following order: (1) Type (air, surface, or submarine); (2) Class (civilian or military); (3) Intent (peaceful or hostile); and (4) Engage (shoot or clear).

Skill components. Throughout training, all participants had access to a comprehensive training manual. During a two minute period before each trial, the manual was presented on-line so as to provide the capability of tracking the content and duration of studied material. Three sets of skills were documented in the comprehensive manual. These sets included basic functionality, declarative knowledge, and strategic knowledge.

Basic functionality on the task involves learning those features of the program, in terms of both hardware and software, which make it possible to perform the task. Task features which must be learned in order for a participant to perform well on TAG include hooking targets, accessing cue menus, and "zooming" to alter the display radius. In addition, individuals need to understand several basic functions of a PC, such as using a mouse and keyboard.

Declarative knowledge is also required to process information and render target sub-decisions. The cue information is accessed from pull-down menus, with 3 cues available for each of the three component decisions. After making the three component decisions regarding the Type (air, surface, submarine), Class (civilian or military), and Intent (peaceful or hostile) of a target, participants are required to either shoot targets (if hostile) or clear them from the radar screen (if peaceful). For individuals to successfully progress to learning the strategic aspects of the game, it is important that they first become proficient at making correct and efficient component and final engagement decisions. These skills, which are a foundation for later strategic skills, are measured by indicators of basic performance, such as number of correct sub-decisions and final engagement decisions.

Strategic knowledge involves the participant's ability to understand the deeper elements of the simulation and to develop two critical strategic skills: situational assessment and target prioritization. Three elements of the task (using the zoom function, identifying defensive perimeters, and locating and utilizing marker targets) are relevant to situational assessment. The zoom function allows participants to either expand (zoom out) or constrict (zoom in) the radius of their radar screen. Participants need to "zoom out" to determine the overall situation in which they are operating. This action is critical because of the presence of two "defensive perimeters" within the task. The inner defensive perimeter, located at 10NM, is clearly marked and easy for participants to identify. However, the outer perimeter, located at 256 NM, is beyond the initial viewing range of 32 NM, and is not clearly marked. Thus, participants must first "zoom out" and then locate "marker targets" that serve to identify the outer boundary.

Target prioritization requires the trainee to utilize a separate set of strategic skills. Decisions about which targets constitute the greatest threats to the participant's defensive perimeters are critical, as the scenarios are designed so there is often multiple targets approaching each perimeter, some of which are more threatening than others. The order in which targets should be prosecuted should be based on two pieces of information, speed and distance from the perimeter. Faster targets are of higher priority than slower targets because they will penetrate the defensive perimeters more quickly. Also, targets close to either of the defensive perimeters are of higher priority than those which are farther away. Thus, the highest priority targets are those that are both (a) moving quickly and (b) near a defensive perimeter. Trainees also need to "trade off" targets approaching their inner and outer perimeters. Strategic decisions related to such trade-offs revolve around the number of targets at each perimeter, their priority, and their "cost" if they penetrate.

Procedure

Participants. A total of 292 undergraduate college students from a large Midwestern university participated in the present study. A total of 15 participants were dropped from the sample for various reasons, resulting in a final sample of 277 participants.[1] All participants were volunteers who received course credit for their participation in the three hour experiment. Fifty-six percent of the participants were female, and most (86.3 percent) of the participants were between 18 and 21 years old. The experimental sessions were conducted with groups consisting of from one to 12 participants. These groups were randomly assigned to one of the four experimental conditions, resulting in a relatively even distribution of participants across the four experimental conditions. Using Cohen's (1988) sample size tables for analysis of covariance (ANCOVA), it was found that a sample size of 277 participants (approximately 70 participants per cell) resulted in approximately 25 percent power to detect small (f = .10) effect sizes, 95 percent power to detect medium (f = .25) effect sizes, and over 99 percent power to detect large (f = .40) effect sizes.

Informed consent. Before beginning the experiment, all subjects were required to read, sign, and date a consent form which provided a general description of the experiment and its risks and benefits. After completing the study, all participants were debriefed. The consent form is presented in Appendix A, and the debriefing sheet is shown in Appendix B.

Experimental training. After reading a short introduction to the experiment, the experimenter presented participants with a brief demonstration of the task, outlining its features and decision sequence. During this demonstration, the experimenter briefly displayed how to hook targets, use the pull down menus, use the zoom function, and make decisions in the proper order. The experimenter also demonstrated how to use the on-line manual and how to scroll through the feedback and guidance. Participants were informed that they would have an opportunity to practice the TAG game in a one-minute "familiarization" trial. The purpose of this familiarization trial was to provide a basis for presenting the first block of guidance. Trainees were told that they would progress through three blocks of study, practice, feedback, and guidance (if appropriate) cycles, followed by an opportunity to demonstrate how much they had learned on a more difficult and complex version of the task.

Practice. The experimenter first instructed the participants to begin the "familiarization trial." Participants were told that the purpose of this initial trial was to allow them to get familiar with the task and to obtain a baseline measure of their performance, which was used to provide the first presentation of guidance. Following this initial trial, participants in the behavioral\cognitive guidance condition and participants in the affective and behavioral\cognitive guidance condition were given the first presentation of behavioral\cognitive guidance, which was the same for all participants. This guidance instructed the participants on what topics they should focus on during the upcoming block of practice trials. In addition, all participants were given a list of TAG topics and told that they may want to focus on these areas during their training. For participants in the behavioral and cognitive guidance conditions, the list of TAG topics was presented in the appropriate sequence (basic to strategic). This list is presented in Appendix C. Participants in the other two conditions, however, received a random list of the same TAG topics. This list is presented in Appendix D. After reviewing the guidance, participants then began the regular practice cycle, consisting of a two minute study period, a five minute practice trial, and a two minute feedback and guidance session. Trainees were asked to complete the Wonderlic Personnel Test and a short demographic questionnaire before beginning the experiment (see Appendix E). In addition, other measures, including dependent variables, were collected at the end of block 1 and the end of block 3.

Generalization. The generalization task was designed to substantially increase both the workload and complexity of the task. Effective performance on the generalization trial required that trainees adapt the knowledge and skills they had acquired throughout training to a new and more complex situation. Following the nine trials, trainees received instructions describing important task differences they would encounter in the final session.

To increase the workload, the number of targets was increased from 22 to 60, a 172% increase. Task complexity was increased by (1) including more "pop-up" targets, which appeared suddenly on the screen; (2) changing the "rules of engagement" so that a greater number of points were deducted when targets crossed the visible inner perimeter (175 points) and the invisible outer defensive perimeter (125 points); (3) creating more defensive perimeter intrusions; (4) creating "pop-up" targets that appeared very close to defensive perimeters; and (5) differentially distributing boundary intrusions to create a situation in which many targets threatened the outer perimeter, while fewer targets threatened the inner perimeter, requiring strategic trade-offs on the part of trainees. The generalization task represented a much more demanding, difficult, and complex task than that faced in training, requiring the adaptation of trainee's strategies and the generalization of their skills.

Incentives. Trainees were informed about awards for (a) questions answered during the training trials (knowledge) and (b) performance on the final, more difficult generalization trial. The instructions at the beginning of training indicated that trainees would be asked to answer questions throughout the training program, emphasizing that they needed to "...think carefully about your answers to the questions." They were told that awards would be given to the four players who answered these questions the best, and that four additional awards would be given to the players who did the best on the final (generalization) trial. Written instructions regarding incentives were provided to trainees at the beginning of the experiment, and they were reminded by the experimenter just prior to the start of the generalization trial. These instructions are presented in Appendix F.

Manipulations

Behavioral\cognitive guidance. Due to the difficulty in distinguishing between behavioral and cognitive guidance, the two manipulations were combined throughout the experiment. The initial presentation of behavioral and cognitive guidance followed the "familiarization" trial and was the same for all participants. This initial behavioral and cognitive guidance instructed trainees that they should learn how to hook targets and make correct Type, Class, Intent, and Final Engagement decisions, and that they should study their manual to help them learn these skills. Following this initial presentation, all subsequent behavioral and cognitive guidance was adaptive and was based on the trainee's performance on the preceding practice trial.

Adaptive behavioral and cognitive guidance was based on three levels of performance. The first level was represented by a failure to reach a minimum level of performance on a particular skill or strategy. This is basically an inability to perform the required skill or strategy. The second level of performance was represented by the ability to achieve minimum performance on a skill or strategy, but a failure to achieve the desired level of performance. This was indicative of trainees who showed they could perform a certain action, but were not yet proficient. The third level of performance was representative of those individuals who had achieved the desired level of performance on a skill or strategy. To create cutoff scores for these three levels of performance, prior experimental data employing the TAG simulation was analyzed.

Based on that data, cutoff scores for each skill and strategy were set at the 50th and 85th percentiles. It was determined that these cutoffs allowed for adequate discrimination between scores representing low, medium, and high performance. In addition, these scores make minimum performance quite easily achievable, and maximum performance difficult to achieve. The behavioral and cognitive guidance for individuals scoring within each of the three ranges of performance on a particular skill or strategy was designed as follows:

Individuals scoring below the 50th percentile: The behavioral and cognitive guidance for individuals scoring within this range informed the person that they had not yet learned how to perform the necessary skill or strategy and instructed the individual on what they should be practicing and studying to achieve the desired level of performance.

Individuals scoring between the 50th and 85th percentile: The behavioral and cognitive guidance for individuals scoring within this range informed the individual that they had reached a level of minimal performance, but needed to become more proficient at the skill or strategy. In addition, the guidance instructed the trainee on what he or she should be practicing and studying to achieve the desired level of performance.

Individuals scoring above the 85th percentile: The behavioral and cognitive guidance for individuals falling within this range informed the person that they had mastered the specific skill or strategy, and that they should concentrate on improving in areas in which they were still deficient.

The behavioral aspect of the guidance directed trainees on what skills and strategies they should be practicing based on their previous performance. For example, if a person hadn't learned how to hook targets, the behavioral guidance suggested to the person that this is an area in which he or she needs additional practice. The cognitive aspect of guidance directed trainees on what material they should be studying based on their previous performance. For example, if a trainee was allowing too many outer penalty circle intrusions, the cognitive guidance suggested that the trainee should review the material in the manual on "zooming out" and identifying the outer penalty circle. The behavioral and cognitive guidance were designed to complement one another, and were framed in a manner which recommends or suggests certain actions or behaviors, rather than telling participants what to do. See Appendix G for more examples of behavioral and cognitive guidance.

In addition to helping trainees identify areas of needed improvement, the behavioral and cognitive guidance was also designed to sequence the learning and practice of trainees. This sequencing is important because it allows trainees to develop the fundamental skills of TAG before proceeding to the more strategic aspects of the simulation, where the fundamental skills will be required. Before each training block, the behavioral and cognitive guidance recommended general areas they should be covering during the upcoming practice and study sessions. Then, following each practice session, the behavioral and cognitive guidance gave trainees specific information about what they needed to practice and study to improve their performance in these general areas.

Affective guidance. Affective guidance directs the trainee to exercise emotional control with respect to his or her reactions to feedback (Kozlowski et al., 1997). The main goal of the affective guidance was to maintain trainees' effort and lessen the chances that they would withdraw from the task. The affective guidance was designed to provide trainees with techniques to help them handle the emotions, thoughts, and feelings they may encounter during their training. For example, trainees who become extremely frustrated or upset with how they are performing at the task are more likely to withdraw from training. Thus, the affective guidance might provide techniques that help the trainees to relax and control their frustrations.

The first step in designing the affective guidance was to determine the affective states that trainees were most likely to experience at different points during the three-hour training session. To determine the emotional states of trainees while playing the TAG simulation, thirty individuals participated in pilot sessions of the experiment. These sessions were run using the no guidance or control version of the simulation. To allow the experimenter to interact and question the participants, the sessions were run with groups of three to four participants. Following each block of three practice trials, the experimenter questioned the participants about the emotions and thoughts they experienced during the preceding practice block. These discussions with participants yielded a relatively consistent pattern of emotions experienced by trainees across the training blocks, which I present in the following section.

During the first block of practice trials, trainees typically became discouraged, frustrated, anxious, or upset due to the fact that they were not performing as well as they would like. This is not surprising considering the fact that it takes some time to become proficient at the TAG simulation. The first few practice trials were characterized by a great deal of trainee error and typically poor performance. During the second block of practice trials, however, trainees began to see some improvement in their performance. At this point in the training, most individuals had become fairly proficient at the basic TAG skills. This resulted in slightly lower levels of frustration and anxiety during the beginning of the second practice block. However, trainees who began to work towards learning some of the more difficult, strategic TAG skills once again experienced frustration and anxiety due to an initial period of poor performance. Thus, it was necessary to determine methods of reducing trainee frustration and anxiety during the first and second practice blocks. By the beginning of the third trial block, most trainees had become fairly proficient at the TAG simulation. They had mastered the basic skills and were improving on the strategic skills. This increased performance on the task combined with over two hours of steady study and practice made motivation a major issue in the final trial. Some trainees began to withdraw from the task due to fatigue, while others became less motivated due to what they perceived as high levels of performance. As a result, it was necessary to devise methods for keeping trainees engaged on the task to the end of training.

After determining the affective states experienced by individuals during the TAG training, it was then necessary to devise techniques to help trainees handle these emotions. In the first and second practice blocks, the affective guidance provided trainees with several skills or techniques they could use to reduce their anxiety and frustrations and maintain their focus on the task. One such technique was guided mental imagery. A guided mental imagery script can involve several components, including relaxation, thought stopping, and covert reinforcement scenes (Wheatley, Maddox, and Anthony, 1989). Guided mental imagery can help an individual change the way he or she communicates intrapersonally, and in doing so can help to reduce feelings of anxiety and frustration and can help to eliminate self-defeating thoughts (e.g., Carter & Kelly, 1997; Mace & Carroll, 1985; Murphy & Woolfolk, 1987; Sapp, 1994). To replace negative thoughts with more positive thoughts (a combination of thought stopping and reinforcement), trainees who became frustrated were instructed to imagine themselves performing extremely well at the TAG simulation. Another technique used to reduce trainee frustration and anxiety was relaxation therapy. Some relaxation therapy techniques are fairly involved, such as Bernstein and Borkovec's (1973) progressive muscle relaxation in which individuals tense and relax 16 different muscle groups during a 90 minute session. Due to time constraints, more simple relaxation techniques were used in the present study, such as breathing. It has been suggested that controlled breathing is an important part of nearly all relaxation techniques (e.g., Foreyt, 1990; Lichtenstein, 1988). A final technique used to help trainees handle their emotions in the first two training blocks was functional self-talk. A major premise of Ellis' (1962) rational-emotive theory is that irrational self-statements produce psychological distress and rational self-statements decrease it. Consistent with this theory, research has shown that reciting rational statements, such as "If I am not performing as well I would like it is not terrible," or positive statements can help to reduce individuals' anxiety (Cramer & Kupshik, 1993; Rosin & Nelson, 1983), increase their self-efficacy (Milliman & Latham, 1996), and improve their performance (Van Raalte et al., 1995).

In the final block of practice trials, the main goal of the affective guidance was to provide trainees with techniques that would help them maintain motivation and stay focused on the task. This was done by providing trainees with, for lack of a better term, "psyching-up" techniques. Research in sports psychology has shown that "psyching-up" techniques can be effective for increasing the energizing capacity of the body and focusing an athlete's attention (Caudill, Weinberg, & Jackson, 1983; Genov, 1970; Weinberg, Gould, & Jackson, 1980). Research has also shown that there are several different effective "psyching strategies" (Shelton & Mahoney, 1978; Weinberg, Gould, & Jackson, 1980). In the present study, the affective guidance provided individuals with several psyching strategies, such as imagery, control of attention, and self-statements, in an attempt to maintain trainee motivation.

The affective guidance was not adaptive; however, it was designed so that each presentation was unique and novel. The affective guidance was presented after the practice feedback, immediately following the behavioral and cognitive guidance (if applicable). The affective guidance presented to participants in each trial is presented in Appendix H.

In the affective guidance only conditions, trainees were given a random list of objectives or topics that they should learn throughout the training session. This list contained the same topics given to individuals receiving behavioral\cognitive guidance; however, the information was not sequenced as it was for those trainees in the behavioral\cognitive guidance conditions.

Measures

Control variables. Previous studies conducted using the TEAMS/TANDEM simulation have shown cognitive ability to be a significant predictor of performance (Kozlowski et al., 1995, 1996). As a result, all participants were administered the Wonderlic Personnel Test at the beginning of the experiment. The Wonderlic Personnel Test is a well-known and widely used index of cognitive ability. The user's manual for the Wonderlic (1992) offers predictive validities as high as .63, with reliability estimates from .73 to .95, depending on the type of reliability estimated.

Veridical feedback on the task was provided immediately following the completion of each training trial. Although the specific nature of the feedback was based on each trainee's performance, all trainees received the same type of information. The feedback provided information relevant to the full range of training objectives. One piece of information given in the feedback was a score. Task score was computed by adding 100 points to the trainee's score every time a target was identified and prosecuted correctly, and subtracting 100 points from the trainee's score every time a target was misidentified or prosecuted incorrectly. In addition, 10 points were deducted from the trainee's score for each target that crossed a defensive perimeter. In addition to score, the feedback provided information concerning the trainee's performance on both basic and strategic TAG skills, such as making correct cue decisions and "hooking" marker targets. An example of the feedback is presented in Appendix I.

The no guidance condition acted as the control condition in this experiment. Individuals in this condition received the same feedback as other trainees, but did not receive any of the guidance information. They did, however, receive the random list of

TAG topics. The control condition served as a learner control condition. As discussed earlier, individuals can be given control over several different aspects of the learning process, including pace, sequence, and content. In the present study, all individuals were given control over what they wanted to study and practice (content) and the order in which they wanted to study and practice the material (sequence). Trainees were also given some control over the pace of their learning, such as being able to exit the computerized manual early if they chose; however, for practical reasons it was necessary to impose maximum time limits on the study and practice sessions. All trainees had access to the same training materials (e.g., training manual) and all had the same control over the sequence, content, and pace of the learning process. However, because the experimental conditions contained one or both forms of advisement or guidance, only the control condition was a "pure" learner control situation.

Basic and strategic task knowledge. Basic task knowledge was assessed following the completion of the first and third practice blocks (after trial 3 and trial 9). Thirteen multiple-choice items focusing on the extent to which declarative knowledge about the task had been acquired were utilized, focusing on cue values and basic operating features of the task. This measure is presented in Appendix E. Strategic task knowledge was also assessed following the completion of the first and third training blocks. Fourteen multiple-choice items focusing on the extent to which strategic knowledge about the task had been acquired were utilized. This measure focused on aspects of the game such as locating the outer defensive perimeter and prioritizing targets. The measure of strategic task knowledge is presented in Appendix E.

To ensure that the basic and strategic knowledge scales were measuring different components of knowledge, I performed a confirmatory factor analysis (CFA) to assess the factor structure of the two scales. Because the knowledge items were binary in nature, I created continuously scaled indicators by summing two or three knowledge variables. This resulted in six or seven indicators for each of the two knowledge scales. At each time period, I then assessed the fit of the data to the path model in which each component of knowledge was linked to its respective indicators. This path model is presented in Figure 3. The path model was tested using AMOS. The fit indices at Time 1 were as follows: $\chi^2(64, \underline{N} = 277) = 69.40$, $\underline{p} = .30$; GFI = .96; AGFI = .95; CFI = .98; and RMSEA = .02. The fit indices at Time 2 were as follows: $\chi^2(64, \underline{N} = 277) = 94.25$, $\underline{p} < .01$; GFI = .95; AGFI = .93; CFI = .94; and RMSEA = .04. The results at both time periods indicated an excellent fit of data to the hypothesized model, confirming the a priori factor structures of the two scales.

Self-efficacy. Following the first and third training blocks, self-efficacy was assessed using an 8-item self-report measure developed for use in this research paradigm (see Kozlowski, Gully, Smith, Brown, Mullins, & Williams, 1996). This measure assesses self-efficacy with a Likert-type scale rather than with ratings of confidence about particular aspects of the task (Hysong & Quinones, 1997; Lee & Bobko, 1994). The construct of self-efficacy is operationalized as a "task-focused, self-perception with item content specifically focused on the capability to cope and to develop methods to effectively deal with the information, decisions, and challenges of the simulation" (Kozlowski et al., 1996, p. 18). This is consistent with conceptualizations of efficacy as central to self-regulatory processes (Gist & Mitchell, 1992). Response options for this scale range from "strongly disagree" (1) to "strongly agree" (5). Coefficient alpha for this scale was .91 at Time 1 and .94 at Time 2. The self-efficacy measure is presented in Appendix E.

Self-satisfaction. Following the first and third trial blocks, trainees completed a 5-item measure of self-satisfaction. This scale is similar to one used by Podsakoff & Fahr (1989), but was modified to measure satisfaction rather than dissatisfaction. Likert-type response options have also been reduced from 13 to 5, ranging from "strongly disagree" (1) to "strongly agree" (5). Coefficient alpha for this scale was .89 at Time 1 and .86 at Time 2. The self-satisfaction scale is presented in Appendix E.

On-task cognition. Following the first and third trial blocks, trainees completed an 8-item measure designed to assess their on-task cognition. This measure was adapted from Kanfer and colleagues (1994) and is designed to measure the frequency of on and off-task thoughts. Response options are on a five-point Likert-type scale ranging from "never" (1) to constantly (5). Higher scores on this measure indicate more on-task cognition and greater persistence on the task. Coefficient alpha for the on-task cognition scale was .75 at Time 1 and .81 at Time 2. The on-task cognition measure is presented in Appendix E.

Attributions. Following the first and third trial blocks, trainees completed a six item questionnaire designed to measure the causes to which they attribute their performance. One item was dropped from the scale to increase its internal consistency, resulting in a final scale of five items. The attribution items were restricted to internal versus external locus of control. Response options are on a five-point Likert-type scale ranging from "strongly disagree" (1) to "strongly agree" (5). Coefficient alpha for this scale was .57 at Time 1 and .67 at Time 2. This measure is presented in Appendix E.

Practice Sequence. The sequence of trainees' practice was measured by having trainees complete a self-report measure after each trial block which asked them to record the three main concepts or skills they practiced during the preceding three trials. The self-report measures were scored by determining how many of the relevant TAG skills the trainee practiced during the relevant trial block.[2] A trainee could receive a score ranging from zero to three on each questionnaire depending on how many of the appropriate TAG skills (presented in Figure 2) the trainee indicated practicing during each training block. This measure is presented in Appendix J.

Study sequence. The data collected by the computerized TAG manual provided information concerning what each participant studied, and when during the training they studied the material. For each training block, the amount of time a trainee spent studying the relevant pages of the manual was calculated and used to determine the degree to which the trainee was following the appropriate sequence of study (presented in Figure 2).

Study time. The amount of time each participant spent studying the TAG material during the study sessions was measured using the computerized TAG manual. Trainees had a maximum of two minutes before each practice trial during which they could review the computerized manual. The total amount of time spent studying the manual during each training block was calculated and used as a measure of study time. Although trainees were instructed to exit the manual if they finished studying early, some trainees would instead leave the table of contents page on the screen and wait for the manual to exit automatically after two minutes. As a result, time spent on the table of contents page was not included in the total time spent studying. Only time spent studying pages of the manual that contained TAG content was included in total time spent studying.

Time spent on feedback. The FASTBACK feedback program measured the amount of time trainees spent on feedback. As trainee's scrolled through the feedback, FASTBACK recorded the amount of time (in seconds) that the trainee spent on each screen. The time spent on each screen of feedback was summed within each training block to determine the total time spent on feedback.

Basic and strategic performance. Within the task itself, data were collected that allowed assessments to be made of trainees' basic performance and also the extent to which strategies were being utilized in the domains of situational assessment and target prioritization. Indicators of a trainee's basic performance were the number of points a trainee gained for correct decisions and the number of points the trainee lost for incorrect decisions. These were the two main components of a trainee's score. Score during the training trials was calculated by adding 100 points for each target correctly identified and prosecuted, and subtracting 100 points for each target misidentified or prosecuted incorrectly. Ten points were also subtracted for each target that crossed a defensive perimeter over the course of the training. In terms of strategic performance, the number of times participants zoomed out and the number of marker targets hooked served as indicators of situational assessment. Target prioritization was assessed by the number of high priority targets (those targets that are both moving fast and near a perimeter) prosecuted. Time one indicators are based on performance in the third training trial, and time two indicators are based on performance in the final or ninth training trial.

To examine whether separate basic and strategic composite variables could be created by combining the relevant performance indicators, I conducted an exploratory factor analysis. This factor analysis was conducted on the indicators as measured after the final training trial to allow time for the factor structure to stabilize. Principal components analysis using varimax rotation was utilized. Following the Kaiser normalization criterion guideline of selecting components with eigenvalues greater than one, two components were rotated. The eigenvalues for the first and second component were 2.10 and 1.39, respectively. The first component accounted for 42.00% of the variance and the second component accounted for 27.73% of the variance. Thus, the two components collectively explained nearly 70% of the variance. The first component consisted of the strategic performance indicators and the second component consisted of the basic performance indicators. Loadings of the variables on their respective components were all greater than ±.70, and cross-loadings were all less than ±.20. Based on these results, it was deemed appropriate to create basic and strategic performance composite variables. To do so, the performance measures were standardized within training block and then summed using unit weights. The basic performance composite was created by combining points correct and points incorrect. The strategic performance composite was created by combining the total number of times the trainee zoomed out, the number of marker targets hooked, and the number of high priority targets prosecuted. All indicators were given a positive weight except for points incorrect which was given a negative weight similar to how it is used to calculate the overall score value.

RESULTS

The means, standard deviations, and intercorrelations among all variables included in the analyses described below are provided in Table 1. Below I first present the results of a RM-MANCOVA that was used to test the overall and direct effects of the two manipulations. I then provide the results of regression analyses used to test the hypotheses outlined earlier and discuss the results of additional analyses that were performed to test the model in more detail. The results of the regression analyses are organized by the different subsets of variables outlined in Figure 1. Appendix K presents a summary of the tests of the hypotheses.

RM-MANCOVA.

A repeated measures MANCOVA was performed to examine the overall and direct effects that the behavioral\cognitive guidance and affective guidance had on the entire set of dependent measures over time, excluding the generalization outcomes. Cognitive ability, as measured by the Wonderlic Personnel test, was treated as a covariate in these and all subsequent analyses. Using Wilk's Lambda, the MANCOVA demonstrated a significant overall effect for cognitive ability, $F(12, 261) = 9.25$, $p < .001$, $\eta^2 = .30$. These results suggest that the use of cognitive ability as a covariate is appropriate. The MANCOVA also demonstrated a significant overall effect for affective guidance, $F(12, 261) = 2.33$, $p < .01$, $\eta^2 = .10$, and behavioral\cognitive guidance, $F(12, 261) = 18.98$, $p < .001$, $\eta^2 = .47$. In addition, behavioral\cognitive guidance was found to have a significant effect over time, $F(2, 261) = 8.93$, $p < .001$, $\eta^2 = .29$. Significant overall effects suggest that regression analyses exploring each of the proposed hypotheses are appropriate. The repeated measures MANCOVA described here will also be used to test the direct effects of the manipulations on the different sets of dependent variables. The results of the overall RM-MANCOVA are presented in Table 2. The between-subjects tests from the RM-MANCOVA for affective guidance are presented in Table 3, and the between-subjects tests from the RM-MANCOVA for behavioral and cognitive guidance are presented in Table 4.

Relevance of Effort Variables

The relevance of trainees' effort was measured by the sequence of their practice and study. The direct effect of the behavioral and cognitive guidance on the relevance of effort variables was analyzed using the between-subject effects from the repeated measures MANCOVA described above (see Tables 3 and 4). The results for specific hypotheses are described below.

Hypothesis 1. The first hypothesis suggested that trainees receiving behavioral and cognitive guidance would display a more appropriate practice sequence. In other words, trainees receiving behavioral and cognitive guidance would be more likely to practice the TAG skills and strategies in the appropriate order. It was found that behavioral and cognitive guidance had a significant overall effect on trainees' practice sequence, $F(1, 272) = 131.35$, $p < .001$, $\eta^2 = .33$. An analysis of the means revealed that trainees receiving behavioral and cognitive guidance practiced significantly more of the TAG skills in the appropriate sequence. Thus, hypothesis 1 was supported. The effect of the behavioral\cognitive guidance on practice sequence is presented in Figure 4.

Hypothesis 2. The second hypothesis predicted that trainees receiving behavioral and cognitive guidance would display a more appropriate study sequence. In other words, trainees receiving behavioral and cognitive guidance would be more likely to study the TAG skills and strategies in the appropriate order. The repeated measures MANCOVA revealed that the behavioral and cognitive guidance had a significant overall effect on study sequence, $F(1, 272) = 79.87$, $p < .001$, $\eta^2 = .23$. Consistent with hypothesis 2, an examination of the means showed that trainees receiving behavioral and cognitive guidance spent significantly more time studying relevant TAG skills and strategies during the appropriate training blocks. The effect of the behavioral\cognitive guidance on study sequence is presented in Figure 5.

Additional analyses. Post-hoc analyses were performed to examine whether affective guidance had a direct effect on the relevance of effort variables. The repeated measures MANCOVA indicated that affective guidance had a significant overall effect on both practice sequence, $F(1, 272) = 3.23$, $p < .05$, $\eta^2 = .01$, and study sequence, $F(1, 272) = 10.57$, $p < .01$, $\eta^2 = .04$. An examination of the means revealed that individuals receiving affective guidance actually practiced significantly less of the TAG skills and strategies in the appropriate sequence, but they did study significantly more of the TAG skills and strategies in the appropriate sequence.

Summary. As expected, trainees who received behavioral\cognitive guidance displayed a more appropriate sequence of practice and study. They practiced and studied more of the relevant TAG skills and strategies during the appropriate training blocks. Post-hoc analyses revealed that affective guidance also had significant effects on practice and study sequence. Trainees who received affective guidance practiced significantly fewer of the TAG skills and strategies in the appropriate sequence; however, they studied significantly more of the TAG skills and strategies during the relevant training blocks.

Process Variables

The model presented in Figure 1 hypothesizes relationships between the guidance manipulations and several process variables. The process variables examined in the present study were self-satisfaction, self-efficacy, on-task cognition, and the locus of trainees' attributions. The hypothesized relationships between the manipulations and the process variables were tested using the between-subject effects from the repeated measures MANCOVA described earlier (see Tables 3 and 4). The results of the analyses for specific hypotheses are presented below.

Hypothesis 3a. This hypothesis predicted that behavioral and cognitive guidance would lead to lower levels of self-satisfaction by means of providing individuals with sometimes negative evaluations of their performance. The MANCOVA revealed that behavioral and cognitive guidance had a significant overall effect on self-satisfaction, $F(1, 272) = 8.79$, $p < .01$, $\eta^2 = .03$. Contrary to expectations, however, it was found that individuals receiving behavioral and cognitive guidance displayed higher levels of self-satisfaction. Thus, hypothesis 3a was not supported, although there was a significant relationship between behavioral and cognitive guidance and self-satisfaction. This relationship is presented in Figure 6.

Hypothesis 4. The fourth hypothesis suggested that individuals receiving behavioral and cognitive guidance would display higher levels of self-efficacy. The MANCOVA revealed instead that behavioral and cognitive guidance did not have a significant overall effect on self-efficacy. However, the MANCOVA did reveal a significant interaction between time and behavioral\cognitive guidance on self-efficacy, $F(1, 272) = 16.36$, $p < .001$, $\eta^2 = .06$. Follow-up univariate tests conducted at each time period revealed that behavioral and cognitive guidance led to significantly higher levels of self-efficacy at Time 1, $F(1, 274) = 4.34$, $p < .05$, $\eta^2 = .02$, but significantly lower levels of self-efficacy at Time 2, $F(1, 274) = 3.89$, $p = .050$, $\eta^2 = .01$. Although the effects at Time 1 were consistent with the hypothesized relationship between behavioral and cognitive guidance and self-efficacy, the overall effects of behavioral and cognitive guidance on self-efficacy did not support hypothesis 4. The effect of the behavioral\cognitive guidance on self-efficacy is presented in Figure 7.

Hypothesis 6. The sixth hypothesis predicted that affective guidance would lead to higher levels of self-efficacy. The repeated measures MANCOVA, however, revealed that affective guidance did not have a significant overall effect on self-efficacy. Thus, hypothesis 6 was not supported.

Hypothesis 7a. This hypothesis suggested that individuals receiving affective guidance would display greater on-task cognition than individuals not receiving affective guidance. Contrary to expectations, however, affective guidance did not have a significant effect on trainees' on-task cognition. Thus, hypothesis 7a was not supported.

Hypothesis 8a. It was predicted that trainees receiving affective guidance would display a more internal locus of attributions. In other words, trainees receiving affective guidance would attribute their performance to internal rather than external causes. However, the MANCOVA revealed that affective guidance did not have a significant effect on the locus of trainees' attributions. Thus, hypothesis 8a was not supported.

Hypotheses 9a & 9b. It was predicted that both higher levels of self-efficacy and a more internal locus of attributions would lead to greater on-task cognition. To test these hypotheses, a two-step hierarchical regression analysis using on-task cognition as the dependent measure was performed at each time period. Cognitive ability was entered in the first step and treated as a covariate. Self-efficacy and attributions were entered in the second step. At Time 1, it was found that the step containing self-efficacy and attributions explained a significant portion of the variance ($\Delta R^2 = .113$, $p < .001$) after controlling for ability. Both self-efficacy ($\beta = .284$, $p < .001$) and attributions ($\beta = .130$, $p < .05$) had significant and positive effects on on-task cognition. The results for Time 1 are presented in Table 5. The results at Time 2 were similar. Once again, the step containing self-efficacy and attributions explained a significant portion of the variance ($\Delta R^2 = .199$, $p < .001$) after controlling for ability. Both self-efficacy ($\beta = .209$, $p < .01$) and attributions ($\beta = .318$, $p < .001$) had significant and positive effects on on-task cognition. The results for Time 2 are presented in Table 6. Thus, hypotheses 9a and 9b were supported at both Time 1 and Time 2.

Additional analyses. Post-hoc analyses were performed to examine whether behavioral and cognitive guidance influenced on-task cognition and the locus of trainees' attributions and whether affective guidance influenced trainees' self-satisfaction. The MANCOVA revealed that behavioral and cognitive guidance did not have a significant overall effect on on-task cognition or attributions and that affective guidance did not have a significant overall effect on self-satisfaction. However, the MANCOVA did reveal a significant interaction between time and behavioral\cognitive guidance on attributions, $F(1, 272) = 9.88$, $p < .01$, $\eta^2 = .04$. Follow-up univariate tests conducted within each time period revealed that behavioral and cognitive guidance led to a significantly more internal locus of attributions at Time 1, $F(1, 276) = 7.61$, $p < .01$, $\eta^2 = .03$, but did not significantly effect the locus of trainees' attributions at Time 2.

Summary. Contrary to expectations, it was found that behavioral\cognitive guidance led to significantly higher levels of self-satisfaction. Individuals who received behavioral\cognitive guidance also displayed significantly higher levels of self-efficacy at the beginning of training, but significantly lower levels of self-efficacy at the end of training. Affective guidance, however, did not have a significant effect on self-efficacy, on-task cognition, or the locus of trainees' attributions. As expected, individuals with higher levels of self-efficacy and more internal attributions displayed significantly higher levels of on-task cognition. Post-hoc analyses revealed that behavioral\cognitive guidance did not have a significant effect on on-task cognition and affective guidance did not have a significant effect on self-satisfaction; however, behavioral\cognitive guidance did lead to significantly more internal attributions among trainees early in training.

Effort Variables

The amount of effort put forth by participants during training was measured by the total amount of time spent studying and the total amount of time spent on feedback. These effort variables were measured both at Time 1 and Time 2. However, it was expected that the greatest differences on these variables would be observed at Time 2 when some trainees are withdrawing or have already withdrawn from the task. Thus, the effects of the process variables on the effort variables were tested at Time 2 using two-step hierarchical regression analyses. Cognitive ability was entered in the first step and treated as a covariate and the process variables were entered in the second step. Two separate hierarchical regression analyses were performed. In one analysis, the dependent measure was total study time. The results of this analysis are presented in Table 7. In the second analysis, the dependent measure was total time spent on feedback. The results of this analysis are presented in Table 8. The results of the regression analyses for specific hypotheses are presented below.

Hypothesis 3b. This hypothesis suggested that individuals who were more dissatisfied with their performance would display greater effort on the task. Specifically, individuals with lower levels of self-satisfaction would spend more time studying and reviewing feedback. Contrary to expectations, however, self-satisfaction did not significantly effect total study time or time spent reviewing feedback. Thus, hypothesis 3b was not supported.

Hypothesis 5. The fifth hypothesis predicted that higher levels of self-efficacy would lead to more time spent studying and reviewing feedback. The regression analyses revealed, however, that self-efficacy did not significantly effect total study time or time spent reviewing feedback. Thus, hypothesis 5 was not supported.

Hypothesis 7b. This hypothesis predicted that individuals who had higher levels of on-task cognition would display greater effort. Specifically, individuals who displayed more on-task cognition would spend more time studying and reviewing feedback. It was found that on-task cognition had significant and positive effects on both total study time ($\beta = .199$, $p < .01$) and time spent on feedback ($\beta = .198$, $p < .01$) after controlling for ability. Thus, hypothesis 7b was supported. The effect of on-task cognition on total time spent studying is presented in Figure 8.

Hypothesis 8b. It was predicted that individuals with a more internal locus of attributions would spend more time studying and reviewing feedback. However, the regression analyses revealed that attributions did not significantly effect time spent studying or reviewing feedback. Thus, hypothesis 8b was not supported.

Additional Analyses. The between-subject effects from the repeated measures MANCOVA conducted earlier were examined to determine whether the manipulations had direct effects on either total time spent studying or time spent reviewing feedback. The MANCOVA revealed that affective guidance had a significant overall effect on total time spent studying, $F(1, 272) = 14.97$, $p < .001$, $\eta^2 = .05$, but did not have a significant overall effect on time spent reviewing feedback. An examination of the means revealed that individuals who received affective guidance spent significantly more time studying. The effect of the affective guidance on total study time is presented in Figure 9. The MANCOVA also revealed that behavioral and cognitive guidance had a marginally significant effect on total time spent studying, $F(1, 272) = 3.40$, $p = .066$, $\eta^2 = .01$, and a significant effect on time spent reviewing feedback, $F(1, 272) = 8.77$, $p < .01$, $\eta^2 = .03$. An analysis of the means revealed that individuals who received behavioral and cognitive guidance spent significantly more time studying but significantly less time reviewing feedback.

Summary. Contrary to expectations, it was found that neither self-satisfaction, self-efficacy, nor locus of attributions had a significant effect on trainee effort. As predicted, however, higher levels of on-task cognition led to significantly higher levels of effort among trainees. Although affective guidance did not have a significant effect on time spent reviewing feedback, trainees who received affective guidance did spend significantly more time studying the computerized training manual. Finally, individuals who received behavioral\cognitive guidance spent significantly more time studying than other trainees, but also spent significantly less time reviewing their feedback.

Outcome Variables – Practice

The sequence of trainees' study and practice and the amount of time trainees spent studying and reviewing their feedback were hypothesized to influence a number of outcome variables. The outcome variables measured in the present study were basic knowledge, strategic knowledge, basic performance, and strategic performance. All of these outcome variables were measured at both Time 1 and Time 2. However, the basic outcome measures were analyzed at Time 1 because the guidance directs trainees to focus on practicing and studying basic TAG components early in training. In contrast, the strategic outcomes were analyzed at Time 2 because the guidance directs trainees to focus on practicing and studying strategic TAG components later in training. Once again, two-step hierarchical regression analyses were used to test specific hypotheses. Ability was entered in the first step and treated as a covariate and the relevance of effort and effort variables were entered in the second step. Four separate hierarchical regression analyses were performed on the outcome variables. The first analysis was conducted with basic knowledge at Time 1 as the dependent variable. The results of this analysis are presented in Table 9. The second analysis was conducted with strategic knowledge at Time 2 as the dependent variable. The results of this analysis are presented in Table 10. The third analysis was conducted with basic performance at Time 1 as the dependent variable. The results of this analysis are presented in Table 11. The final analysis was conducted with strategic performance at Time 2 as the dependent variable.

The results of this analysis are presented in Table 12. The results for specific hypotheses are presented below.

Hypothesis 10a. This hypothesis predicted that individuals who displayed a more appropriate practice and study sequence and who spent more time studying and reviewing feedback would exhibit higher levels of basic knowledge. The results of the hierarchical regression analysis indicated that only practice sequence had a significant effect on basic knowledge ($\beta = .109$, $p = .05$) after controlling for ability. As expected, individuals with a more appropriate practice sequence exhibited higher levels of basic knowledge. Thus, hypothesis 10a was partially supported. The effect of practice sequence on trainees' basic knowledge is shown is Figure 10.

Hypothesis 10b. This hypothesis suggested that individuals who displayed a more appropriate practice and study sequence and who spent more time studying and reviewing feedback would exhibit higher levels of strategic knowledge. The regression analysis revealed that both practice ($\beta = .264$, $p < .001$) and study sequence ($\beta = .259$, $p < .001$) had significant effects on strategic knowledge after controlling for ability; however, neither total study time nor time spent on feedback had a significant effect on strategic knowledge. Thus, hypothesis 10b was partially supported. The effect of practice sequence on trainees strategic knowledge is presented in Figure 11.

Hypothesis 10c. This hypothesis predicted that individuals with a more appropriate practice and study sequence and who spent more time studying and reviewing feedback would display higher levels of basic performance. Contrary to expectations, however, none of the relevance of effort or effort variables significantly affected basic performance. Thus, hypothesis 10c was not supported.

Hypothesis 10d. This hypothesis suggested that individuals who displayed a more appropriate practice and study sequence and who spent more time studying and reviewing feedback would exhibit higher levels of strategic performance. The regression analysis revealed that practice sequence ($\beta = .268$, $p < .001$), study sequence ($\beta = .186$, $p < .01$), and total study time ($\beta = -.213$, $p < .001$) had significant effects on strategic performance after controlling for ability. As expected, individuals with a more appropriate practice and study sequence had significantly higher levels of strategic performance. Contrary to expectations, however, more time spent studying resulted in significantly lower levels of strategic performance. Thus, hypothesis 10d was partially supported. The effect of practice sequence on strategic knowledge is presented in Figure 12.

Additional Analyses. The repeated measures MANCOVA was used to examine the direct effects of the manipulations on the outcome variables. The MANCOVA revealed that affective guidance did not have a direct overall effect on any of the outcome variables. However, behavioral and cognitive guidance had an overall effect on strategic knowledge, $F(1, 272) = 9.90$, $p < .01$, $\eta^2 = .04$, and strategic performance, $F(1, 272) = 15.76$, $p < .001$, $\eta^2 = .06$. Individuals who received behavioral and cognitive guidance displayed significantly higher levels of both strategic knowledge and performance. Although behavioral and cognitive guidance did not have an overall significant effect on basic knowledge and performance, there was a significant interaction between time and behavioral and cognitive guidance on basic knowledge, $F(1, 272) = 5.60$, $p < .05$, $\eta^2 = .02$, and basic performance, $F(1, 272) = 21.20$, $p < .001$, $\eta^2 = .10$. As would be expected, follow-up univariate tests conducted within each time period revealed that behavioral and cognitive guidance had a significant effect on both basic performance, $F(1, 276) = 13.12$,

$p < .001$, $\eta^2 = .05$, and basic knowledge, $F(1, 276) = 7.93$, $p < .01$, $\eta^2 = .03$, at Time 1 but not Time 2. Individuals who received behavioral and cognitive guidance displayed higher levels of both basic knowledge and basic performance at Time 1.

Another series of post-hoc analyses were performed to examine whether the process variables had direct effects on the outcome variables. Once again, two-step hierarchical regression analyses were performed. In the first step, ability was entered and treated as a covariate. In the second step, the process variables were entered. As before, four separate hierarchical regression analyses were performed. In the first analysis, basic knowledge at Time 1 was the dependent variable. The results of this analysis are presented in Table 13. In the second analysis, strategic knowledge at Time 2 was the dependent variable. The results of this analysis are presented in Table 14. In the third analysis, basic performance at Time 1 served as the dependent variable. The results of this analysis are presented in Table 15. In the final analysis, strategic performance at Time 2 was the dependent variable. The results of this analysis are presented in Table 16. A summary of the findings from these analyses is provided below.

The first hierarchical regression analysis demonstrated that both self-efficacy ($\beta = .159$, $p < .05$) and attributions ($\beta = .156$, $p < .010$) had significant and positive effects on basic knowledge after controlling for ability. The second hierarchical regression revealed that self-efficacy ($\beta = -.191$, $p < .05$) and on-task cognition ($\beta = .166$, $p < .05$) had significant effects on strategic knowledge after controlling for ability. While higher levels of self-efficacy resulted in significantly lower levels of strategic knowledge, higher levels of on-task cognition resulted in significantly more strategic knowledge. The third hierarchical regression analysis indicated that self-satisfaction ($\beta = .354$, $p < .001$) and internal locus of attributions ($\beta = .212$, $p < .001$) had significant and positive effects on basic performance after controlling for ability. The final hierarchical regression demonstrated that self-satisfaction ($\beta = .142$, $p < .05$) and on-task cognition ($\beta = .171$, $p < .01$) both had significant and positive effects on strategic performance after controlling for ability.

Summary. Analyses revealed that individuals with a more appropriate study sequence had significantly higher levels of strategic knowledge and performed significantly better than other trainees on the strategic aspects of the task. Individuals with a more appropriate practice sequence had significantly higher levels of basic and strategic knowledge and also performed significantly better than other trainees on the strategic aspects of the task. In addition, individuals who spent more time studying performed significantly better on the strategic portions of the task. Post-hoc analyses revealed that while affective guidance did not have a significant effect on any of the outcome variables, behavioral\cognitive guidance led to significantly higher overall levels of strategic knowledge and performance and also led to higher levels of basic knowledge and performance early in training. Additional post-hoc analyses revealed that higher levels of self-efficacy led to significantly higher levels of basic and strategic knowledge. A more internal locus of attributions led to significantly higher levels of basic knowledge, while more on-task cognition led to significantly higher levels of strategic knowledge and performance. Finally, higher levels of self-satisfaction led to significantly better basic and strategic performance.

Outcome Variables – Generalization

Basic and strategic performance were also measured in the more difficult and complex generalization trial. The model presented in Figure 1 hypothesizes relationships between the outcome variables measured during training and the outcome variables measured during generalization. To test these relationships, the outcome variables measured during the generalization trial were regressed onto the outcome variables measured at Time 2 during training. A hierarchical regression was performed in which cognitive ability was entered in the first step and the training outcome variables at Time 2 were entered in the second step. Two separate hierarchical regression analyses were performed. In the first analysis, basic performance during generalization served as the dependent variable. The results of this analysis are presented in Table 17. In the second analysis, strategic performance during generalization was the dependent variable. The results of this analysis are presented in Table 18.

Hypothesis 11. This hypothesis predicted that individuals who performed better during practice and who displayed higher levels of knowledge during practice would exhibit higher levels of basic and strategic performance during the generalization trial. The regression analyses revealed that basic knowledge during practice ($\beta = .193$, $p < .001$), basic performance during practice ($\beta = .552$, $p < .001$), and strategic performance during practice ($\beta = .153$, $p < .01$) each had a significant and positive effect on basic performance during generalization after controlling for ability. The relationship between basic performance during practice and basic performance during generalization is shown in Figure 13. Strategic knowledge at the end of training did not predict basic performance during transfer. However, strategic knowledge during training ($\beta = .200$, p

< .001) and strategic performance during training (β = .648, p < .001) each had a significant and positive effect on strategic performance during generalization after controlling for ability. Thus, hypothesis 11 was supported. The effect of strategic performance during practice on strategic performance during generalization is shown in Figure 14.

Additional analyses. A MANCOVA was performed to examine the direct effects of the manipulations on the outcome variables during generalization. Cognitive ability served as a covariate and basic and strategic performance during generalization served as the dependent variables. The MANCOVA revealed that affective guidance did not have a significant overall effect on the combined dependent variables. Behavioral and cognitive guidance, on the other hand, did have a significant overall effect on the generalization variables, $F(1, 271) = 16.35$, $p < .001$, $\eta^2 = .11$. The overall results are presented in Table 19. Follow-up between subjects analyses revealed that behavioral and cognitive guidance did not have a significant effect on basic performance during generalization, but it did have a significant effect on strategic performance during generalization, $F(1, 271) = 29.86$, $p < .001$, $\eta^2 = .10$. An examination of the means revealed that individuals who received behavioral and cognitive guidance displayed significantly higher levels of strategic performance in the more difficult and complex generalization trial. The between-subject effects for behavioral and cognitive guidance on the generalization variables are presented in Table 20.

Summary. As expected, individuals with higher levels of basic knowledge, basic performance, and strategic performance during practice displayed significantly higher levels of basic performance during generalization. In addition, higher levels of strategic knowledge and strategic performance led to significantly higher levels of strategic performance on the generalization trial. Post-hoc analyses revealed that while affective guidance did not have an effect on performance during the generalization trial, behavioral\cognitive guidance led to significantly higher levels of strategic performance.

Overall Model Fit

After testing the individual hypotheses, I performed an overall test of the hypothesized model using structural equation modeling. The model was tested using AMOS, and the path diagram that was analyzed is presented in Figure 15. The fit indices for the hypothesized model were as follows: $\chi^2(88, N = 277) = 550.78, p < .001$; GFI = .79; AGFI = .64; CFI = .67; and RMSEA = .138. Values of around .90 or higher for the GFI, AGFI, and CFI indicate good fit. Values between 0 and .05 for the RMSEA indicate very good fit, and values between .05 and .10 indicate good fit. Thus, the observed fit statistics indicate that the hypothesized model did not fit the data very well.

Because the hypothesized model did not provide a good fit to the data, a post-hoc or revised model was constructed and tested using AMOS. Although guided somewhat by earlier analyses, this post-hoc model was conceptual in nature. The path diagram used to test the revised model is presented in Figure 16. Both the hypothesized and revised model contained mostly the same variables; however, an attempt was made to create a more parsimonious model. As a result, total time spent on feedback and self-satisfaction were not included in the revised model. Total time spent on feedback was eliminated due to restricted variance. Trainees only spent an average of 1 minute 41 seconds reviewing the feedback during the third training block, which limited the degree of variability among trainees. Self-satisfaction was eliminated because it was highly correlated with both self-efficacy (r = .481) and attributions (r = .347). In addition to eliminating these two variables, several other changes were made to the hypothesized model.

As can be seen in Figure 16, the revised model included a link between attributions and self-efficacy. It was hypothesized that more internal attributions would lead to higher levels of self-efficacy. In addition, it was predicted that self-efficacy and attributions early in training would be significantly and positively related to level of on-task cognition at the end of training. This relationship was examined across time because it was hypothesized that the behavioral\cognitive guidance would have its effects on self-efficacy and attributions early in training, but that differences in on-task cognition would be observed later in training as individuals begin to withdraw from the task. On-task cognition, in turn, was hypothesized to directly affect all four of the outcome variables: basic knowledge, basic performance, strategic knowledge, and strategic performance. Greater focus on the task should result in improved performance. Relationships were also hypothesized between total study time and study sequence and study sequence and practice sequence. I predicted that the more time an individual spent studying the more likely they were to study the relevant training material. Also, there should be a positive and significant relationship between study and practice sequence because trainees will practice the skills and strategies they learn while studying. The remainder of the revised model is very similar to the original, hypothesized model. In the original model, it was hypothesized that each of the relevance of effort and effort variables would have an effect on all of the outcome variables. In the revised model, however, specific relationships were specified in an attempt to create a more parsimonious fit. Thus, it was predicted that total time spent studying would have significant and positive effects only on basic and strategic knowledge. The effect of total study time on performance would exist through these knowledge variables. Study sequence at the end of training should have significant and positive effects only on strategic knowledge because this is the material that the guidance is directing trainees to study. Thus, those individuals following the proper study sequence should display higher levels of strategic but not basic knowledge. For similar reasons, practice sequence at the end of training should only have positive effects on strategic knowledge and strategic performance. It was also hypothesized that basic performance during generalization would be affected only by basic performance and knowledge during practice. Likewise, strategic performance during generalization should only be affected by strategic performance and knowledge during practice.

The revised model resulted in a much better fit to the data. . The fit indices for the hypothesized model were as follows: $\chi^2(73, \underline{N} = 277) = 228.08$, $\underline{p} < .001$; GFI = .90; AGFI = .84; CFI = .88; and RMSEA = .088. The revised model resulted in a moderately good fit to the data and a much better and more parsimonious fit than the original, hypothesized model.

DISCUSSION

Computers have been used to train individuals since computer-managed and computer-assisted instruction first emerged in the early 1970's. These initial computer-based training programs were designed to accomplish two main goals: (1) reduce total training time and the amount of student-instructor interaction; and (2) provide individualized instruction by giving people control over different aspects of the learning process, such as sequence, content, and pace. The idea was that individuals could learn more and more quickly if given control over the learning process, and could do so with little or no student-instructor interaction. Although much more complex, many of today's computer-based training techniques, such as web-based training and distance learning, incorporate these same principles (Brown, 1999).

A considerable amount of research over the last three decades has focused on the advantages and disadvantages of different aspects of computer-based training, including the effects of learner control. One of the most consistent findings associated with learner control has been that individuals do not make good use of the control they are given (Williams, 1993). Typically, when given control over their learning, most individuals will either exit instruction before they have mastered the task (Tennyson, Tennyson, & Rothen, 1980; Ross & Rakow, 1981) or practice well beyond the point at which concepts have been acquired (Tennyson 1980, 1981). Despite this drawback, learner control has been shown to offer several benefits, such as reduced student-instructor time with little or no performance decrement. Thus, a major challenge is to find a way to eliminate the negative aspects of learner control while maintaining its positive contributions. One proposed means of achieving this goal is to supplement learner control with some form of advisement or guidance that helps to direct trainees' learning.

Although there hasn't been much research conducted on advisement, it appears that advising individuals on their learning needs and providing them with information for making learning decisions is an effective instructional approach (Tennyson, 1980; Tennyson & Buttrey, 1980, Santiago & Okey, 1992). The present study was designed to build on the past research on advisement in several ways. Most of the research on both learner control and advisement has focused on only one main dependent variable, post-test performance (i.e., declarative knowledge). In addition, past research has failed to examine the use of guidance for influencing individuals' affect. In the present study, however, I examined the effect of two forms of guidance, behavioral\cognitive and affective, on several different behavioral, cognitive, and affective variables, and investigated how different levels of these variables subsequently influenced performance. Another limitation of past research on learner control and advisement is that it has been conducted using simple learning tasks. In the present study, guidance was applied to a complex and difficult training simulation.

<u>Behavioral\Cognitive Guidance</u>

One problem with giving individuals control over their learning is that they often spend too little time studying and practicing important training content (Tennyson, Tennyson, & Rothen, 1980; Ross & Rakow, 1981). For example, individuals may spend too much time on material that is easy to learn and too little time on that material which is difficult to grasp. Even if individuals do spend enough time studying and practicing relevant training material, they may fail to do so in the appropriate sequence. Learning is typically a gradual process in which the acquisition of difficult and complex skills and knowledge depends on the degree to which one has previously learned more fundamental or basic skills and knowledge. Thus, poor sequencing of learning can inhibit the acquisition of critical skills and knowledge. This is especially true when learning complex tasks, like the one used in the present study.

In the present study, one of the major goals of the behavioral\cognitive guidance was to direct individuals' learning so that they not only studied and practiced relevant training material, but also did so in the appropriate sequence. As trainees mastered basic knowledge and skills, the guidance adapted to their level of acquisition and instructed them to focus attention and effort on increasingly advanced knowledge and skills. The behavioral\cognitive guidance was not aimed at getting trainees to practice and study more, but rather to practice and study better. It appears from the results that the manipulation was extremely successful in this regard. Individuals who received behavioral\cognitive guidance practiced almost twice as many of the relevant training topics as those trainees who did not receive the guidance (see Figure 4). In addition, they spent over 25% more time studying the relevant training topics than other trainees (see Figure 5). These findings not only illustrate the effectiveness of the guidance for directing trainees' study and practice but also support past research that has shown that individuals do not make good use of the control they are given over the sequence and content of their study and practice.

While the behavioral\cognitive guidance was primarily aimed at influencing the sequence of trainees' study and practice, it was also expected to have an effect on several affective variables. One such variable was self-satisfaction. Past research has found that individuals need to be able to compare their past performance to some standard of performance if they are going to develop feelings of self-satisfaction or self-dissatisfaction (Bandura & Cervone, 1983). In the present study, the behavioral\cognitive guidance provided trainees with specific information about how their performance on particular skills or strategies compared to a desired level of performance. Because it would be difficult for trainees to reach the desired level of performance, it was hypothesized that the behavioral\cognitive guidance would lead to higher levels of self-dissatisfaction. Contrary to expectations, however, it was found that the behavioral\cognitive guidance actually resulted in significantly higher overall levels of self-satisfaction. As can be seen in Figure 6, the greatest difference in self-satisfaction between trainees who received behavioral\cognitive guidance and those who did not is found early in training. Most likely, trainees who received behavioral\cognitive guidance displayed higher levels of self-satisfaction because they learned the basic skills more quickly and experienced more rapid progress in their performance early in training.

Behavioral\cognitive guidance was also expected to influence trainees' self-efficacy. Whether perceived discrepancies between personal standards and attainments are motivating or discouraging depends in part on the degree to which people believe they can achieve the standards they are pursuing (Bandura & Cervone, 1983, 1986a). In the present study, individuals who received behavioral\cognitive guidance were told that they would be guided through training. In addition, they were given information about their performance deficiencies and told exactly what they could do to meet the set performance standards. Thus, it was hypothesized that the behavioral\cognitive guidance would increase self-efficacy. In the beginning of training, individuals who received behavioral\cognitive guidance did display significantly higher levels of self-efficacy. This is extremely important considering that early in training is when trainees received the most negative feedback and were thus most likely to develop feelings of low self-efficacy. In contrast, however, behavioral\cognitive guidance actually led to significantly lower levels of self-efficacy at the end of training. As can be seen in Figure 7, trainees who received behavioral\cognitive guidance experienced a very small increase in self-efficacy from early in training to the end of training. Trainees who did not receive behavioral\cognitive guidance, on the other hand, displayed a much more dramatic increase in self-efficacy across time. This difference is most likely caused by the fact that trainees who did not receive behavioral\cognitive guidance were focusing mostly on the basic aspects of the task and thus had unrealistically high perceptions of their progress and overall performance. Trainees who received behavioral\cognitive guidance, on the other hand, were focusing not only on the basic aspects but also the more difficult, strategic aspects of the task and thus had a more realistic perception of their progress and overall performance. Just as low self-efficacy can lead trainees to withdraw from a task, high levels of self-efficacy can result in overconfidence and the same outcome. Thus, the moderately high level of self-efficacy maintained by trainees who received behavioral\cognitive guidance is probably more realistic for effective performance in the long run.

The behavioral\cognitive guidance was expected to have an affect on trainee performance and knowledge through the variables discussed above. However, the results for these relationships, which will be discussed in more detail below, were mixed. One possible explanation is that the behavioral\cognitive guidance had an effect on individual performance and knowledge that was not explained by the mediating variables. Thus, we chose to perform post-hoc analyses to examine the direct effect of the behavioral\cognitive guidance on trainees' performance and knowledge during practice. These analyses showed that the behavioral\cognitive guidance had significant overall effects on both strategic knowledge and performance. As expected, the behavioral\cognitive guidance led to significantly higher levels of both strategic knowledge and performance. The behavioral\cognitive guidance also had an effect on the basic outcome indicators; however, as expected, these effects were only found early in training. Trainees who received behavioral\cognitive guidance displayed higher levels of basic performance and knowledge early in training. By the end of training, however, most trainees had acquired the basic skills and knowledge and there was no difference between groups on these basic outcome variables.

In summary, the behavioral\cognitive guidance had a large impact on a number of behavioral, cognitive, and affective variables. The major goal of the behavioral\cognitive guidance was not to get trainees to practice and study more, but to get them to practice and study better. The behavioral\cognitive guidance was able to achieve this goal by getting trainees to follow the appropriate sequence of study and practice, and, as we will discuss below, the sequence of trainees' study and practice had substantial effects on how they performed on the task. Although not the major focus of the behavioral\cognitive guidance, the manipulation did have an effect on two affective variables, self-satisfaction and self-efficacy, that were later shown to effect trainees' level of on-task cognition. Finally, the guidance had significant and positive direct effects on basic and strategic knowledge and performance variables.

Affective Guidance

One of the primary challenges of training design for complex tasks is that trainees often perform poorly during the initial stages of skill acquisition. Performance that fails to meet the trainees' – often unrealistic – expectations undermines self-evaluations, and can lead to significant reductions in motivation to learn (Bandura, 1991; Kanfer & Ackerman, 1989). As a result, a second form of guidance, affective, was created in an attempt to help trainees exercise emotional control and to bolster self-evaluations in the face of early task difficulties. The affective guidance was not an instructional intervention per se, but rather a support that was intended to work in concert with the behavioral\cognitive guidance.

The affective guidance was hypothesized to influence a number of process variables, such as self-efficacy and on-task cognition, that would in turn influence the amount of effort trainees put forth on the task. Contrary to expectations, however, the affective guidance did not have a significant effect on any of the process variables. Instead, post-hoc analyses revealed that the affective guidance had a significant direct effect on the amount of effort trainees put forth on the task. As we would expect, individuals who received affective guidance spent significantly more time than other trainees studying the on-line training manual. It appears, therefore, that although the affective guidance did not influence the process variables as we expected, it led to the desired outcome – more on-task effort.

Additional post-hoc analyses also revealed that trainees who received affective guidance were more likely than other trainees to follow the desired study sequence. This was most likely a by-product of their increased time spent studying. Trainees who studied more were probably just more likely to study the appropriate material. This conclusion is supported by the fact that trainees who received affective guidance were actually less likely than other trainees to follow the appropriate sequence of practice. Regardless, the affective guidance was successful in influencing two variables that had significant and positive impacts on trainees' performance and degree of knowledge.

Process Variables

One goal of this study was to explain the process by which both behavioral\cognitive and affective guidance influenced different training outcomes, such as performance and knowledge. It was expected that a major determinate of these outcomes would be the degree of effort trainees put forth on the task. As discussed above, the behavioral\cognitive and affective guidance were expected to influence a number of process variables that would, in turn, influence the amount of effort trainees put forth on the task. Unfortunately, however, the process variables did not have much of an impact on trainee effort. On-task cognition was the only process variable that had a significant effect on the amount of effort trainees put forth on the task. As expected, trainees with higher levels of on-task cognition spent significantly more time studying the on-line training manual. Although on-task cognition was the only process variable to have a direct effect on trainee effort, both self-efficacy and attributions were significantly related to on-task cognition. As hypothesized, higher levels of self-efficacy and more internal attributions led to significantly higher levels of on-task cognition. It appears, therefore, that self-efficacy and attributions both affected trainee effort by keeping trainees focused on the task.

Relevance of Effort, Level of Effort, and Outcome Variables

In the present study, the variables expected to influence trainee performance and knowledge were divided into two categories. One category was the relevance of trainees' effort, which included the sequence of trainees' study and practice. As mentioned earlier, these variables measured the extent to which the guidance was able to get trainees to work better or smarter. The second category was the level of trainee effort, and included the amount of time trainees spent studying and the amount of time they spent reviewing feedback. These variables measured the extent to which the guidance was able to get trainees to work more.

As expected, the relevance of trainees' effort had a large impact on a number of training outcome variables. Trainees who followed a more appropriate sequence of study displayed significantly higher levels of strategic knowledge and performance. Similarly, trainees who followed a more appropriate practice sequence displayed significantly higher levels of both basic and strategic knowledge and higher levels of strategic performance. In terms of trainee effort, it was found that individuals who studied more performed significantly better on the strategic aspects of the task. It is important to note that both the relevance and amount of trainee effort affected mostly the strategic, or more difficult and complex, training outcomes. This may explain why past research on learner control and advisement, which has used mostly simple tasks, has failed to find consistent effects. Most trainees are able to acquire the basic skills and knowledge; however, the more complex skills are not as easy to learn. Thus, the guidance had its largest impact by way of directing individuals' learning of these more difficult and complex aspects of the task.

Generalization Performance

In the present study, trainee performance was measured not only during practice but also in a final generalization trial. The generalization trial was designed to assess the degree to which trainees were able to adapt their basic and strategic skills and knowledge to a more difficult and challenging environment.

As expected, trainees' performance and level of knowledge during practice were the best predictors of their performance during the generalization trial. Both basic knowledge and basic performance during practice had significant and positive effects on basic performance during generalization. In addition, higher levels of strategic performance during practice led to significantly higher levels of basic performance during generalization. As hypothesized, strategic knowledge and strategic performance during practice had positive and significant effects on strategic performance during generalization.

While the best predictor of trainees' performance during generalization was their performance during practice, it is important to note that behavioral\cognitive guidance also had a significant and positive effect on trainees' level of strategic performance during generalization. This finding has two important implications. First, it once again shows that the guidance had its largest impact on how trainees performed on the more difficult and complex aspects of the task. Second, it suggests that trainees who received behavioral\cognitive guidance were not only better able to learn the strategic elements of the task, as illustrated by the practice results, but they were also better able to adapt those skills to the more difficult and challenging generalization task.

Overall Model Fit

After testing the individual hypotheses, an overall test of the hypothesized model was performed using structural equation modeling. As described earlier, the hypothesized model did not provide a good fit to the data. As a result, we modified the hypothesized model on both a conceptual and empirical basis in an attempt to better explain the process by which the behavioral\cognitive and affective guidance had their effects.

In many ways, the revised model was quite similar to the original, hypothesized model. Major changes, however, were made in the area of the process variables. Whereas the process variables were originally hypothesized to have an impact on trainee effort, tests of the original model led us to believe that on-task cognition might itself be a measure of trainee effort. Trainee effort was originally measured by the amount of time trainees spent studying and reviewing their feedback. However, we felt that the degree to which trainees displayed on-task thoughts, or metacognition, might also serve as a measure of their level of effort, and therefore may directly affect training outcomes, such as knowledge and performance. Fisher & Ford (1998) found, for example, that on-task cognition and time on task were only minimally related; however, both measures of trainee effort significantly predicted trainee performance. It was also expected that the other process variables, such as self-efficacy and attributions, may influence trainee performance and knowledge by means of on-task cognition. This relationship was partially specified in the original model. These revised relationships are displayed in Figure 16.

In addition to the changes made in the area of the process variables, several conceptual links were added to the model. For example, links were inserted between basic knowledge and basic performance and strategic knowledge and strategic performance. These links are also shown in Figure 16. The final change to the original model was made by eliminating several of the links between the effort, relevance of effort, and practice outcome variables. The original model did not specify specific relationships between these variables, and as a result each outcome variable was linked to each effort and relevance of effort variable. In an attempt to create a more parsimonious model, specific relationships were specified. For example, total study time was expected to only influence the knowledge variables. In addition, since the guidance late in training directed individuals to study and practice the strategic aspects of the task, study and practice sequence measured at the end of training were expected to only effect strategic knowledge and performance.

The revised model produced a much better fit to the data. The fit statistics indicated that the revised model fit the data moderately well and provided a more parsimonious explanation of the data than the original model. As mentioned above, the revised model was quite similar to the original, hypothesized model. Sections of the original model fit the data quite well. However, major changes were needed in the area of the process variables in order to better explain the effects of the behavioral\cognitive and affective guidance. As we expected, on-task cognition had significant and positive effects on all of the basic and strategic outcome variables. This supports the use of this measure as an indication of the amount of effort trainees put forth on the task.

Limitations

The results of the present study clearly demonstrate that the behavioral\cognitive guidance was a much more effective training intervention than the affective guidance. There are a few possible reasons for this finding. First, while the behavioral\cognitive guidance was adaptive to trainees' performance, it was not feasible to individualize the affective guidance. Although pilot tests were performed to determine the most likely pattern of trainee emotions across the course of training, there was almost certainly a great deal of variability in how trainees reacted to their performance. As a result, the affective guidance may have been helpful for some trainees, but ineffective or possibly detrimental for other trainees. Another factor that most likely limited the effect of the affective guidance was the rather short duration of the present experiment. The main goal of the affective guidance was to maintain trainees' effort and to keep them from withdrawing from the task. It is possible, however, that the present study was not long enough to induce factors, such as fatigue, that increase the likelihood of trainee withdrawal. The affective guidance would probably prove much more effective in training paradigms in which individuals are trained over the course of days or weeks.

One goal of the present study was to explain the process by which behavioral\cognitive and affective guidance influence a number of different training outcomes, such as knowledge and performance. I was only able, however, to partially capture this process. One reason why I may have been unable to fully explain this process is its complexity. I examined the effect of the behavioral\cognitive and affective guidance on a number of different variables; however, there were surely variables that were not measured in the present study but nonetheless influenced the process. I am currently collecting additional data from individuals who participated in the experiment to examine one such variable, goal orientation. Fisher & Ford (1998) found that goal orientation had a significant effect on both the amount and type of trainee effort, two major constructs examined in the present study. Similarly, I am interested in whether guidance and goal orientation may interact to influence the amount and nature of trainee effort.

Although the behavioral\cognitive guidance had rather large and widespread effects in the present study, it is important to note that it was a limited form of advisement. It was not feasible to design the guidance to adapt to very small differences in trainees' performance. Instead, the behavioral\cognitive guidance was designed to adapt to three major levels of performance. More detailed and specific forms of behavioral\cognitive guidance would probably demonstrate even larger effects on training outcomes.

A final limitation that should be noted is the generalizability of the results of the present study. The use of a student sample and a synthetic task may somewhat limit the degree to which the results of the present study can be generalized to other instructional paradigms. Although many of the findings will probably generalize to other situations, caution should be used in this process. That said, however, it is important to note that this is one of the first studies to examine the effects of advisement in a complex training situation. Thus, the results of the present study are probably our best current indication of how guidance can be used to direct the training of individuals on complex and difficult tasks.

Research and Practical Implications

Computers give us the ability to provide trainees with not only a great deal of control over their learning but also a great deal of individualized and adaptive performance information. The results of the present study suggest that combining these two benefits of computer-based training in an appropriate fashion may help to overcome some of the disadvantages associated with learner control. The present study supported past research by showing that individuals who did not receive advisement failed to make good use of the control they were given. Trainees who were guided through the learning process, however, displayed a more effective use of the control they were given over the sequence and content of their learning.

One of the major contributions of the present study is that it illustrates the effects of guidance in a complex training situation. This appears to be especially critical considering that the guidance had its most consistent effects on the more complex and strategic outcomes. This finding may help to explain why previous learner control and advisement research, which has used, almost exclusively, simple tasks, has produced mixed and inconsistent findings. It is not surprising that the guidance had its largest effects on those aspects of the task which were difficult and complex, for these are the areas in which the qualitative aspects of learning, such as sequence, are most critical. Future research should expand on the present research by examining the effects of guidance on training individuals on other complex and difficult tasks. In addition, more advanced forms of guidance should be designed and tested in complex experimental situations.

Another contribution of the present research was the partial explanation of the process by which guidance influences different training outcomes. While, the effects of the guidance on trainees' study and practice sequence and the effects of these variables on the training outcomes were clear, the process by which the guidance affected trainees' effort was only partially explained. Future research should examine this process in more detail. Variables that appeared promising in the present study, such as on-task cognition, should be examined further, and additional variables not measured in the present study, such as goal orientation, should be included and tested.

Conclusion

The present study was designed to examine the effects of two forms of guidance, behavioral\cognitive and affective, in a complex training environment. It was found that the behavioral\cognitive guidance had pervasive and substantial impacts on self-regulation process indicators and on the sequence of trainees' study and practice. Behavioral\cognitive guidance yielded significant improvements in the acquisition of basic knowledge and performance capabilities early in training, significant improvements in the acquisition of strategic knowledge and strategic performance skills later in training, and significant improvements in the capability to retain and adapt skills in a more difficult and complex generalization situation. Despite the fact that the affective guidance did not influence the self-regulation process indicators as expected, it did have a significant and positive effect on the amount of trainee effort. Although the process by which the two forms of guidance operated was only partially explained, the results of the present study suggest that both behavioral\cognitive and affective guidance have high potential as effective training strategies. Future research should expand on these findings in an effort to capitalize on the benefits and eliminate the drawbacks of computer-based training.

FOOTNOTES

[1] A total of 15 participants were dropped from the sample for various reasons. Three participants were dropped due to extremely low scores on a motivation scale administered at the end of the experiment. The motivation scale included three items measured on a five point Likert scale ranging from strongly disagree (1) to strongly agree (5). A sample item was, "I put forth effort to answer questions accurately and honestly." The three individuals described above were dropped from the sample for a mean score below 2.0 on this scale. The 12 remaining participants were dropped for reasons such as missing or incomplete data, not following experimenter instructions, and not attending to the experimental manipulations.

[2] The self-report practice measures were scored by both the author and an assistant. The author provided the assistant with a written scoring guide, explained the scoring system, and trained the assistant on a random sample of 50 questionnaires. The author and assistant then independently scored each questionnaire. Inter-rater reliability was .96 for the session one practice questionnaire, .99 for the session two practice questionnaire, and .96 for the session three practice questionnaire. Any disagreements in ratings were resolved through discussion.

APPENDIX A

Date:_______ Subject #:________

Informed Consent
Tactical Action Game (TAG)

The study in which you are about to participate investigates your learning and performance on the Tactical Action Game (TAG). TAG is a computer-simulated, radar tracking task that you will be trained to use, and then you will practice. Using the computer-mouse, you will assess the attributes of contacts that appear on your screen and decided what action should be taken for each contact. You will also be asked to answer questions which will help us understand your task performance and learning.

Your participation in this study requires three and one-half (3.5) hours of your time. Your participation is completely voluntary and you are free to discontinue the study at any time for any reason without penalty. No risks or discomforts are anticipated as a result of this study.

You will be given a subject number at the beginning of the experiment. The purpose of this subject number is to keep track of the various materials you will complete throughout the study. Your name will not be associated with your responses and will be kept confidential.

Awards available for this study are explained in detail in a separate handout. Winners will be determined at the conclusion of the study. If you win, you will be contacted at the address and phone number you indicate below within 3 weeks of the study's conclusion. Instructions for claiming the award will be provided when you are contacted.

At the end of your involvement in this study, you will be provided with feedback explaining the purpose of the research in more detail. You may ask about the results of the study when it is complete by contacting the investigator. The investigator's name and phone number is on the debriefing form you will receive at the conclusion of your involvement. If you have any question about your participation in this study, ask the investigator before you indicate your consent to voluntarily participate by signing below.

Consent: I have been fully informed of the above-described study and its possible risks. I give permission for my participation in this study. I know that the investigator will be available to answer any questions I may have. I understand that I am free to withdraw this consent and discontinue my participation in this study at any time without penalty.

Print Name___________________________ Signature________________________

Address______________________________ Phone__________________________

APPENDIX B

Debriefing Form
Tactical Action Game (TAG)

The study in which you just participated was designed to examine the effects of guidance and training on learning and decision-making processes. During this study, you operated the TAG radar simulation. TAG simulates the complex physical performance, information processing, and decision-making demands of performing fast-paced, critical tasks. To perform the TAG simulation, you needed to learn how to operate the task and develop strategies for effective task performance. TAG required you to gather information about the objects on the screen, make decisions, and take actions based on the information you gathered. We will use the information gathered during the study to link your performance on the task to your knowledge of the task.

If you have any questions about this study or would like to receive a copy of the results when they are complete, please notify the investigator now. If, in the future, you have any questions about the study or would like to receive the results when they are complete, please call the investigator listed below. Finally, thank you for participating in this study. If you have any other questions or comments please do not hesitate from contacting the experimenter.

<u>Investigator:</u> Brad Bell 353-9166

APPENDIX C

TAG TOPICS SHEET

Listed below are a number of topics that you may want to focus on during your training. However, these are just suggested topics and you can focus on learning anything you choose.

- Exploring the game and getting familiar with your equipment.
- Making correct Type decisions.
- Making correct Class decisions.
- Making correct Intent decisions.
- Making correct Final Engagement Decisions.
- Zooming-out to see the big picture.
- Recognizing "pop-up" targets.
- Defending your inner and outer defensive perimeters.
- Making "trade-offs" between targets approaching your inner and outer defensive perimeters.
- Prioritization strategies.

APPENDIX D

TAG TOPICS SHEET

Listed below are a number of topics that you may want to focus on during your training. However, these are just suggested topics and you can focus on learning anything you choose.

- Exploring the game and getting familiar with your equipment.
- Recognizing "pop-up" targets.
- Making "trade-offs" between targets approaching your inner and outer defensive perimeters.
- Making correct Intent decisions.
- Zooming-out to see the big picture.
- Making correct Type decisions.
- Prioritization strategies.
- Making correct Final Engagement Decisions.
- Defending your inner and outer defensive perimeters.
- Making correct Class decisions.

APPENDIX E

Measures

INSTRUCTIONS FOR ANSWERING QUESTIONS ON THE SCANTRON

Please write your last name in the area marked YOUR LAST NAME. Please write in your first name and middle initials in the areas marked YOUR FIRST NAME and MI. Do NOT bubble the letters since we will not be using your name for data, and your responses will be kept anonymous.

Please Do fill in your PID and bubble the corresponding numbers. After filling in your name and PID, please answer the following questions by filling in the appropriate bubble, beginning with question number 1.

After filling in your name and subject number, please answer the following questions by filling in the appropriate bubble, beginning with question number 1.

1. What is your sex?

   (1) Male (2) Female

2. What is your age?

   (1) < 18 yrs (2) 18- 19 yrs (3) 20 - 21 yrs (4) 22-23 yrs (5) > 23 yrs

3. What is your overall grade point average?

   (1) 0 - 1.0 (2) 1.1 - 2.0 (3) 2.1 - 3.0 (4) 3.1 - 4.0 (5) > 4.0

4. Have you ever been to this particular lab before?

   (1) Yes (2) No

5. Are left or right handed?

   (1) Left (2) Right

6. Do you play with video games?

   (1) Never (2) Rarely (3) Sometimes (4) Frequently (5) Always

Self-Efficacy Scale

This set of questions asks you to describe how you feel about your capabilities for playing TAG. Please use the scale shown below to make your ratings.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
(1)	(2)	(3)	(4)	(5)

<-------|-----------------|-----------------|-----------------|-----------------|-------->

7. I can meet the challenges of this simulation.

8. I am confident in my understanding of how information cues are related to decisions.

9. I can deal with decisions under ambiguous conditions.

10. I am certain that I can manage the requirements of this task.

11. I believe that I will fare well in this task if the workload is increased.

12. I am confident that I can cope with this simulation if it becomes more complex.

13. I believe I can develop methods to handle changing aspects of this task.

14. I am certain I can cope with task components competing for my time.

Self-Satisfaction Scale

This set of questions asks you to describe how you feel about your performance on the last TAG practice period. Please use the scale shown below to make your ratings.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
(1)	(2)	(3)	(4)	(5)

15. I am satisfied with my overall performance on this task.

16. I am pleased with how I am doing.

17. My current performance satisfies me.

18. I am happy with my performance at this point.

19. I would be happier if I were performing better than I am now.

On-Task Cognition

This set of questions asks you to describe your thoughts during the last TAG practice period. Please use the scale shown below to make your ratings.

Never	Rarely	Sometimes	Frequently	Constantly
(1)	(2)	(3)	(4)	(5)

20. I paid close attention to the kind of errors I was making.

21. I focused my attention on learning a specific rule.

22. I thought about new strategies for improving my performance.

23. I thought ahead to what I would do next to improve my performance.

24. I took "mental breaks" during the task.

25. I daydreamed while doing the task.

26. I lost interest in the task for short periods.

27. I thought about other things that I have to do.

Attribution Scale

This set of questions asks you to describe how you feel about your performance on the last TAG practice period. Please use the scale shown below to make your ratings.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
(1)	(2)	(3)	(4)	(5)

<--------|------------------|------------------|------------------|------------------|-------->

28. The cause of my performance involved something I did.

29. The cause of my performance was not related to what I did.

30. My performance was mostly caused by the amount of effort I put into the task.

31. My performance was mostly caused by how good I was at the task.

32. My performance was mostly caused by luck.

33. My performance was mostly caused by how difficult the task was.

Basic Knowledge Test

The following is a knowledge test about TAG. Please use the Scantron sheet to answer the following questions. Bubble in the correct letter for each question, making sure the question numbers match.
Check to make sure you are beginning on question number 7.

34. If a Response is Given, what is the likely Intent of the target?

    a. Military
    b. Hostile
    c. Civilian
    d. Peaceful

35. If a target's Speed is 25 knots, its Communication Time is 85 seconds, and its Altitude/Depth is 0 feet, what does this suggest about the target's Type?

    a. The target is a Surface Vessel
    b. The target is a Submarine
    c. The target is Civilian
    d. The target is Military

36. A submarine may have which of the following characteristics?

    a. Speed 30 knots, Altitude/Depth - 20, Communication time 85 seconds.
    b. Speed 30 knots, Altitude/Depth 0, Communication time 30 seconds.
    c. Speed 20 knots, Altitude/Depth 0, Communication time 80 seconds.
    d. Speed 20 knots, Altitude/Depth -20, Communication time 90 seconds.

37. A Maneuvering Pattern of Code Delta indicates the target is which of the following?

    a. Air
    b. Military
    c. Surface
    d. Civilian

38. A Blue Lagoon Direction of Origin indicates the target is which of the following?

    a. Unknown
    b. Sub
    c. Civilian
    d. Military

39. If a target's Altitude/Depth is 10 feet, what is the Type of the target?

   a. Air
   b. Surface
   c. Submarine
   d. Unknown

40. If a target's Intelligence is Unavailable, what Class does this suggest for the target?

   a. Air
   b. Civilian
   c. Military
   d. Unknown

41. If a target's characteristics are Communication Time = 20 seconds and Speed = 50 knots, which of the following actions should you take?

   a. Choose Intent is Peaceful
   b. Choose Type is Surface
   c. Get another piece of information
   d. Choose Type is Air

42. A Communication Time of 52 seconds indicates that the target is likely:

   a. Air
   b. Surface
   c. Submarine
   d. Unknown

43. If a target's characteristics are Intelligence in Private and Maneuvering Pattern is Code Foxtrot, which of the following actions should you take?

   a. Choose Class is Military
   b. Choose Intent is Peaceful
   c. Choose Class is Civilian
   d. Choose Intent is Unknown

44. If a target's Maneuvering Pattern is Code Echo, this suggests that the target falls into which category?

   a. Class in unknown.
   b. Class is Military
   c. Class is Hostile
   d. Class is Peaceful

45. If a target's characteristics are Response is Inaudible, Threat Level = 3, and Countermeasures are Jamming, which of the following actions should you take?

a. Choose Intent is Unknown
b. Choose Intent is Peaceful
c. Choose Intent is Hostile
d. Choose Intent is Military

46. If a target's Speed is 40 knots, what does this suggest about the target?

a. The target is Air.
b. The target is Surface.
c. The target is Civilian
d. The target is Military.

Strategic Knowledge Test

47. Your Outer Defensive Perimeter is located at:

    a. 64 nm
    b. 128 nm
    c. 256 nm
    d. 512 nm

48. If a target is outside the current radius of your console, you can view it by doing what?

    a. There is nothing you can do.
    b. Wait for the target to enter
    c. Zoom out
    d. Zoom in

49. If you've just noticed three targets near your inner perimeter, which of the following should you do next?

    a. Engage the target nearest the inner perimeter.
    b. Engage the fastest target near the inner perimeter.
    c. Zoom-Out to check the outer perimeter.
    d. Zoom-In to check how close targets are to the inner perimeter.

50. If three Targets are about 20 miles outside your inner defensive perimeter, which of the following should you do to prioritize the Targets?

    a. Engage the closest Target
    b. Engage the hostile Target
    c. Engage the fastest Target
    d. It makes no difference in what order you engage the Targets.

51. If you Zoom-Out to find three targets clustered around your Outer Perimeter, how would you determine which target is the marker target?

    a. Check to see which target is closest to the outer perimeter.
    b. Check the speeds of the targets
    c. Check to see which target is Civilian
    d. Check to see which target is Hostile

52. Which of the following targets would be the lowest priority?

a. A target which has a speed of 15 knots.
b. A target which has just crossed your inner defensive perimeter.
c. A target which is Peaceful.
d. A target which is Civilian.

53. What is the purpose of marker targets?

a. To determine which Targets are Hostile and which are Peaceful.
b. To locate your Inner Defensive Perimeter.
c. To quickly determine the speeds of targets near your perimeters.
d. To locate your Outer Defensive Perimeter.

54. Which of the following functions is most useful for identifying marker targets?

a. Zoom-in
b. Right-button feedback.
c. Engage Shoot or Clear
d. Zoom-out

55. If three Targets are about 10 miles outside your outer defensive perimeter, which of the following should you do to prioritize the Targets?

a. Engage the fastest Target
b. Engage the hostile Target
c. Engage the closest Target
d. It makes no difference in what order you engage the Targets.

56. On the average, approximately how many Targets pop-up during each practice trial?

a. 1
b. 3
c. 6
d. 9

57. Which of the following would be the most effective strategy for defending your outer defensive perimeter?

    a. Zoom-out to 128 nm, locate the Marker Targets, and check the speed of targets near the outer perimeter.
    b. Zoom-out to 256 nm, locate the Marker Targets, and check the speed of targets near the outer perimeter.
    c. Zoom-out to 128 nm, locate a Hostile Air Target, and check the speed of targets near that target.
    d. Zoom-out to 256 nm, locate a Hostile Air Target, and check the speed of targets near that target.

58. If all penalty intrusions are cost -100 points, which would be the most effective strategy?

    a. Do not allow any Targets to enter your Inner Defensive perimeter, even if it means allowing targets to cross your Outer Defensive perimeter.
    b. Do not allow any Targets to enter your Outer Defensive perimeter, even if it means allowing targets to cross your Inner Defensive perimeter.
    c. Defend both your Inner and Outer Defensive perimeters equally.
    d. None of these are effective strategies.

59. It is important to make trade-offs between targets:

    a. That are Hostile and those that are Peaceful.
    b. Approaching your Inner and Outer perimeters.
    c. That are Civilian and those that are Military.
    d. That have already crossed your Inner Defensive perimeter, and those that are approaching your Outer Defensive perimeter.

APPENDIX F

Incentive Instructions

TAG:
TACTICAL ACTION GAME

We will award a total of eight cash prizes to the best TAG players. Two categories of proficiency will be recognized, and four awards will be offered in each category:

Two 1st place prizes at $50 each
Two 2nd place prizes at $40 each
Two 3rd place prizes at $30 each
Two 4th place prizes at $20 each

Each set of four awards will be made for different types of game proficiency:

One pair of awards will be made for the players who understand the game the best during the three practice sessions. You will answer several questionnaires about the game during and after the practice sessions. You need to think carefully about your answers to the questions. The top players who answer these questions the best will be awarded 1st, 2nd, 3rd, and 4th place prizes.

The second pair of awards will be made for the players who do the best on the final TAG session that will take place at the end of the experiment. The top players who do the best will be awarded 1st, 2nd, 3rd, and 4th place prizes. I will let you know when the final session is about to begin.

The Prizes are independent of each other. That means its possible to be awarded prizes in both categories of proficiency. Your changes of getting an award are pretty good – it's all up to you.

APPENDIX G

Example of Behavioral and Cognitive Guidance

Practice Trial Seven

High Priority Targets:

Minimum Performance – In the last practice trial, you only engaged # high priority targets. This means that you haven't learned how to prioritize targets. You should study the material in your TAG manual on prioritization strategies and practice engaging high priority targets in the next practice trial.

Medium Performance – In the last practice trial, you engaged # high priority targets. This is good but you are still missing some of the high priority targets. You should study the material in your TAG manual on prioritization strategies and practice engaging high priority targets in the next practice trial.

Maximum Performance – In the last practice trial, you engaged # high priority targets. Nice work. This shows that you have learned how to prioritize targets. You should concentrate now on other areas in which you need to improve, but make sure you continue to apply your prioritization strategies.

Making Trade-Offs Between Targets Approaching the Inner and Outer Perimeters:

Minimum Performance – In the last practice trial, you didn't check the speed of any of the targets near your inner defensive perimeter. This means that you have not learned how to make trade-offs between targets approaching your inner and outer defensive perimeters. You should study the material in your TAG manual on making trade-offs between targets and you should practice this skill in the next practice session.

Medium Performance – In the last practice trial, you checked the speed of # targets near your inner defensive perimeter, which is good. But, to effectively make trade-offs between targets approaching your inner and outer defensive perimeters, you should study the material in your TAG manual on making trade-offs and practice this skill in the next practice section.

Maximum Performance – In the last practice trial, you checked the speed of # targets near your inner defensive perimeter. Hopefully you are using this information to make trade-offs between targets approaching your inner and outer defensive perimeters. You should concentrate now on other areas in which you need to improve your performance, but make sure you continue to make trade-offs between targets.

Making Trade-Offs Between Targets Approaching the Inner and Outer Perimeters

Minimum Performance – In the last practice trial, you didn't check the speed of any of the targets near you outer defensive perimeter. This means that you have not learned how to make trade-offs between targets approaching your inner and outer defensive perimeters. You should study the material in your TAG manual on making trade-offs between targets and you should practice this skill in the next practice session.

Medium Performance – In the last practice trial, you checked the speed of # targets near your outer defensive perimeter, which is good. But, to effectively make trade-offs between targets approaching your inner and outer defensive perimeters, you should study the material in your TAG manual on making trade-offs and practice this skill in the next practice trial.

Maximum Performance – In the last practice trial, you checked the speed of # targets near you outer defensive perimeter. Hopefully you are using this information to make trade-offs between targets approaching your inner and outer defensive perimeters. You should concentrate now on other areas in which you need to improve your performance, but make sure you continue to make trade-offs between targets.

APPENDIX H

Affective Guidance

Practice Trial One

The TAG simulation is difficult and complex. It takes time to become good at the TAG simulation and there is a lot to learn. Sometimes people become frustrated or discouraged if they are not performing as well as they would like. If you become frustrated while performing the task, sit back, breathe in and then out, and say to yourself, "I am calm." Do this whenever you feel yourself getting frustrated, it will help you relax.

Practice Trial Two

You are still in the beginning of your training and it takes time to learn all the necessary TAG skills and strategies. Sometimes people become worried if they are not performing as well as they would like. If you feel yourself getting worried, sit back, relax, and imagine yourself performing extremely well during the TAG simulation. This will help you to relax and will build your confidence.

Practice Trial Three

You just finished the first block of practice trials. Good work. You should look back on these practice trails and say to yourself, "I have learned a great deal in a short period of time. This task is difficult and I have made some mistakes, but it is alright to make mistakes because I am learning." Keep up the good work and remember that you can perform well if you want, it's all up to you.

Practice Trial Four

You are now in the second block of practice trials and should be beginning to see some improvement in your performance. Since the task is difficult and complex, you may have a tendency to get frustrated or anxious if you are not performing as well and you would like. If this happens, imagine yourself being more relaxed, less tense, but with a moderate level of anxiety and a great deal of motivation to do well on the task.

Practice Trial Five

Although the TAG skills are difficult and complex, you have every opportunity to master the simulation. You have come this far, and you are doing a great job. If you feel yourself becoming anxious or are worried about your performance, it may be helpful to sit back and concentrate on feeling confident and focused. Do whatever you need to do to relax your mind. You may want to close your eyes and breathe in and out or count backwards from 20. This will help you relax and prepare you for the next practice trial.

Practice Trial Six

You have just finished the second block of practice trials. Good work. Just think about how much you have learned in such a short period of time. There are three practice trials remaining in your training. You should prepare yourself for these trials. You may want to say to yourself, "I can do well at this task. If I am not performing as well as I would like, it is not terrible. I have learned a great deal and I am going to maintain a positive outlook.

Practice Trial Seven

Over the last seven practice trials you have been asked to learn a great deal and handle a lot of information. You may begin to feel mentally tired and fatigued. If this happens, take a deep breath, relax, and clear your mind. Then do whatever it takes to charge yourself up and return to the simulation. For example, you may imagine yourself performing the task in an actual battle situation. This will help you focus your attention on the task at hand.

Practice Trial Eight

You now have only one practice trial remaining. Since you have been training for a while now, it may be easy to let yourself get distracted from the task. If you feel yourself getting distracted or feel like giving up, say to yourself, "I have come this far. It makes no sense to give-up now. I am going to stay focused on the simulation and concentrate on becoming the best TAG player I can."

Practice Trial Nine

You are now finished with the practice trials. Great work. Soon you will be asked to show how much you have learned the final and more challenging TAG trial. If you feel tired or fatigued, it may be helpful for you to emotionally charge-up before the final trial. In essence, psych yourself up for maximum performance. In addition, if you get frustrated or anxious during the final trial, remember all the techniques you have learned to handle these emotions.

APPENDIX I

Example of Feedback

For this practice period:

Number of targets engaged: #

Number of targets engaged correctly: #

Number of targets engaged incorrectly: #

Your total score: ###

Targets that popped-up: 6

Number of pop-up targets you engaged: #

Percentage of pop-up targets you engaged: #%

Press any key to continue . . .

APPENDIX J

Practice and Study Sequence and Content Measure

In the blanks provided below, **please list the three main concepts, skills, or strategies you plan to PRACTICE during the upcoming three practice trials**. If you cannot think of three items or are unsure of what you are going to practice, you may leave one or more of the lines blank.

1. ____

2. ____

3. ____

APPENDIX K

Hypotheses and Results

Hypothesis	Independent Variable(s)	Dependent Variable(s)	Result
Hypothesis #1: Trainees receiving behavioral and cognitive guidance will be more likely to follow the appropriate sequence of practice.	Behavioral\cognitive Guidance	Practice Sequence	Supported
Hypothesis #2: Trainees receiving behavioral and cognitive guidance will be more likely to follow the suggested study sequence.	Behavioral\cognitive Guidance	Study Sequence	Supported
Hypothesis 3a: Behavioral and cognitive guidance will increase trainees' self-dissatisfaction.	Behavioral\cognitive Guidance	Self-dissatisfaction	Rejected
Hypothesis #3b: Higher levels of self-dissatisfaction will lead to higher levels of effort on the task.	Self-dissatisfaction	Effort (Time Spent Studying and Reviewing Feedback)	Rejected
Hypothesis #4: Trainees receiving behavioral and cognitive guidance will display higher levels of self-efficacy.	Behavioral\cognitive Guidance	Self-efficacy	Rejected

Hypothesis #5: Higher levels of self-efficacy will lead to more effort on the task.	Self-efficacy	Effort (Time Spent Studying and Reviewing Feedback)	Rejected
Hypothesis #6: Trainees receiving affective guidance should display higher levels of self-efficacy.	Affective Guidance	Self-efficacy	Rejected
Hypothesis #7a: Trainees who receive affective guidance will be less likely to withdraw from the task.	Affective Guidance	On-task Cognition	Rejected
Hypothesis #7b: Trainees who persist on the task will display more effort than those who withdraw.	On-task Cognition	Effort (Time Spent Studying and Reviewing Feedback)	Supported
Hypothesis #8a: Trainees receiving affective guidance will display a more internal locus of attributions.	Affective Guidance	Locus of Trainees' Attributions (Internal vs. External)	Rejected
Hypothesis #8b: Trainees with an internal locus of attributions will put forth more effort on the task.	Locus of Trainees' Attributions (Internal vs. External)	Effort (Time Spent Studying and Reviewing Feedback)	Rejected
Hypothesis #9a: Higher levels of self-efficacy will result in greater task persistence.	Self-efficacy	On-task Cognition	Supported
Hypothesis #9b: Trainees with an internal locus of attributions will be more likely to persist on the task.	Locus of Trainees' Attributions (Internal vs. External)	On-task Cognition	Supported

Hypothesis #10a: The effort trainees expend on the task and the relevance of their effort will influence their basic task knowledge.	Effort (Time Spent Studying and Reviewing Feedback) and Relevance of Effort (Study and Practice Sequence and Content)	Basic Task Knowledge	Partially Supported
Hypothesis #10b: The effort trainees expend on the task and the relevance of their effort will influence their strategic task knowledge	Effort (Time Spent Studying and Reviewing Feedback) and Relevance of Effort (Study and Practice Sequence and Content)	Strategic Task Knowledge	Partially Supported
Hypothesis #10c: The effort trainees expend on the task and the relevance of their effort will influence their basic task performance.	Effort (Time Spent Studying and Reviewing Feedback) and Relevance of Effort (Study and Practice Sequence and Content)	Basic Performance	Rejected
Hypothesis #10d: The effort trainees expend on the task and the relevance of their effort will influence their strategic task performance.	Effort (Time Spent Studying and Reviewing Feedback) and Relevance of Effort (Study and Practice Sequence and Content)	Strategic Performance	Partially Supported
Hypothesis #11: Performance on the Generalization Trial will be correlated with trainees' basic and strategic performance during practice and their basic and strategic knowledge.	Basic and Strategic Performance during Practice and Basic and Strategic Knowledge	Performance in the Generalization Trial	Supported

APPENDIX L

Table 1

Means, Standard Deviations, and Intercorrelations for Variables Included in Analyses

Variable	M	SD	1	2	3	4	5	6	7	8
1. Affective Guidance	--	--	--							
2. Beh/Cog Guidance	--	--	-.040	--						
3. Ability	24.73	4.62	.065	.002	--					
4. Practice Sequence(1)	2.02	1.03	-.105	.422**	.080	--				
5. Practice Sequence(2)	1.15	0.90	-.081	.515**	.057	.340**	--			
6. Study Sequence(1)	4:08	0:48	.099	.191**	-.024	.135*	.093	--		
7. Study Sequence(2)	1:22	1:01	.122*	.477**	-.051	.153*	.470**	.128*	--	
8. Self-satisfaction(1)	2.55	0.87	.026	.308**	.142*	.156**	.163**	.023	.189**	--
9. Self-satisfaction(2)	3.28	0.80	.064	-.042	.162**	-.013	-.038	.002	.011	.328**
10. Self-efficacy(1)	3.51	0.70	.048	.123*	.207**	.011	.097	-.036	.012	.481**

Note: (1) denotes that the variable was measured at the end of session one; (2) denotes the variable was measured at the end of session three. * Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at 0.01 level (2-tailed). Times are in minutes and seconds. Beh/Cog Guidance = Behavioral and Cognitive Guidance.

Table 1 (cont.)

Means, Standard Deviations, and Intercorrelations for Variables Included in Analyses

Variable	M	SD	1	2	3	4	5	6	7	8
11. Self-efficacy(2)	3.86	0.73	.019	-.116	.180**	-.041	-.050	.017	-.101	.156**
12. On-task Cog.(1)	4.00	0.55	.030	.045	.169**	.010	.094	.038	.009	.159**
13. On-task Cog.(2)	3.98	0.64	.001	-.005	.239**	.052	.130*	.037	.028	.036
14. Attributions(1)	3.64	0.54	.064	.158**	.296**	.089	.119*	.110	.078	.347**
15. Attributions(2)	3.83	0.57	.033	-.055	.265**	-.055	-.038	-.038	-.053	.221**
16. Tot. Study Time(1)	5:10	0:42	.098	.029	.119*	-.066	.035	.646**	.000	.043
17. Tot. Study Time(2)	4:26	1:21	.206*	.103	-.159**	-.087	.146	.150*	.355**	-.111
18. Tot. Feed. Time(1)	2:49	0:40	-.056	-.171**	.027	.014	.021	-.153*	.056	.001
19. Tot. Feed. Time(2)	1:41	0:35	.014	-.138*	.123*	-.015	-.022	-.049	.059	-.046
20. Basic Know.(1)	8.69	2.40	.040	.155*	.394**	.145*	.142*	.208**	.060	.250**

Note: On-task Cog. = On-task Cognition. Tot. Study Time = Total Time Spent Studying. Tot. Feed. Time = Total Time Spent on Feedback. Basic Know. = Basic Knowledge.

Table 1 (cont.)

Means, Standard Deviations, and Intercorrelations for Variables Included in Analyses

Variable	M	SD	1	2	3	4	5	6	7	8
21. Basic Know.(2)	10.84	2.11	.100	.016	.316**	.008	.099	.080	.015	.210**
22. Strategic Know.(1)	6.12	2.41	-.105	-.050	.271**	.024	.078	-.236**	-.111	.110
23. Strategic Know.(2)	9.07	2.59	-.016	.330**	.341**	.103	.394**	.026	.350**	.327**
24. Basic Perf.(1)	0.00	1.72	.025	.206**	.272**	.078	.117	.129*	.125*	.506**
25. Basic Perf.(2)	0.00	1.83	.127*	-.083	.339**	-.005	-.059	.077	-.024	.167**
26. Strategic Perf.(1)	0.00	1.89	-.018	-.017	.227*	.000	.058	-.195**	-.103	.083
27. Strategic Perf.(2)	0.00	2.31	-.068	.340**	.309**	.134*	.337**	-.064	.229**	.341**
28. Basic Perf.(G)	0.00	1.73	.123*	-.004	.390**	.040	.051	.029	.054	.218**
29. Strategic Perf.(G)	0.00	2.68	-.003	.303**	.281**	.073	.273	-.127*	.248	.297**

Note: (G) denotes variable measured during generalization session. Strategic Know. = Strategic Knowledge. Basic Perf. = Basic Performance. Strategic Perf. = Strategic Performance.

Table 1 (cont.)

Means, Standard Deviations, and Intercorrelations for Variables Included in Analyses

Variable	9	10	11	12	13	14	15	16	17	18
10. Self-efficacy(1)	.217**	--								
11. Self-efficacy(2)	.607**	.496**	--							
12. On-task Cog.(1)	.075	.342**	.245**	--						
13. On-task Cog.(2)	.278**	.237**	.395**	.572**	--					
14. Attributions(1)	.153*	.335**	.226**	.246**	.210**	--				
15. Attributions(2)	.417**	.304**	.520**	.260**	.457**	.363**	--			
16. Tot. Study Time(1)	.164**	.034	.134*	.084	.158**	.113	.109	--		
17. Tot. Study Time(2)	-.063	-.162**	-.082	.022	.093	-.050	-.061	.137*	--	
18. Tot. Feed. Time(1)	.079	-.029	.087	.103	.104	.004	.063	-.109	.085	--
19. Tot. Feed. Time(2)	.126*	-.006	.121*	.123*	.235**	.016	.152*	-.008	.147*	.591**
20. Basic Know.(1)	.105	.312**	.148*	.160**	.215**	.327**	.215**	.243**	-.133*	-.083

Table 1 (cont.)

Means, Standard Deviations, and Intercorrelations for Variables Included in Analyses

Variable	9	10	11	12	13	14	15	16	17	18
21. Basic Know.(2)	.266**	.328**	.288**	.171**	.359**	.171**	.446**	.196**	-.028	-.019
22. Strategic Know.(1)	.138*	.138*	.148*	.166**	.154*	.212**	.245**	.050	-.101	.107
23. Strategic Know.(2)	.141*	.295**	.054	.185**	.242**	.248**	.210**	.156**	.031	.051
24. Basic Perf.(1)	.229*	.395**	.195**	.232**	.128*	.424**	.278**	.143*	-.132*	.005
25. Basic Perf.(2)	.504**	.345**	.540**	.151*	.340**	.156**	.451**	.180**	-.136*	-.004
26. Strategic Perf.(1)	.162**	.075	.159**	.144*	.099	.051	.150*	.058	-.152*	.000
27. Strategic Perf.(2)	.211**	.304**	.159**	.256**	.266**	.199**	.220**	.087	-.135*	-.039
28. Basic Perf.(G)	.356**	.314**	.397**	.200**	.343**	.232**	.424**	.158**	-.096	.005
29. Strategic Perf.(G)	.136*	.273**	.127*	.227**	.248**	.159**	.229**	.047	-.107	-.031

Table 1 (cont.)

Means, Standard Deviations, and Intercorrelations for Variables Included in Analyses

Variable	19	20	21	22	23	24	25	26	27	28	29
19. Tot. Feed. Time(2)	--										
20. Basic Know.(1)	-.004	--									
21. Basic Know.(2)	.057	.465**	--								
22. Strategic Know.(1)	.092	.251*	.225**	--							
23. Strategic Know.(2)	.102	.309**	.312**	.361**	--						
24. Basic Perf.(1)	.015	.448**	.324**	.170**	.314**	--					
25. Basic Perf.(2)	.136*	.346**	.557**	.148*	.166**	.442**	--				
26. Strategic Perf.(1)	.033	.056	.141*	.242*	.160**	.010	.131*	--			
27. Strategic Perf.(2)	.099	.354**	.235**	.307**	.469**	.320**	.206**	.284**	--		
28. Basic Perf.(G)	.072	.376**	.566**	.234**	.251**	.442**	.723**	.209**	.339**	--	
29. Strategic Perf.(G)	.076	.327**	.251**	.273**	.515**	.324**	.197**	.291**	.751**	.357**	--

Table 2

RM-MANCOVA for Affective Guidance and Behavioral and Cognitive Guidance on Dependent Measures During Training

Effect	Df	F	η^2
Covariate			
Ability	12, 261	9.25**	.298
Independent Variables			
Affective Guidance (AG)	12, 261	2.33**	.097
Beh.\Cog. Guidance (BCG)	12, 261	18.98**	.466
Time	12, 261	15.81**	.421
Interactions			
AG X BCG	12, 261	0.51	.023
Time X AG	12, 261	1.45	.062
Time X BCG	12, 261	8.93**	.291
Time X AG X BCG	12, 261	1.29	.056

* $p < .05$. ** $p < .01$.

Table 3

Between-subjects Effects from RM-MANCOVA for Affective Guidance

Effect	Df	F	η^2
Practice Sequence	1, 272	3.90*	.014
Study Sequence	1, 272	10.57**	.037
Self-satisfaction	1, 272	0.70	.003
Self-efficacy	1, 272	0.17	.001
On-task Cognition	1, 272	0.00	.000
Attributions	1, 272	0.45	.002
Total Study Time	1, 272	14.97**	.052
Total Feedback Time	1, 272	0.41	.002
Basic Knowledge	1, 272	1.07	.004
Strategic Knowledge	1, 272	2.64	.010
Basic Performance	1, 272	1.54	.006
Strategic Performance	1, 272	1.58	.006

* $p < .05$. ** $p < .01$.

Table 4

Between-subjects Effects from RM-MANCOVA for Behavioral and Cognitive Guidance

Effect	df	F	η^2
Practice Sequence	1, 272	131.35**	.326
Study Sequence	1, 272	79.87**	.227
Self-satisfaction	1, 272	8.79**	.031
Self-efficacy	1, 272	0.00	.000
On-task Cognition	1, 272	0.12	.000
Attributions	1, 272	1.10	.004
Total Study Time	1, 272	3.40†	.012
Total Feedback Time	1, 272	8.77**	.031
Basic Knowledge	1, 272	3.79†	.014
Strategic Knowledge	1, 272	9.90**	.035
Basic Performance	1, 272	1.57	.006
Strategic Performance	1, 272	15.76**	.055

† $p < .10$. * $p < .05$. ** $p < .01$.

Table 5

Summary of Hierarchical Regression Analysis for Variables Predicting On-task Cognition at Time 1 (N = 276)

Variable	β	ΔR^2
Step 1		.028**
Cognitive Ability	.072	
Step 2		.113**
Self-efficacy(1)	.284**	
Attributions(1)	.130*	

Note: β is the standardized regression coefficient from the full regression equation with all predictor variables. Increments for variables entered at the ΔR^2 significance levels are based on F tests for that step. * $p < .05$. ** $p < .01$.

Table 6

Summary of Hierarchical Regression Analysis for Variables Predicting On-task Cognition at Time 2 (N = 276)

Variable	β	ΔR^2
Step 1		.057**
Cognitive Ability	.118*	
Step 2		.199**
Self-efficacy(2)	.209*	
Attributions(2)	.318**	

Note: β is the standardized regression coefficient from the full regression equation with all predictor variables. Increments for variables entered at the ΔR^2 significance levels are based on F tests for that step. * $p < .05$. ** $p < .01$.

Table 7

Summary of Hierarchical Regression Analysis for Variables Predicting Total Time Spent Studying (N = 276)

Variable	β	ΔR^2
Step 1		.025**
Cognitive Ability	-.174**	
Step 2		.033†
Self-satisfaction(2)	-.010	
Self-efficacy(2)	-.096	
On-task Cognition(2)	.199**	
Attributions(2)	-.052	

Note: β is the standardized regression coefficient from the full regression equation with all predictor variables. Increments for variables entered at the ΔR^2 significance levels are based on F tests for that step. * $p < .05$. ** $p < .01$. † $p < .10$.

Table 8

Summary of Hierarchical Regression Analysis for Variables Predicting Time Spent Reviewing Feedback (N = 276)

Variable	β	ΔR^2
Step 1		.015*
Cognitive Ability	.062	
Step 2		.049**
Self-satisfaction(2)	.061	
Self-efficacy(2)	-.022	
On-task Cognition(2)	.198**	
Attributions(2)	.032	

Note: β is the standardized regression coefficient from the full regression equation with all predictor variables. Increments for variables entered at the ΔR^2 significance levels are based on F tests for that step. * $p < .05$. ** $p < .01$.

Table 9

Summary of Hierarchical Regression Analysis for Variables Predicting Basic Knowledge at Time 1 (N = 276)

Variable	β	ΔR^2
Step 1		.155**
Cognitive Ability	.374**	
Step 2		.067**
Practice Sequence(1)	.109*	
Study Sequence(1)	.111	
Total Study Time(1)	-.127	
Total Feedback Time(1)	-.064	

Note: β is the standardized regression coefficient from the full regression equation with all predictor variables. Increments for variables entered at the ΔR^2 significance levels are based on F tests for that step. * $p = .05$. ** $p < .01$.

Table 10

Summary of Hierarchical Regression Analysis for Variables Predicting Strategic Knowledge at Time 2 (N = 276)

Variable	β	ΔR^2
Step 1		.116**
Cognitive Ability	.323**	
Step 2		.193**
Practice Sequence(2)	.264**	
Study Sequence(2)	.259**	
Total Study Time(2)	-.057	
Total Feedback Time(2)	.061	

Note: β is the standardized regression coefficient from the full regression equation with all predictor variables. Increments for variables entered at the ΔR^2 significance levels are based on F tests for that step. *p < .05. ** p < .01.

Table 11

Summary of Hierarchical Regression Analysis for Variables Predicting Basic Performance at Time 1 (N = 276)

Variable	β	ΔR^2
Step 1		.074**
Cognitive Ability	.264**	
Step 2		.168
Practice Sequence(1)	.047	
Study Sequence(1)	.097	
Total Study Time(1)	.054	
Total Feedback Time(1)	.017	

Note: β is the standardized regression coefficient from the full regression equation with all predictor variables. Increments for variables entered at the ΔR^2 significance levels are based on F tests for that step. *$p < .05$. ** $p < .01$.

Table 12

Summary of Hierarchical Regression Analysis for Variables Predicting Strategic Performance at Time 2 (N = 276)

Variable	β	ΔR^2
Step 1		.095**
Cognitive Ability	.258**	
Step 2		.155**
Practice Sequence(2)	.268**	
Study Sequence(2)	.186**	
Total Study Time(2)	-.213**	
Total Feedback Time(2)	.093	

Note: β is the standardized regression coefficient from the full regression equation with all predictor variables. Increments for variables entered at the ΔR^2 significance levels are based on F tests for that step. *$p < .05$. ** $p < .01$.

Table 13

Summary of Hierarchical Regression Analysis for Process Variables Predicting Basic Knowledge at Time 1 (N = 276)

Variable	β	ΔR^2
Step 1		.155**
Cognitive Ability	.303**	
Step 2		.085**
Self-satisfaction(1)	.076	
Self-efficacy(1)	.159*	
On-task Cognition(1)	.004	
Attributions(1)	.156*	

Note: β is the standardized regression coefficient from the full regression equation with all predictor variables. Increments for variables entered at the ΔR^2 significance levels are based on F tests for that step. *p < .05. ** p < .01.

Table 14

Summary of Hierarchical Regression Analysis for Process Variables Predicting Strategic Knowledge at Time 2 (N = 276)

Variable	β	ΔR^2
Step 1		.116**
Cognitive Ability	.288**	
Step 2		.051**
Self-satisfaction(2)	.120	
Self-efficacy(2)	-.191*	
On-task Cognition(2)	.166*	
Attributions(2)	.107	

Note: β is the standardized regression coefficient from the full regression equation with all predictor variables. Increments for variables entered at the ΔR^2 significance levels are based on F tests for that step. *$p < .05$. ** $p < .01$.

Table 15

Summary of Hierarchical Regression Analysis for Process Variables Predicting Basic Performance at Time 1 (N = 276)

Variable	β	ΔR^2
Step 1		.074**
Cognitive Ability	.126*	
Step 2		.286**
Self-satisfaction(1)	.354**	
Self-efficacy(1)	.106	
On-task Cognition(1)	.067	
Attributions(1)	.212**	

Note: β is the standardized regression coefficient from the full regression equation with all predictor variables. Increments for variables entered at the ΔR^2 significance levels are based on F tests for that step. *$p < .05$. ** $p < .01$.

Table 16

Summary of Hierarchical Regression Analysis for Process Variables Predicting Strategic Performance at Time 2 (N = 276)

Variable	β	ΔR^2
Step 1		.095**
Cognitive Ability	.243**	
Step 2		.056**
Self-satisfaction(2)	.142*	
Self-efficacy(2)	-.065	
On-task Cognition(2)	.171**	
Attributions(2)	.052	

Note: β is the standardized regression coefficient from the full regression equation with all predictor variables. Increments for variables entered at the ΔR^2 significance levels are based on F tests for that step. *$p < .05$. ** $p < .01$.

Table 17

Summary of Hierarchical Regression Analysis for Practice Variables Predicting Basic Performance During Generalization (N = 276)

Variable	β	ΔR^2
Step 1		.152**
Cognitive Ability	.097*	
Step 2		.445**
Basic Knowledge(2)	.193**	
Strategic Knowledge(2)	-.006	
Basic Performance(2)	.552**	
Strategic Performance(2)	.153**	

Note: β is the standardized regression coefficient from the full regression equation with all predictor variables. Increments for variables entered at the ΔR^2 significance levels are based on F tests for that step. *p < .05. ** p < .01.

Table 18

Summary of Hierarchical Regression Analysis for Practice Variables Predicting Strategic Performance During Generalization (N = 276)

Variable	β	ΔR^2
Step 1		.079**
Cognitive Ability	-.001	
Step 2		.520**
Basic Knowledge(2)	.028	
Strategic Knowledge(2)	.200**	
Basic Performance(2)	.016	
Strategic Performance(2)	.648**	

Note: β is the standardized regression coefficient from the full regression equation with all predictor variables. Increments for variables entered at the ΔR^2 significance levels are based on F tests for that step. *$p < .05$. ** $p < .01$.

Table 19

MANCOVA for Affective Guidance and Behavioral and Cognitive Guidance on Basic and Strategic Performance During Generalization

Effect	df	F	η^2
Covariate			
Ability	2, 271	29.00**	.176
Independent Variables			
Affective Guidance (AG)	2, 271	1.80	.013
Beh.\Cog. Guidance (BCG)	2, 271	16.35**	.108
Interactions			
AG X BCG	2, 271	0.73	.005

* $p < .05$. ** $p < .01$.

Table 20

Between-subjects Effects from Generalization Trial MANCOVA for Behavioral and Cognitive Guidance

Effect	df	F	η^2
Basic Performance	1, 272	0.00	.000
Strategic Performance	1, 272	29.86**	.099

* $p < .05$. ** $p < .01$.

APPENDIX M

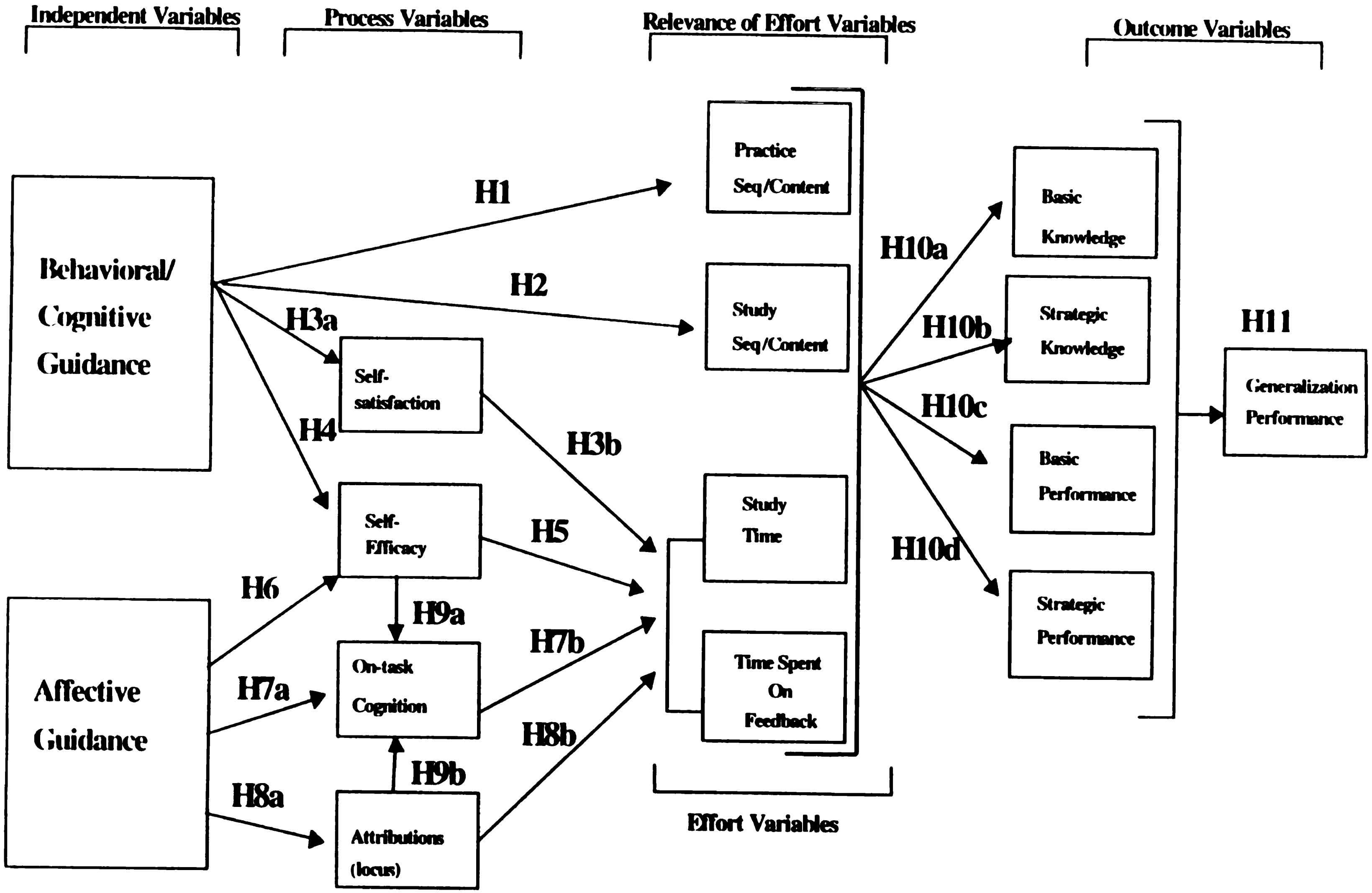

Figure 1. Overall model.

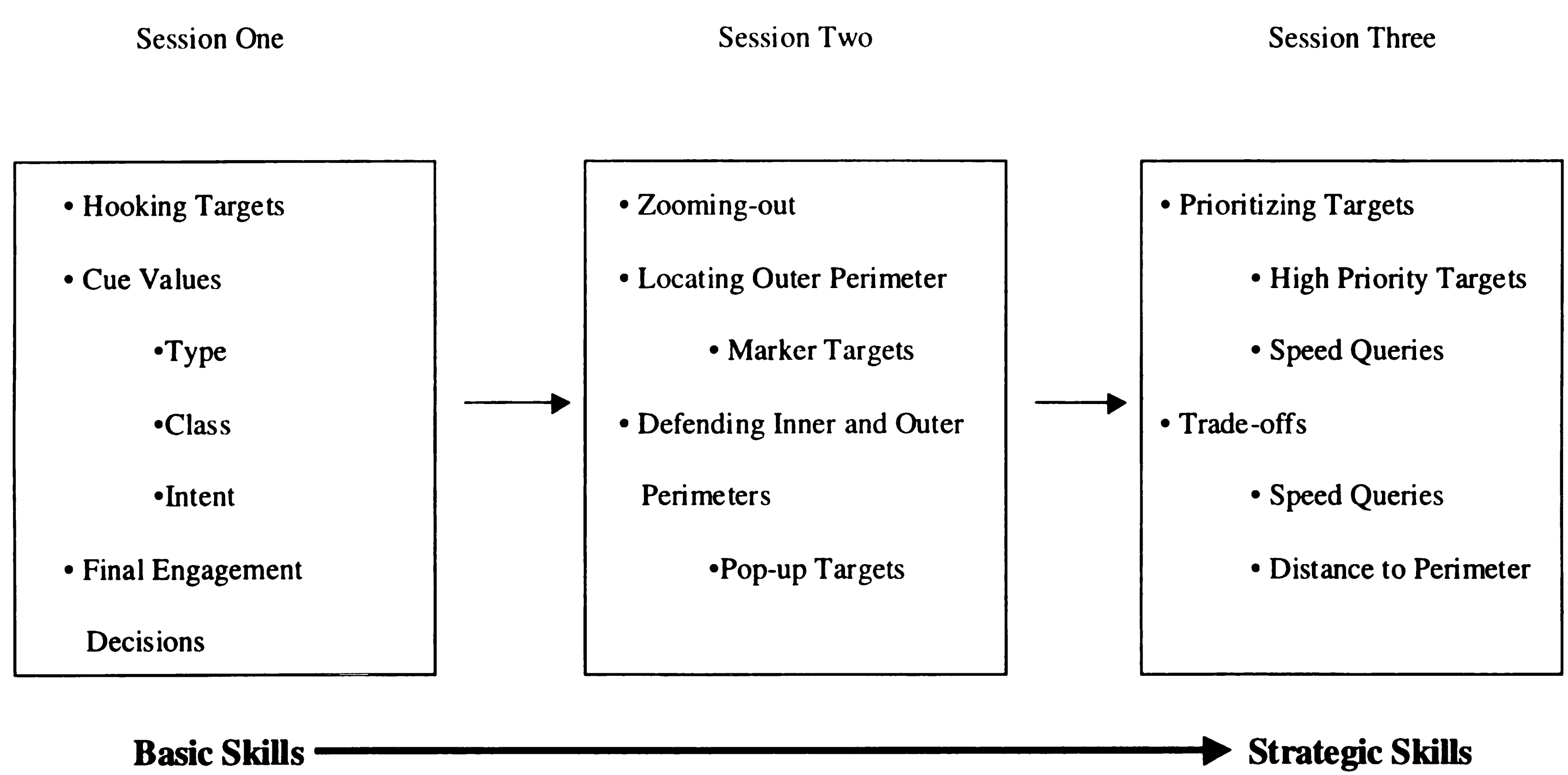

Figure 2. Appropriate sequence of trainee's practice and study

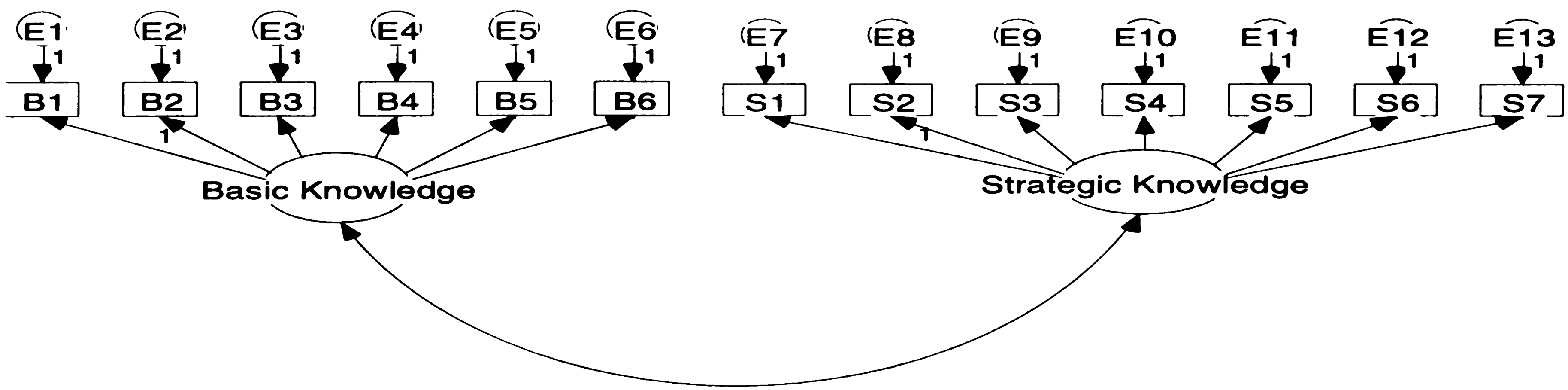

Figure 3. Path model used to test the factor structure of basic and strategic knowledge scales.

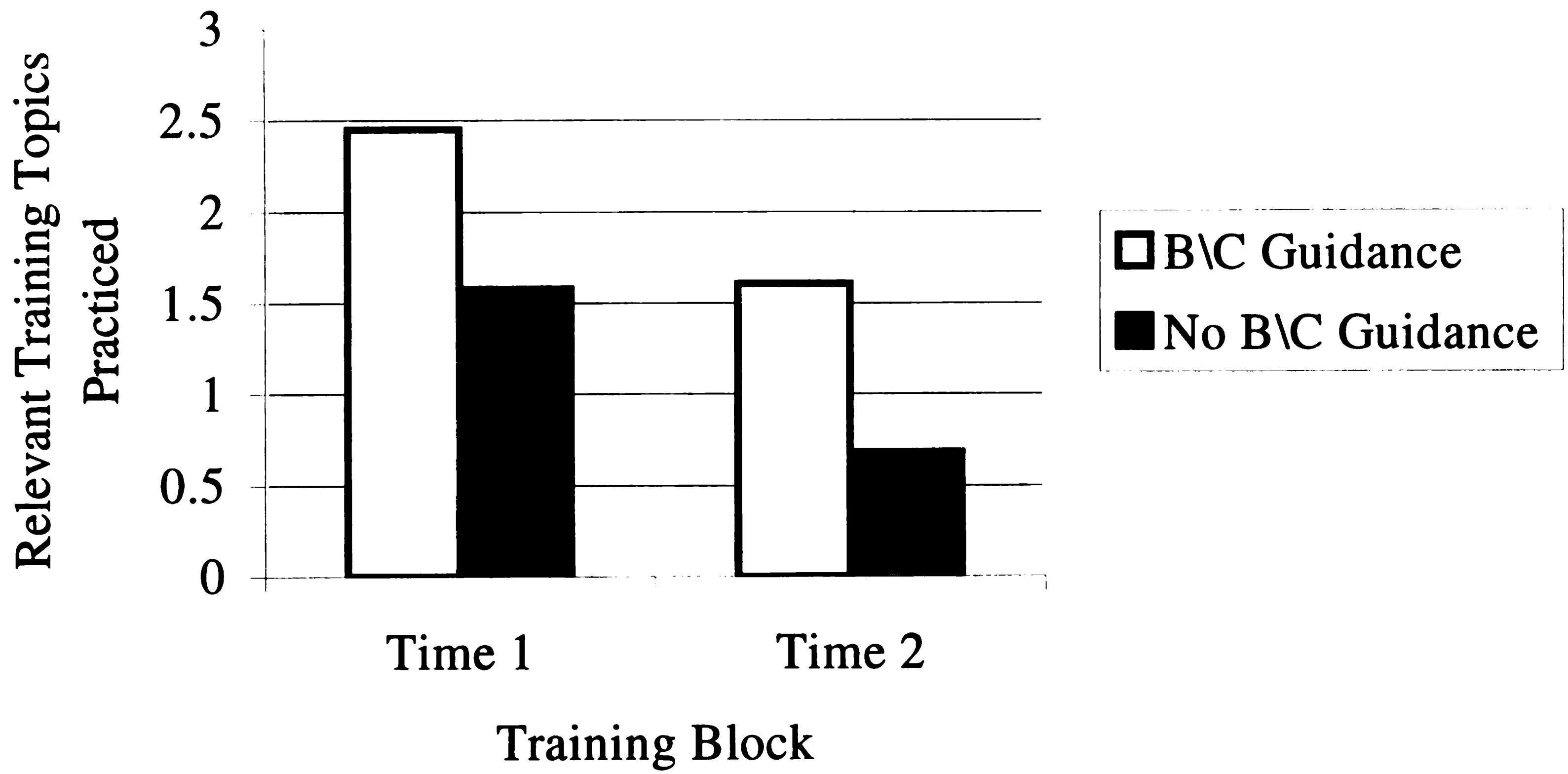

Figure 4. Effect of behavioral\cognitive guidance on practice sequence.

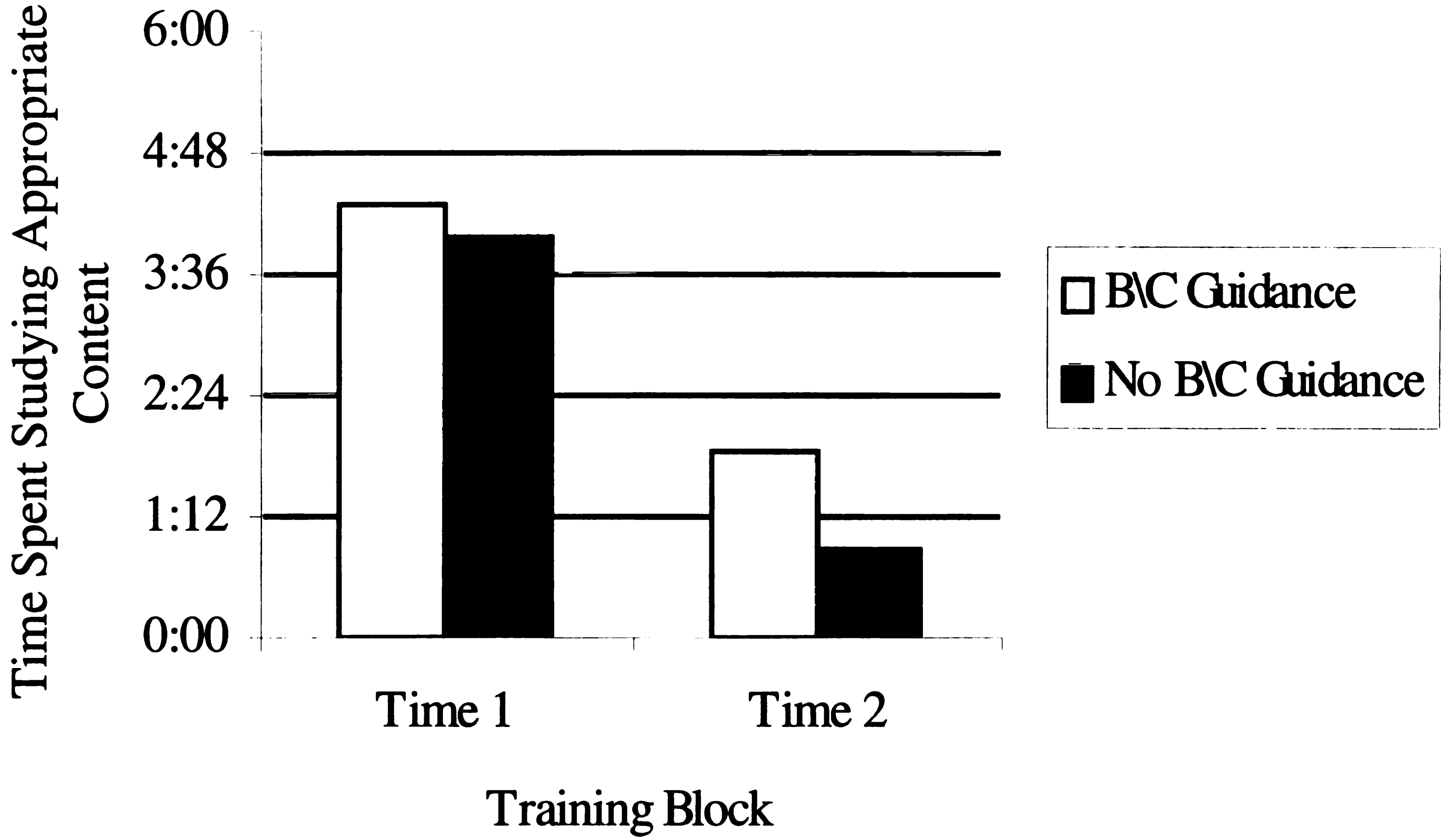

Figure 5. Effect of behavioral\cognitive guidance on study sequence.

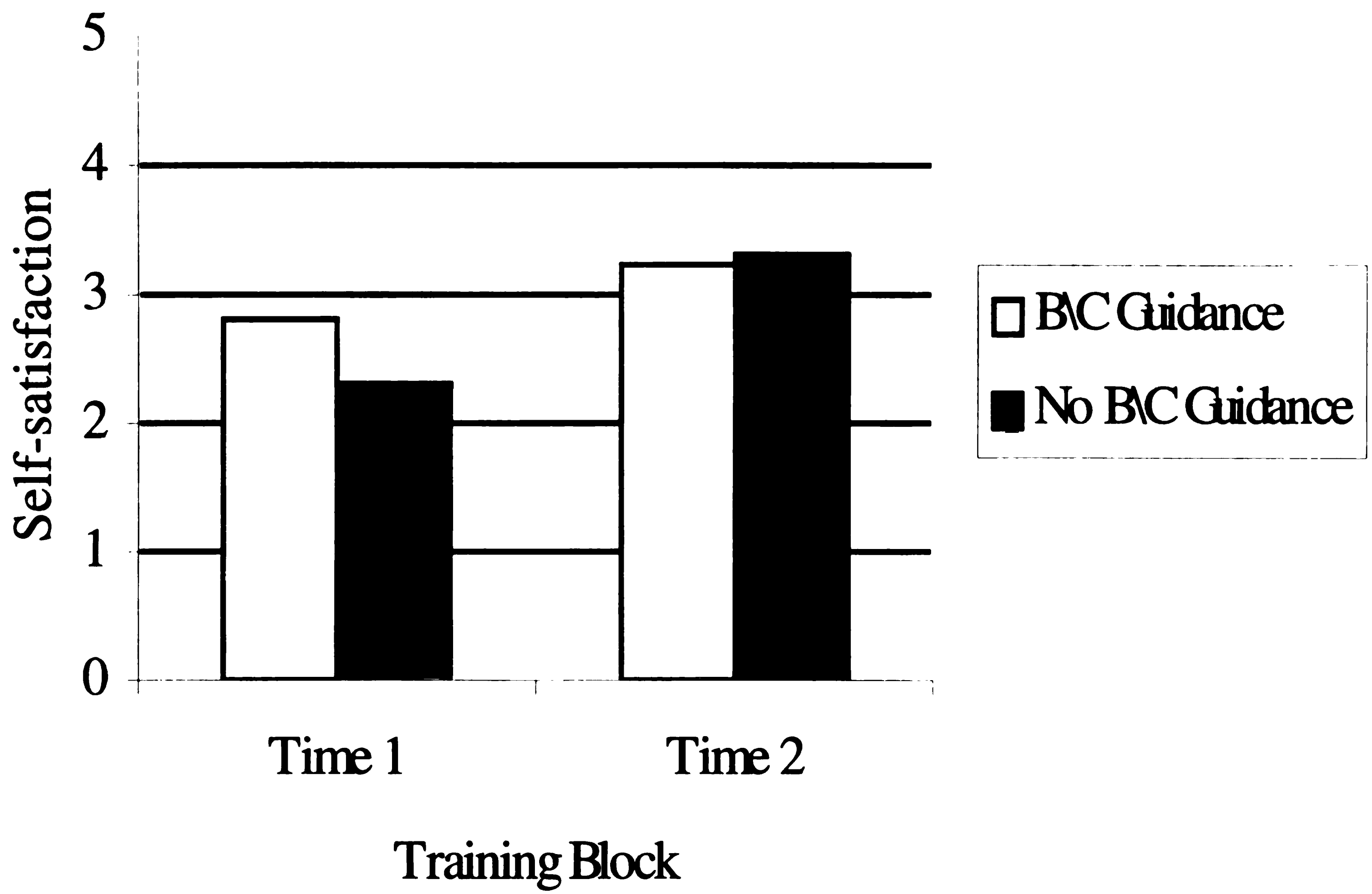

Figure 6. Effect of behavioral\cognitive guidance on self-satisfaction.

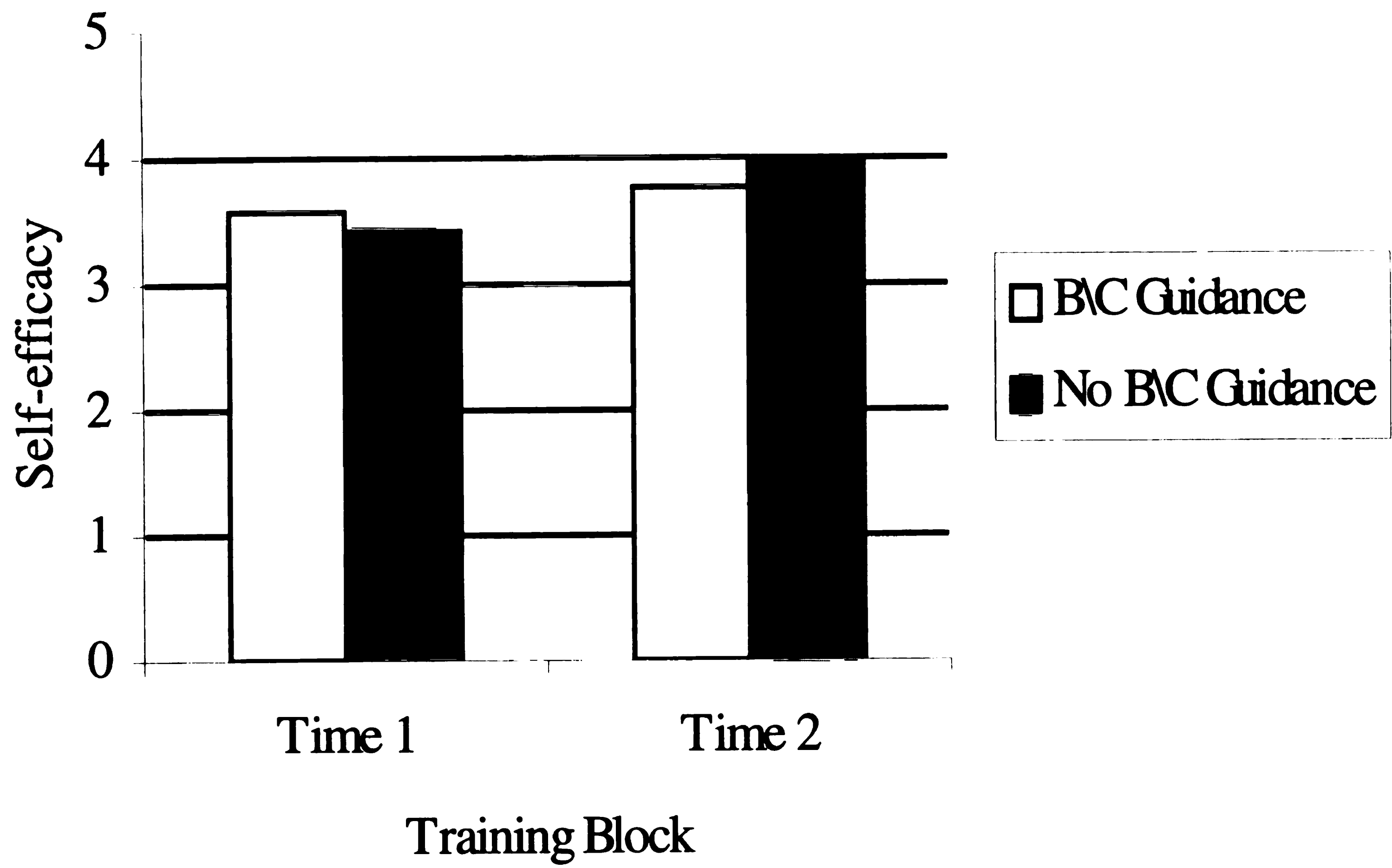

Figure 7. Relationship between behavioral\cognitive guidance and self-efficacy.

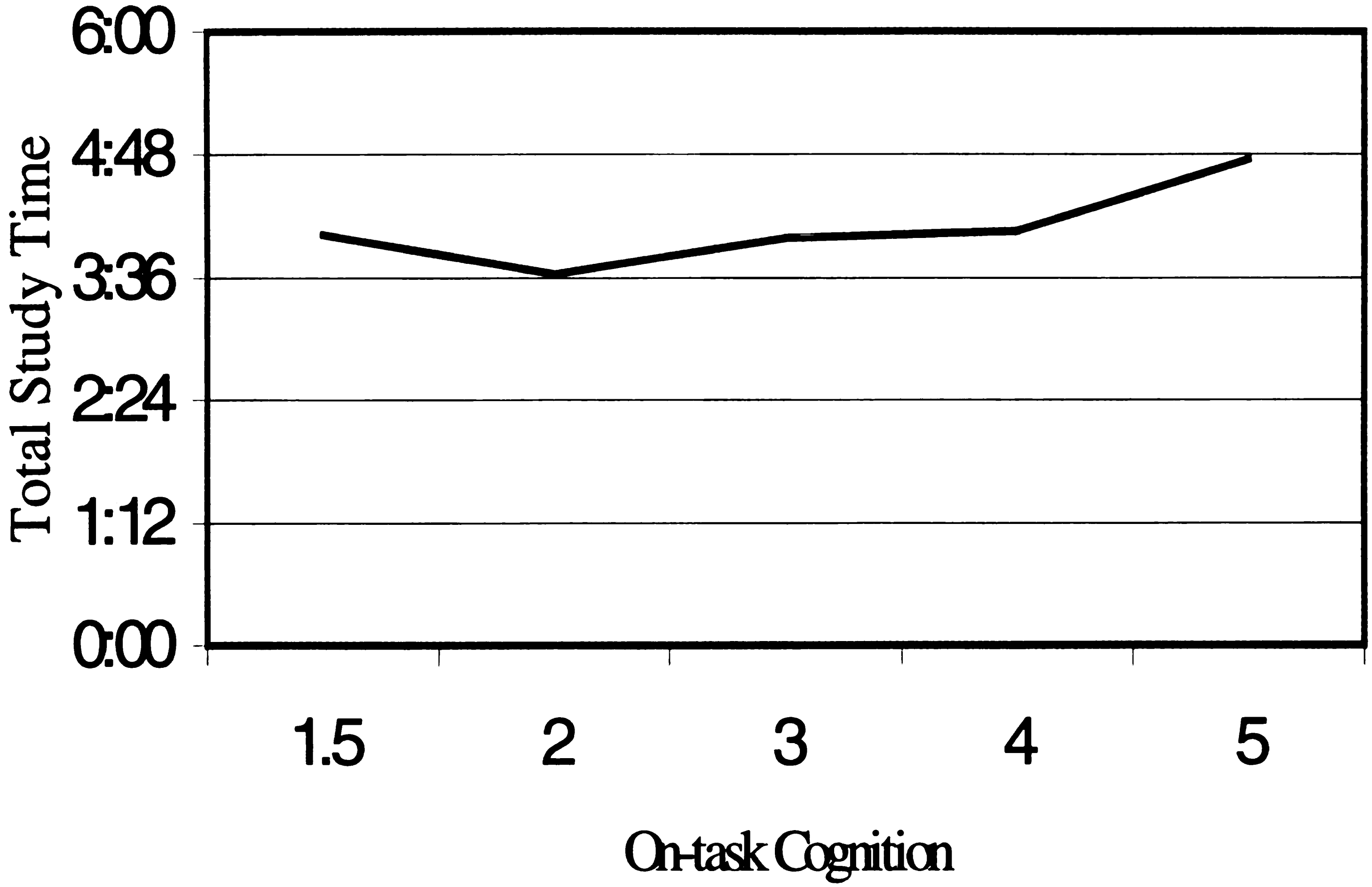

Figure 8. Effect of on-task cognition on total time spent studying.

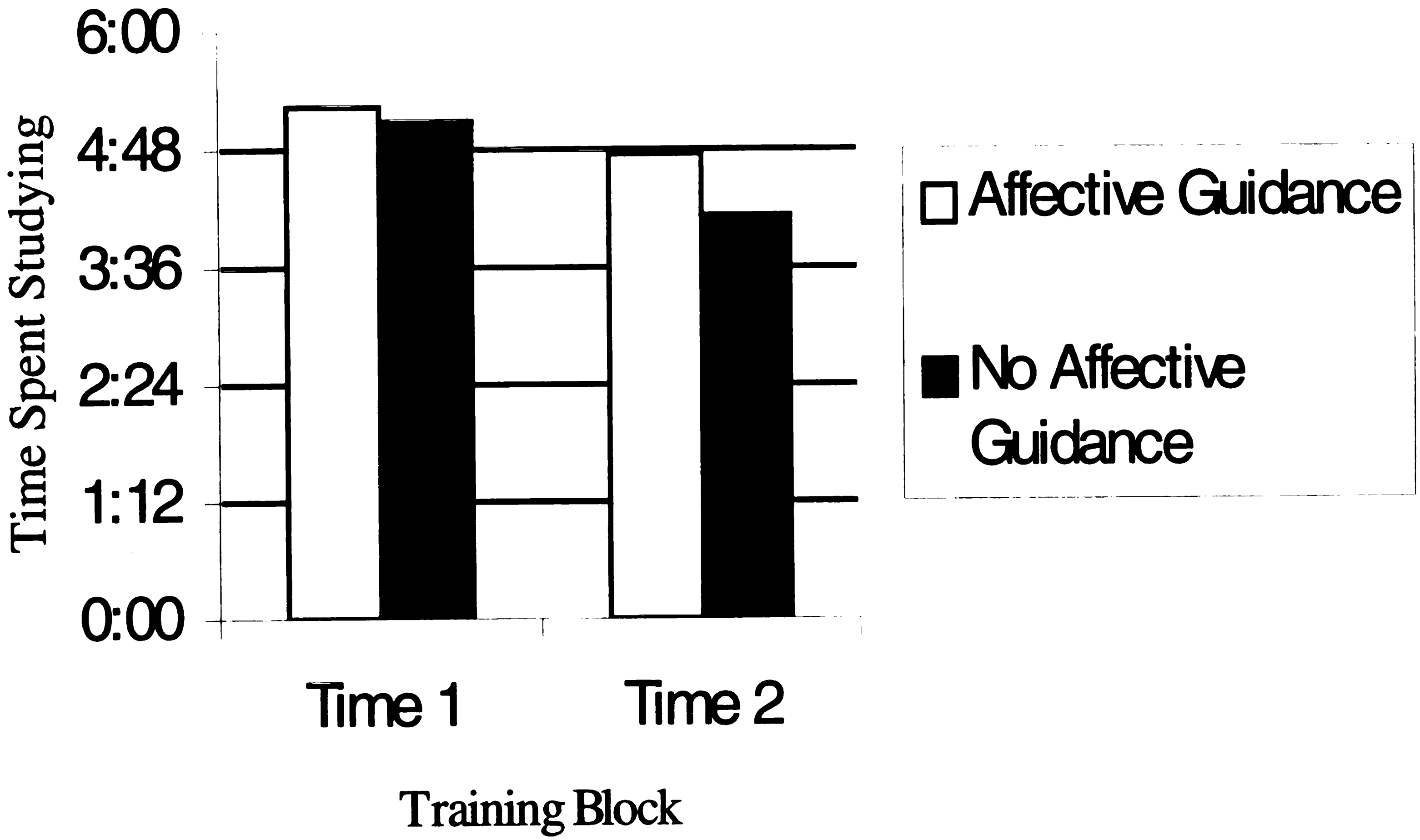

Figure 9. Effect of affective guidance on total study time.

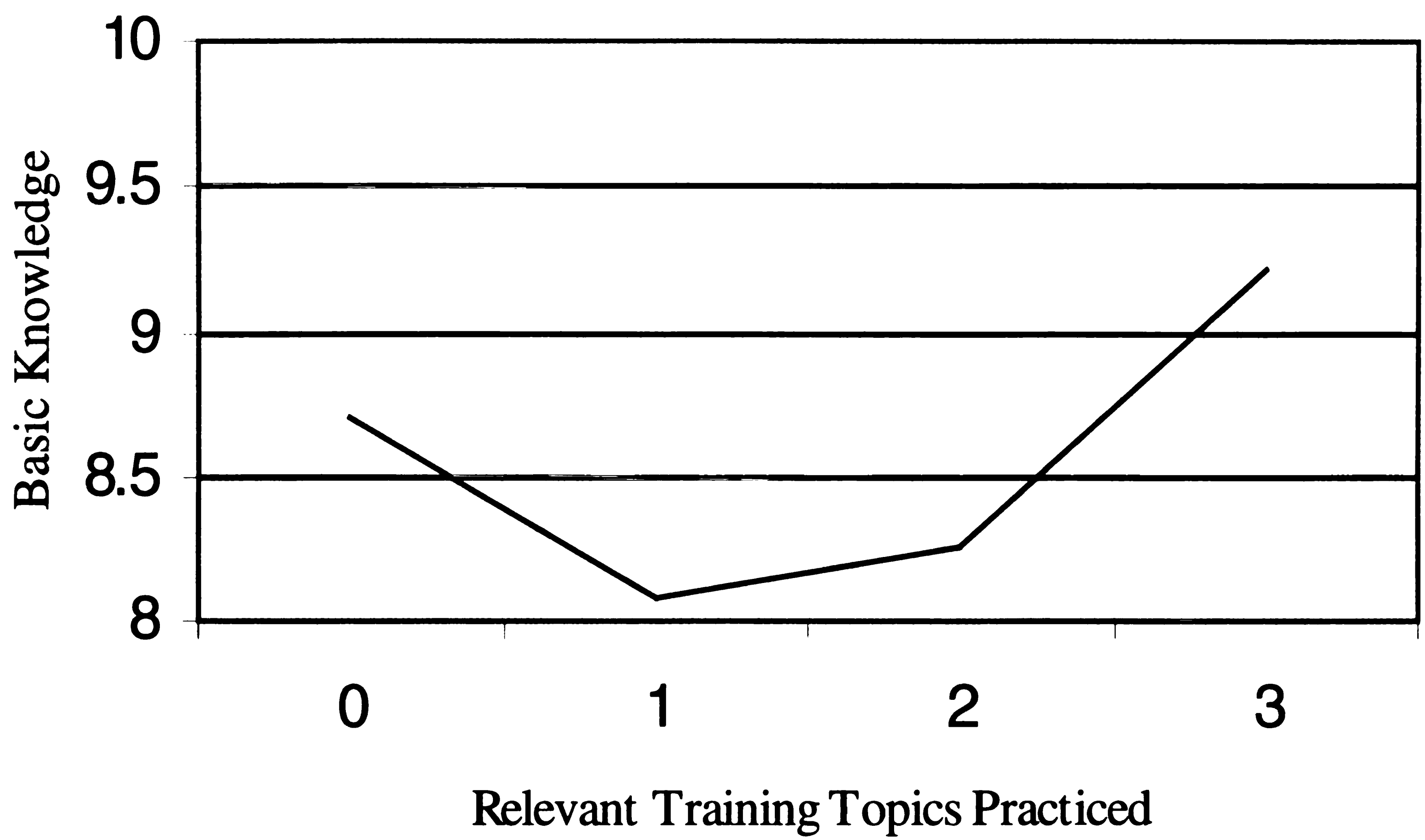

Figure 10. Relationship between practice sequence and basic knowledge. Note: scale has been restricted to more clearly demonstrate effects.

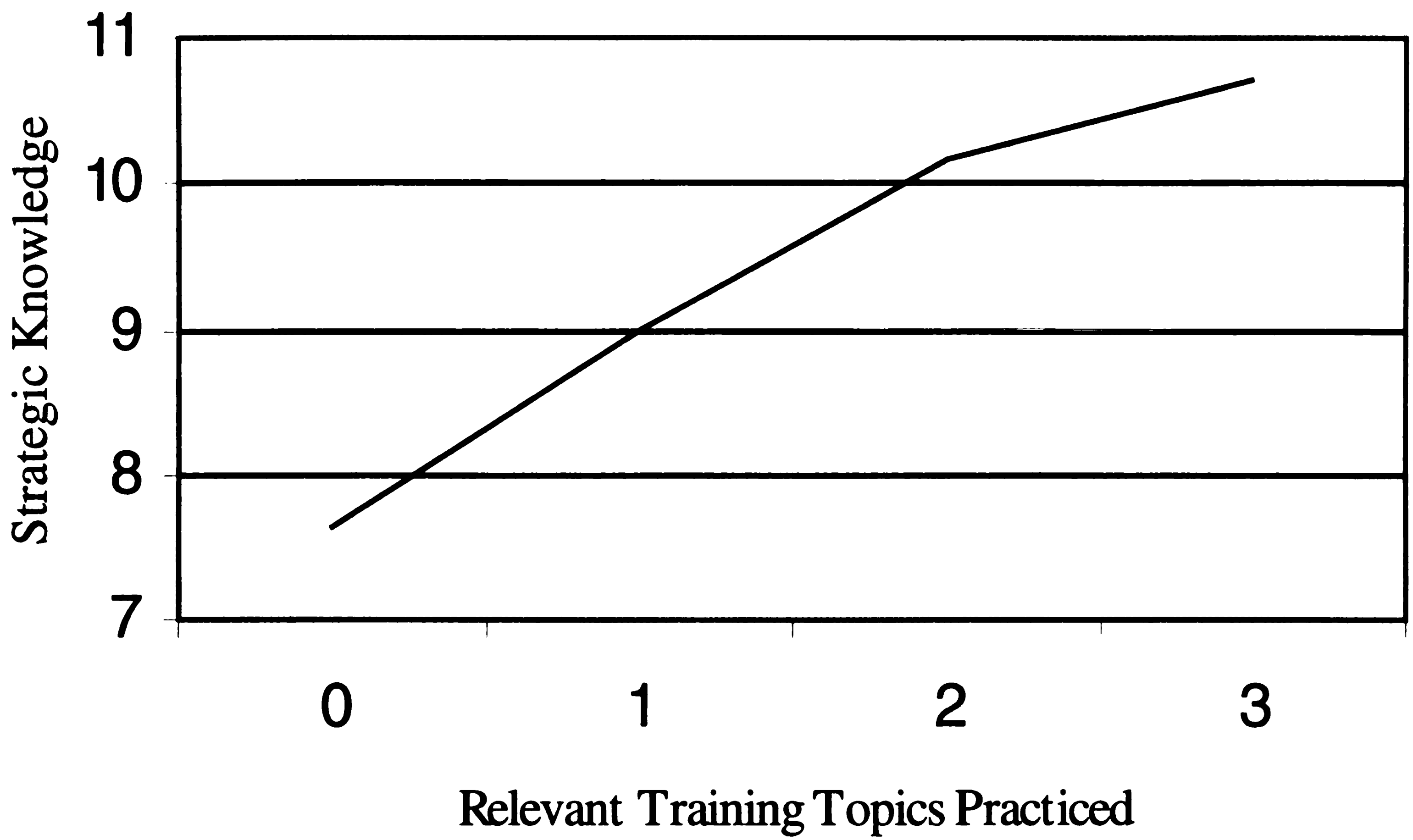

Figure 11. Relationship between practice sequence and strategic knowledge. Note: scale has been restricted to more clearly demonstrate effects.

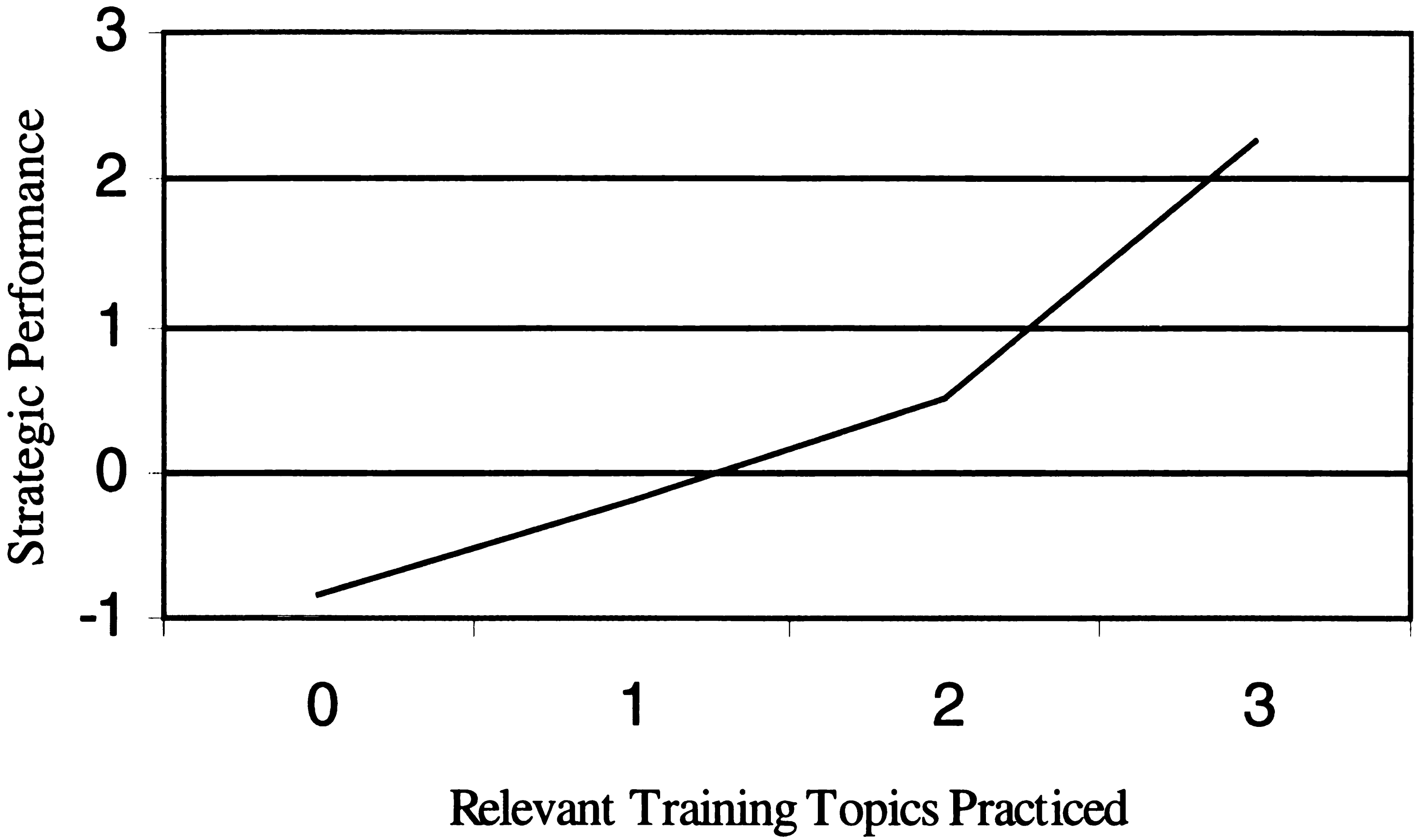

Figure 12. Relationship between practice sequence and strategic performance. Note: scale has been restricted to more clearly demonstrate effects.

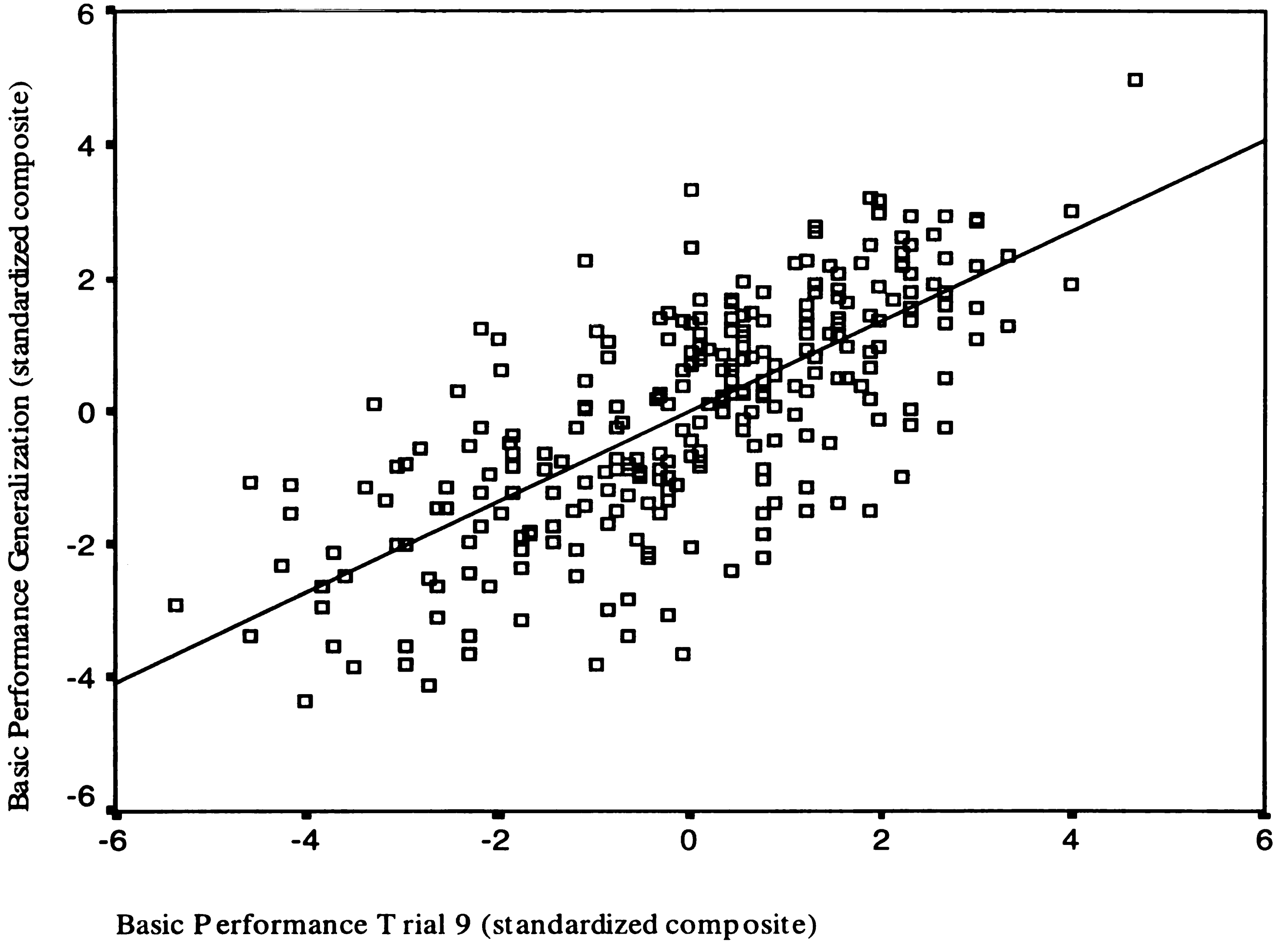

Figure 13. Relationship between basic performance during practice and basic performance during generalization.

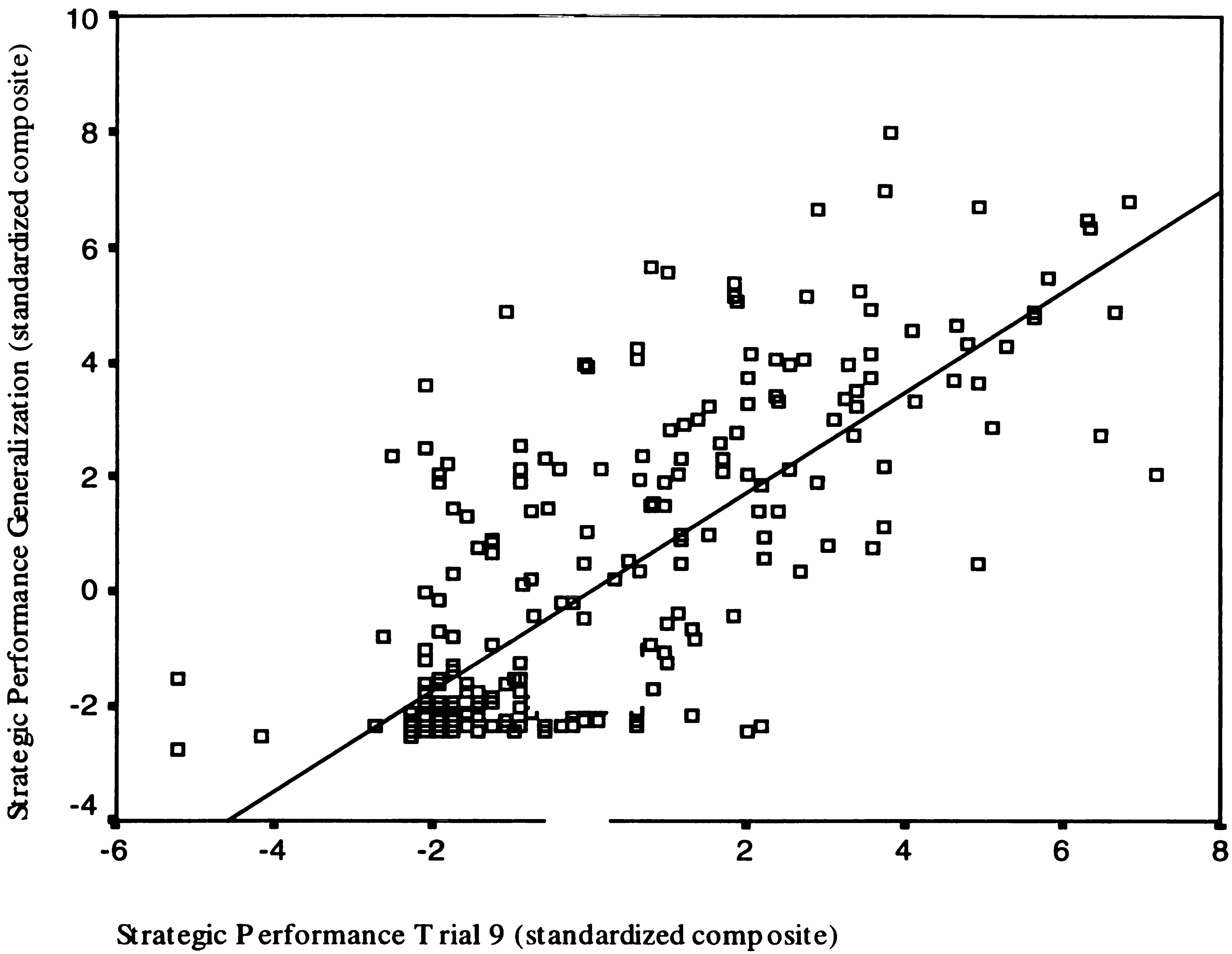

Figure 14. Relationship between strategic performance during practice and strategic performance during generalization.

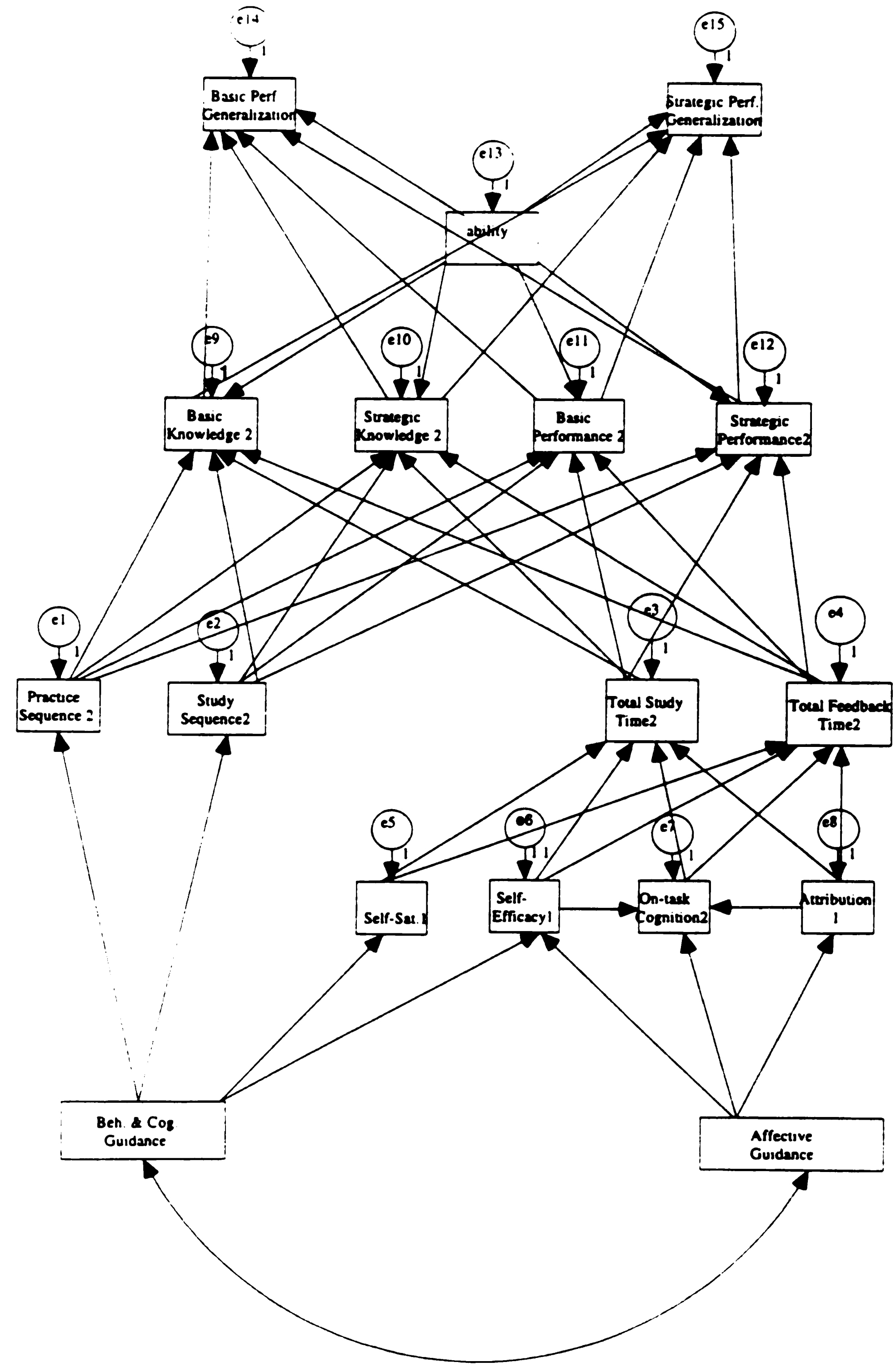

Figure 15. Path diagram used to test hypothesized model.

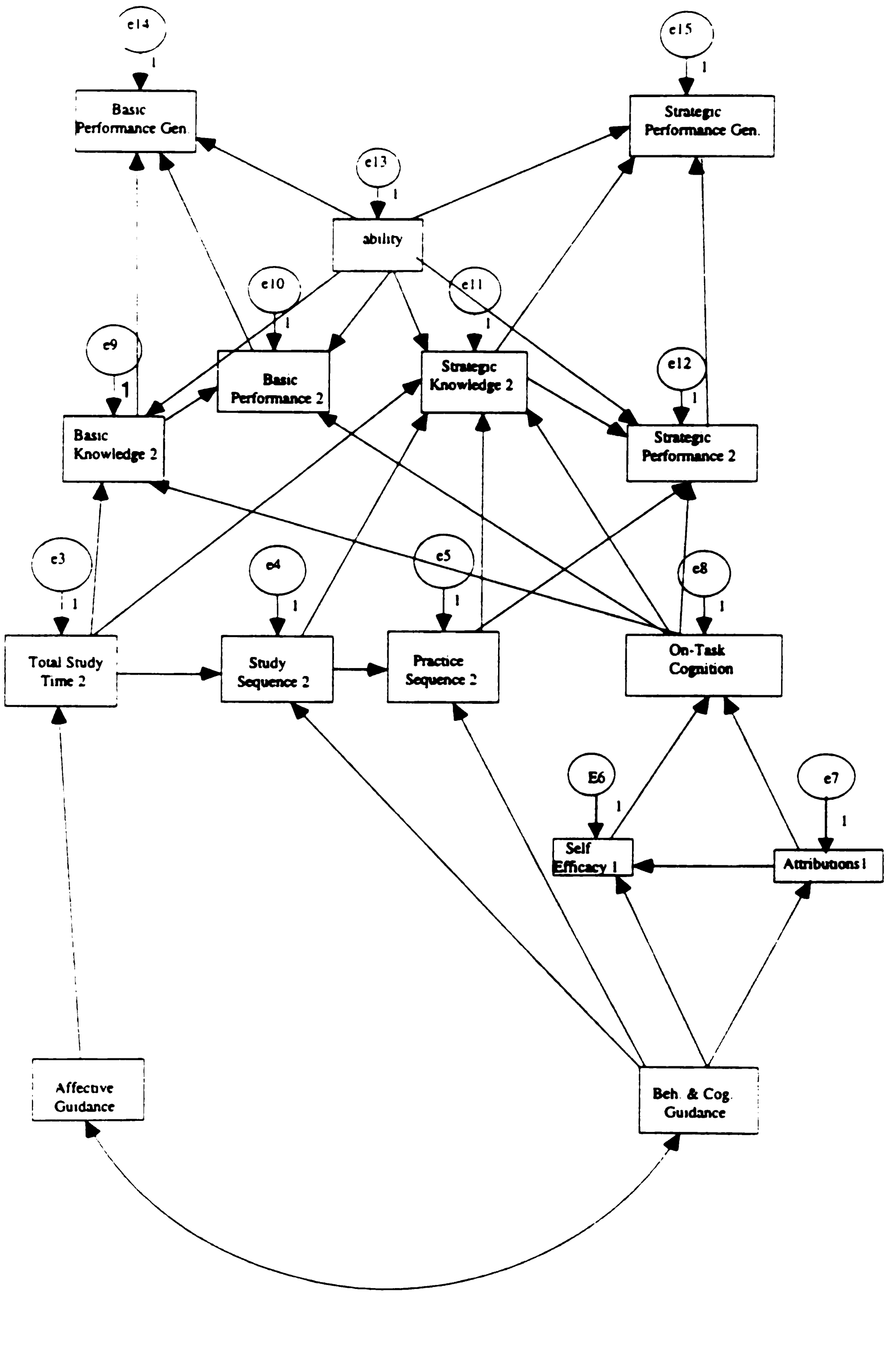

Figure 16. Path diagram used to test revised model.

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