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Training Design, Self-Efficacy, and Transfer: Resolving a Paradox

by

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE

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A possible paradox arises from two major paradigms in the literature studying transfer: designing training to increase transfer (e.g., by including task variation) may lead to lower self-efficacy. The present study investigated this paradox by examining the relationships among design of the practice condition, self-efficacy, and transfer. 82 participants (36 men, 46 women) filled out premeasures, trained on a computer-based task, filled out a self-efficacy measure, and completed a computer-based task for the transfer test. The practice condition was found to impact transfer performance, though not in the expected direction for all transfer tests. While the practice condition did not impact self-efficacy level, the practice condition did impact self-efficacy generalization. Weak support was found for a relationship between self-efficacy and transfer performance. These results suggest relationships among practice condition, self-efficacy, and transfer. Specifically, they indicate that the design of training can influence not only transfer, but also self-efficacy generalization.
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Training Design, Self-Efficacy, and Transfer: Resolving a Paradox

The ultimate goal of training is to enhance the knowledge, skills, and abilities of an individual that will lead to an increase in performance in the work setting. To that end, researchers have tried to identify variables that enhance transfer (Goldstein, 1993). There have been two major paradigms examining the conditions necessary for increasing transfer. The first paradigm has focused on the design of training and has identified factors, such as spaced practice and variable practice, that are necessary components of a training design for increasing transfer (Schmidt, & Bjork, 1992; Ghodsian, Bjork, & Benjamin, 1997). The other paradigm has focused on self-efficacy and its influence on transfer, specifically that high levels of self-efficacy increase transfer (Gist, 1997; Gist, Stevens, Bavetta, 1991). However, there exists a paradox between these two lines of research in that the training design characteristics that lead to transfer may lead to lower levels of self-efficacy.

The purpose of this present study is to examine these two streams of research and to try to resolve this training design paradox. First, the design of a training program is examined – initially by discussing the past stress placed on performance during training, followed by a discussion of the present stress placed on performance on the job (in transfer situations). In this section, studies using type of practice in their training design are presented, and then studies using type of practice and scheduling in their training design are presented. Following this review of studies, the discussion turns to self-efficacy, beginning with its definition. Research on the relationship between self-efficacy and transfer is delved into, and then, research on the relationship between self-efficacy and training design is explored. Subsequently, the present research proposes a paradox
between these two lines of research and a model with specific hypotheses to be tested.

The results of the present study are presented and discussed in terms of their relevance to the existing literature. And finally, the direction of future research and limitations of the present research are explored.

**Training Design on Performance and Transfer**

Historically, trainers have thought that the level of performance during training was an indicator of learning (Ghodsian et al., 1997). In other words, trainers were assuming that a high level of performance during training was an indication that a deeper level of processing was taking place. Further, trainers were assuming that fewer errors committed during training were an indication of learning. Because there was such an emphasis on performance, trainers sought to identify design attributes that would increase performance and reduce the number of errors during training.

One variable with the potential for improving training/acquisition performance is the scheduling of practice. Practice trials can be blocked so that all trials of a task are completed in a sequential order before moving on to a new task. Or, the trials can be scheduled so there is the same number of trials for a given task, but the order is randomized so that a given task is never practiced on successive trials (Schmidt & Bjork, 1992). Research indicates that blocked scheduling leads to higher levels of performance during acquisition than random scheduling (Shea, & Morgan, 1979; Lee, Wulf, & Schmidt, 1992).

A second element of training design evaluated in the literature is the type of practice. Schmidt and Bjork (1992) compared variable to constant practice. In the variable practice condition, different levels of a task are introduced, and trainees perform
at all these levels. In the constant practice condition, only one level of a task is
introduced, and the trainees perform at this one level. The level of a task refers to some
component (e.g., the distance from which a task is practiced, the weight with which the
task is practiced, or the speed with which the task is practiced) of the task being varied, as
in the variable practice condition, or held constant, as in the constant practice condition.
Research shows that constant practice leads to better performance during training
(Carnahan & Lee, 1989; Catalano & Kleiner, 1984).

More recently, there has been a shift in emphasis from performance during
acquisition to performance on the job (performance during the retention phase). This
transition reflects the realization that performance during training may not be related to
performance on the job (Christina & Bjork, 1991). With the focus on the job, researchers
are concerned with the transfer of the trained skills to the workplace. Transfer can be
separated into two subcategories, near or far transfer. Near transfer refers to the situation
in which the stimulus in the transfer condition is similar to the stimulus in the original
learning condition. Far transfer refers to the situation in which the stimulus in the transfer
condition is to some degree different from the stimulus in the original learning condition
(Royer 1979).

In an attempt to account for the transfer of trained skills to the job, Thorndike and
Woodworth (1901) presented the theory of identical elements. This theory predicted that
for transfer to take place conditions in the original learning event had to be identical to
the conditions in the retention task (McGehee, & Thayer, 1961; Thorndike &
Woodworth, 1901). However, as a job progresses, the elements may not remain similar to
those of the original learning condition. Thus, Thorndike’s theory of identical elements
may only account for those conditions of near transfer (i.e., those conditions identical to the original trained task), but not far transfer.

A number of theories have been proposed to address far transfer. One such theory is an information-processing approach. This perspective suggests that exposing people to several versions of a stimulus across a number of presentations will help them integrate the new information with the existing information into a common representation in memory (Baldwin & Ford, 1988). Kadzin (1975) has further stressed the importance of introducing variability in stimuli during training so that individuals do not become reliant on a specific set of stimuli and responses, which reduces their chances for transfer and generalization of skills.

One other theory that has been proposed to account for this effect is schema theory, which suggests that a schema could represent a set of procedures for a skill that could be used in a variety of situations (Holding 1991; Royer 1979; Schmidt 1975). Schema theory, when applied to motor skills (Shapiro & Schmidt, 1982), consists of three components: the generalized motor program, “which is an abstract memory structure that, when activated, causes movement to occur” (p. 115); recall schema, which is formed by initial conditions, response-outcome information, and parameters; recognition schema, which is formed by initial conditions, past actual outcomes, and past sensory consequences. Schema theory predicts, “that an increased amount of variability within a schema class will lead to stronger recall and recognition schemata” (Shapiro & Schmidt, 1982, p. 118).

Different mechanisms for far transfer may be at work because a deeper level of processing is taking place (Schmidt & Bjork, 1992).
Shute and Gawlick (1995) state that what underlies these effects is "simply presenting an item over and over again (as in a constant practice condition) ... does not guarantee an increment in trace strength because subsequent and original items would coincide in working memory and thus not contribute anything unique to the trace activation levels." (p. 782)

In variable practice, however, the information being received is making unique contributions to the activation levels.

Schmidt and Bjork (1992) and Ghodsian et al. (1997) have recognized that the training attributes that may lead to high performance during skill acquisition may not lead to skill retention/transfer and that trainers' earlier attribution of learning to high levels of performance during training is in fact misguided. They note that while performance during training is enhanced by blocked practice, performance on retention tests is enhanced by spaced practice. Also, individuals in a variable practice condition, who experience several variations of a task as opposed to those individuals who only receive one variation of the task, perform better on retention or transfer tests. Thus, even though task variability has a diminishing effect on performance during training (the skill acquisition phase), task variability increases the transfer of skills to new situations. The variable practice condition results in a greater capability to apply the learned skills in novel situations during the retention phases (Catalano & Kleiner, 1984; Ghodsian et al, 1997; Kerr & Booth, 1978; Schmidt & Bjork, 1992; Van Merriënboer, De Croock, & Jelsma, 1997). Thus, this type of practice seems to prepare trainees for conditions that they are likely to encounter on the job.
Mixed findings. Though variability of practice has often been proposed as a technique that can increase transfer, the results of several studies examining its effect on transfer have been mixed (for reviews, see Shapiro & Schmidt, 1982; Van Rossum, 1990).

Newell and Shapiro (1976) investigated the effects of variability of practice with a movement-time task. Participants in the constant conditions practiced with targets of the same speed (70 or 130 msec) whereas participants in the variable conditions practiced with targets of two speeds (70 and 130 msec). In the variable conditions, the first 30 trials consisted of one speed and the second thirty trials consisted of another speed (70-130 or 130-70). The experimenters found that the participants in the four practice conditions performed similarly when they transferred to a task that was within the range (100 msec) that they had previously practiced. However, participants in the 70-130 variable group performed better than the participants in the other three practice conditions when the transfer task was outside the range (180 msec) that they had previously practiced. This led the researchers to conclude that variable practice led to greater transfer, but only when the task was practiced in the appropriate order and when the task was outside the range of previous practice.

In a study by Zelaznik (1977), participants performed a rapid timing task in which distance was manipulated. The variable group practiced with three distances (all trials of one distance were practiced before moving to the next distance) before transferring to the criterion task. The two constant conditions (differing in the amount of practice given) practiced with the same distance before transferring to the criterion task. Zelaznik found that there were no differences between the groups on the criterion task, though the trend
showed that the variable group committed more errors on transfer to the criterion task. This study demonstrates a case in which variable practice did not increase transfer.

One of the most often referenced studies in favor of variability of practice was conducted by Kerr and Booth (1978). In Kerr and Booth’s (1978) study, 8 and 12 year-old participants were tested on a beanbag toss. In the variable practice condition, the participants tossed the beanbags from two distances, while the participants in the constant practice condition tossed the beanbag from only one distance. During the acquisition phase of the training, there were no differences between the two practice conditions in the number of errors made. However, when the participants were tested during retention from the distance that the constant condition had previously practiced, the result was that participants in the variable condition were more accurate than participants in the constant condition. This finding is striking because the variable group had never previously practiced from this distance while the constant group had.

Moxley (1979) found similar results using children ages 6 to 8. In his experiment, participants were asked to throw shuttlecocks at a target from different positions on the floor. Participants in the constant condition practiced all trials from one position while participants in the variable condition practiced all trials from each of the four positions. The groups did not differ greatly during the practice trials; however, the variable group outperformed the constant practice group during the test trials. Again, this study shows the benefit of variable practice in the later transfer tests.

In a study by Margolis and Christina (1981), participants between the ages of 18 to 28 years were tested using a rapid timing task, in which the participant wore prism glasses and reached for a target. In the variable condition, the target was either at one of
four distances (3, 6, 12, or 15 inches). In the constant condition, the target was at only one distance (12 inches). Again, though no difference was found for the practice conditions during training, the variable practice condition was found to perform with fewer errors than the constant practice condition during all the transfer blocks with a novel target (9 inches).

Catalano and Kleiner (1984) manipulated the type of practice in an experiment using 18 to 24 year-old students. The students performed a coincident-timing task and were asked to make a response at either 5, 7, 9, 11 mph in the constant condition or a combination of these speeds in the variable condition (with each velocity only being presented once within each trial block). Catalano and Kleiner (1984) found that on trials during the acquisition phase performance in the variable condition was less accurate than performance in the constant condition. However, performance in the acquisition stage did not predict later performance on retention tests. During the retention test, participants were tested at 1, 3, 13, or 15 mph. The participants in the variable condition performed more accurately on the novel speeds than those participants in the constant condition. This study clearly shows the effect of variable practice performing worse during training, but performing better in a transfer test.

These findings above not only show that variable practice is an important component in increasing transfer, but also that there is some inconsistency in the findings regarding this effect. While Zelaznik (1977) found variable practice did not lead to increased transfer, Newell and Shapiro (1976) found that the variable practice did lead to better performance, but only on far transfer tasks. Other studies (e.g., Catalano & Kleiner, 1984), though, found clear results favoring variable practice on transfer tasks.
Type and scheduling of practice. Results from studies, such as Zelaznik (1977), have led some researchers to question the effect of variability. Due to the inconsistent findings, some researchers have endeavored to discover the circumstances under which variable practice leads to increased transfer when compared to constant practice (Van Rossum, 1990). One explanation for these findings is that variability alone may not facilitate transfer (Lee, Magill, & Weeks, 1985; Schmidt, 1991).

One area of particular relevance to variable practice may concern the scheduling of practice. The scheduling/spacing effect has a robust effect on transfer that has been demonstrated in both verbal (Battig, 1966) and motor skill learning (Shea & Morgan, 1979; for a review, see Magill & Hall, 1990). In a classic study, Shea and Morgan (1979) had participants knocking down barriers in one of three orders (each order was considered a task) while being timed using either blocked or random scheduling. The blocked condition completed all the trials for a task before moving to another task, while the random group had a sequence including all three of the tasks intermingled. The blocked group was found to perform faster than the random group during acquisition; however, in the later retention and transfer tests, the random group was found to perform faster than the blocked group. Shea, Kohl, and Indermill (1989) extended these findings to a retention test that was either blocked or randomly scheduled. They found similar results during acquisition. Specifically, the blocked condition performed with less error than the random condition. In the retention test with blocked scheduling, there was no difference between the conditions until 400 trials. After this point, the random condition performed more accurately than the blocked condition. In the retention test with random scheduling, the random condition became increasingly better than the blocked condition.
as the number of trials increased. Thus, the random group performed better overall than the blocked condition on the retention tests.

The finding of spaced/random practice leading to better transfer is known as the contextual interference effect (Battig, 1979). Increasing contextual interference during practice sessions can lead to better performance on retention or transfer tests (Shea & Morgan, 1979). One possible theory offered to account for this effect is based on elaborative and/or distinctive processing (Shea & Zimney, 1983). Random practice leads to better retention than blocked practice because, during the random practice condition, more elaborative and/or distinctive processing is taking place. Lee and Magill (1985) propose that it is not elaborative and/or distinctive processing occurring during random practice but that forgetting between repetitions is occurring. This forgetting leads to a decrement in acquisition performance but to better retention because the forgetting causes the active processing of information to occur once again (reconstruction). The forgetting does not occur during blocked scheduling, which allows for a passive reliance on what is already in memory (Lee & Magill, 1983). Simply remembering the correct response does not enhance later retention (Jacoby, 1978; Cuddy & Jacoby, 1982). Both of the above accounts for this effect, elaborative processing and forgetting, rely on processing. Specifically, random practice leads to more extensive processing because of the intervening tasks during practice.

The spacing of practice has been given as an explanation of the mixed results in studies looking at variable practice and transfer (Lee et al., 1985). While some studies use blocked spacing in the trials (Newell & Shapiro, 1976, Experiment 1; Zelaznik, 1977), other studies use randomly spaced trials (Catalano & Kleiner, 1984; Lee et al., 1985;
McCracken & Stelmach, 1977) or have the variable groups practice with both random and blocked spaced trials (Hall & Magill, 1995; Newell & Shapiro, 1976, Experiment 2). The studies that have consistently supported the "variability of practice hypothesis" (Schmidt, 1975) have used random variable practice (Lee et al., 1985). These studies find the depressed performance of the variability condition during acquisition followed by its superior performance during transfer.

More recent studies have examined the effects of spacing and variability (Hall & Magill, 1995; Lee et al, 1985). In a study by Lee et al. (1985), participants were assigned to one of three conditions (constant, random variable, or blocked variable). Participants were trained on a rapid timing task. During the acquisition phase of experiment 1, the constant and blocked variable conditions were found to perform better than the random variable condition. However, there was no difference between the three groups in their performance on a task considered "inside" transfer (within the ranges practiced during acquisition). Finally, for a task considered "outside" transfer, the random variable condition performed better. In the second experiment, Lee et al. replicated these findings; the most important finding being that the random variable group performs best at "outside" transfer tests.

Evidence for the interaction between the variability effect and the spacing effect was found in a more recent study conducted by Lee, Wulf, and Schmidt (1992). Participants performed a movement-timing task in one of four conditions, which resulted from two task variations (constant or variable phasing) and two practice conditions (blocked or random). During constant phasing, the task was performed under the same movement time ratio. During variable phasing, the task was performed under different
movement time ratios. When comparing the groups, the researchers looked at groups that had practiced under identical phasings. They were concerned mostly with the difference between the random and blocked groups that received variable phasing. During the practice sessions using variable phasing, there was no difference in the groups’ performance. On the transfer tests with constant phasing, the variable/random group performed better than the variable/blocked group on the first trials. On the transfer tests with variable phasing, the variable/random group was overall more effective than the variable/blocked group. This study shows that spacing is important for transfer; but of even more importance, this study shows that variability and spacing together can make a significant impact.

Hall and Magill (1995) investigated in two experiments the effect of variability and scheduling on practice and subsequent retention and transfer using four practice conditions: constant blocked, variable blocked, constant random, and variable random. In the first experiment, they found that the two blocked groups performed better during acquisition than the two random conditions. In the later retention tests, the random groups outperformed the blocked groups. In the second experiment, the blocked groups performed better than the random conditions during acquisition. In addition to this finding, the constant groups performed better than the variable groups. The influence of schedule on practice variability was found in the first transfer test to variable timed novel tasks in which the random groups performed better than the blocked groups. The trend in the amount of errors was for the variable random condition to have the least amount of errors followed by the constant random, then the variable blocked, and finally the constant blocked condition. This study shows the depressed effects of variability and
random spacing in learning and the better performance caused by variability and random spacing in retention and transfer. In other words, this study shows the importance of both practice variability and random scheduling in training designed for later retention and transfer.

A combination of variable practice and random spacing may be necessary to produce the desired facilitation to transfer (Schmidt, 1991, p. 214). So, when designing a training course, the interaction between the two variables may be essential to consider in order to increase transfer. The present study intends to build upon the past research by investigating the effect of variable practice and spacing, e.g. Lee et al (1985). It will first be necessary for the present study to replicate findings of past research on practice effects. Specifically, research findings suggesting that the constant practice condition will lead to better training performance while the variable practice condition will lead to better performance on transfer tests (Catalano & Kleiner, 1984; Kerr & Booth, 1978; Margolis & Christina, 1981). However, since the findings of variable practice are not always clear, the incorporation of spacing/scheduling into the training design will also be investigated, as done in such studies as Lee et al. (1985) and as suggested by Schmidt (1991). Specifically, the present study will combine the type of practice and the scheduling of practice to produce the most favorable training condition and the most favorable transfer condition. In other words, the most favorable training condition will be comprised of constant practice and blocked scheduling and will be termed the “constant practice condition”. And, the most favorable transfer condition will be comprised of variable practice and random scheduling and will be termed the “variable practice condition”. Thus, this study will investigate the effects of variable and constant practice
under random and blocked scheduling, respectively, in order to assess the effect of training design on acquisition and subsequent transfer.

**Hypothesis 1.** The individuals in the constant practice condition will have higher training performance than those individuals in the variable practice condition.

**Hypothesis 2.** The individuals in the variable practice condition will have higher transfer performance than those individuals in the constant practice condition.

**Self-Efficacy and Transfer**

Another factor that has been linked to successful transfer of skills learned in training is self-efficacy. Self-efficacy refers to “the judgments of one’s capability to organize and execute the courses of action required to produce given attainments” (Bandura, 1997, p. 3). Self-efficacy can vary along three dimensions, level, generality, and strength. First, people may be limited in the difficulty of tasks that they believe they are capable to perform, which refers to **level**. Self-efficacy levels at the end of training have been related to post-training transfer and job performance (Mathieu, Martineau, & Tannebaum, 1993). Efficacy beliefs can be judged across a wide range of activities, which refers to **generality**. The **strength** of self-efficacy beliefs is evident in the individual’s perseverance of a task.

In addition to the dimensions, there are four sources of self-efficacy that have been documented in the literature (Bandura, 1977; Eden & Aviram, 1993; Eden & Kinnar, 1991; Maurer, 2001). These sources are: performance accomplishments, vicarious experiences, verbal persuasion, and emotional arousal (Bandura, 1977). Performance accomplishments, the strongest source of self-efficacy, can be a powerful determinant of “a person’s judgments in his/her future competence at the task or a similar
task" (Maurer, 2001, p. 130). Personal successes will serve to raise self-efficacy while repeated failures will serve to lower efficacy (Shea & Howell, 2000), especially if these failures occur early on in the learning process (Bandura, 1977; 1982). The enactive mastery gained from the performance accomplishments leads to the "highest, strongest, and most generalized increases" in self-efficacy (Bandura, 1982, p.128). The second source, vicarious experience, can also serve to increase a person's self-efficacy as he/she sees others like himself/herself successfully perform a task. Verbal persuasion, e.g., suggesting the person is capable of performing a task, is an easy and inexpensive tool used to bolster self-efficacy. Fourth, emotional arousal affects self-efficacy; specifically, aversive arousal can lead to a person expecting failure (Bandura, 1977).

In new situations, people's beliefs in their capabilities are based on their experiences in the most similar situations (Woodruff & Cashman, 1993). Their estimates of their capabilities influence which tasks they choose to perform, the effort they choose to expend, and the persistence they choose to exert. Self-efficacy has this influence whether it is accurate or false (Bandura, 1982). Level of self-efficacy will have an effect on individuals' interpretation of performance results under failure while their interpretation under success will be similar (Gist & Mitchell, 1992). Those high in self-efficacy will attribute failure to lack of effort or external forces while those low in self-efficacy will attribute failure to lack of ability (Martocchio & Webster, 1992). Because high self-efficacy attributions are changeable, persistence in task performance is likely, whereas low self-efficacy attributions are stable and unchanging, making persistence unlikely (Gist 1997). "If performance on the task is sensitive to ability, effort, and persistence, then efforts to change self-efficacy … may lead to performance increases"
(Gist & Mitchell, 1992, p. 200). Thus, it has been suggested that training aimed at increasing self-efficacy will lead to better performance on the job (Martocchio, 1994; Tannebaum, Mathieu, Salas, & Cannon-Bowers, 1991).

In examining the effect of self-efficacy on performance, it has been shown that self-efficacy can predict future performance (Eden & Aviram, 1993; Gist et al., 1991; Ford, Smith Weissbein, Gully, & Salas, 1998; Martocchio, 1994; Mathieu et al., 1993; Mitchell, Hopper, Daniels, George-Falvy, & James, 1994; Stevens & Gist, 1997). Self-efficacy influences performance both directly and indirectly (Bandura & Wood, 1989; Quiñones, 1995). Mathieu et al. (1993) demonstrated the effect of self-efficacy on performance when they surveyed students in bowling classes. Survey data, including self-efficacy measurements, were gathered on two different occasions. They found that self-efficacy at time 2 had a positive effect on training reactions and subsequent performance. Ford et al. (1998) examined this relationship with undergraduate students participating in a radar operations study. They were looking at how individual differences (a mastery or performance orientation), learning strategies (metacognition, identical elements, or activity level), and training outcomes (final training performance, knowledge, or self-efficacy) influenced transfer. They also found support for self-efficacy having a positive relationship with transfer performance. Specifically, their identical elements strategy was related to self-efficacy, which, in turn, was related to transfer performance. Bandura (1982) has also found support for a relationship between self-efficacy and performance. He concluded from the results of a series of his studies on snake phobics that the higher the level of self-efficacy, the higher the performance.
Evidence for the effect of self-efficacy on performance came from a study in which subjects were given a strategy (high or low) to perform the task (Locke, Frederick, Lee & Bobko, 1984). The task involved participants coming up with uses for an object. In the high strategy condition, participants were given three methods to help in the brainstorming process. In the low strategy condition, participants were told that they should only list uses that were "good" or "high-quality". The experimenters found that self-efficacy not only had a direct influence on performance, but also had an indirect influence on performance through the participants' goal. Moreover, they found that the training affected the self-efficacy of the participants. Thus, self-efficacy not only has an effect on performance, but performance also has an effect on self-efficacy. That is, self-efficacy and performance can be viewed as having a reciprocal relationship (Locke et al., 1984).

In examining the effect of performance on self-efficacy, research has shown that past performance influences self-efficacy, such that successful performances increase self-efficacy (Bandura, 1982, 1991; Martocchio & Judge, 1997; Mitchell, et al., 1994; Smith, 1989). Past performance is an example of the strongest source of self-efficacy, performance accomplishments. From experience with the task, direct knowledge of one's capability can be obtained (Gist & Mitchell, 1992). In the Mitchell et al. study (1994), support was found for performance accomplishments being the strongest source of self-efficacy. Participants performed a simulation task for the job of an air traffic controller. During the study, the experimenters were trying to assess the factors that contributed to people's estimates of their self-efficacy. They found that past performance was the major
determinant of self-efficacy; specifically, past performance was the foremost factor contributing to self-efficacy.

Further, research has indicated that those individuals with high past performance will have higher self-efficacies and will persist longer when faced with difficulties than those who have experienced repeated failures and doubt their capabilities (Bandura & Cervone, 1986; Schunk, 1991; Ford et al., 1998; Gist et al., 1991). In a study by Bandura and Cervone (1986), the impact of self-efficacy on motivation was investigated. Participants operated an exercise device that required “effortful activity”. The exercise device allowed for the experimenters to measure the change in the level of effort. The experiment resulted in self-efficacy strength being higher for those individuals that were closer to meeting their performance goals. Additionally, those participants whose self-reactive influences (self-satisfaction, self-efficacy) were high demonstrated an increase in effort while those participants whose self-reactive influences were low demonstrated little effort. This resilience of high self-efficacy individuals to persist and to increase effort when encountering difficulties will allow them to transfer the skills once learned in training to the job.

**Training Design and Self-Efficacy**

Performance during training can serve as one source of feedback that can influence self-efficacy. This is demonstrated in findings that show that those people who performed well in training left training with a greater belief in their capabilities to perform well on the job (Gist, 1986). Some have suggested that self-efficacy may be “an intervening variable between training and task performance” (Gist, 1989, p.803). Gist (1986) found support for this statement in a study that looked at the effects of training on
self-efficacy and subsequent performance. The participants were managers assigned to one of two conditions, a control and an experimental condition, performing two idea generation tasks. The two conditions were comparable on the learning material; however, the experimental group received techniques meant to provide enactive mastery with positive feedback and cognitive modeling experiences. Gist found that self-efficacy was higher for those individuals in the experimental condition. Further, it was found that the experimental group also had a higher performance gain from task one to task two. Thus, designing training to boost self-efficacy has been investigated as a means to increase later performance on the job. This suggests that self-efficacy is in fact a malleable construct.

Gist (1989) tested the effect of two training methods (lecture/discussion vs. modeling) on self-efficacy and idea generation in managers from a major federal agency. Participants in the modeling condition received cognitive modeling experiences, which were designed to include the components suggested by Bandura (1977) of learning from modeling. The lecture/discussion group practiced the techniques for brainstorming based on the guidelines they were given while the modeling condition practiced the techniques based on the cognitive models. Gist found that self-efficacy was higher for those participants in the modeling condition than for those participants in the lecture/discussion condition. It was also found that self-efficacy correlated positively with performance. In another study, the effect of training methods (tutorial vs. modeling) on self-efficacy was assessed during a computer software course (Gist, Schwoerer, & Rosen, 1989). In the behavioral modeling condition, participants watched a model demonstrate the procedure that needed to be followed in order to accomplish the task. In the tutorial condition, participants interacted one-on-one with a tutorial diskette, which provided instruction on
the monitor. The behavior modeling condition led to higher self-efficacy scores than the tutorial condition. The behavioral modeling program also led to higher performance means than the tutorial condition. It is interesting to note that the condition that led to higher self-efficacy also led to a higher performance level.

Eden and Aviram (1993) found that it was possible to increase self-efficacy through the design of a training program. Participants were in one of two conditions: a behavioral modeling condition or a control condition. The experimenters found that self-efficacy was higher for those individuals in the behavioral modeling condition than for those individuals in the control condition. They also found that boosting self-efficacy led to an intensification of effort. Gist et al. (1991) found similar effects of training design on self-efficacy, specifically, that self-efficacy moderated the relationship between the training condition and performance. Self-management training was better for those individuals low in self-efficacy increasing subsequent skill maintenance and later performance, and goal-setting training was better for those individuals high in self-efficacy increasing subsequent skill maintenance and performance. These results make apparent the effect that the training design can have on self-efficacy.

As discussed earlier, successful attainments during training lead to an increase in an individual's confidence in his or her ability to perform a task (Bandura, 1982). Also as stated above, artificially high performance levels can be obtained by providing constant practice conditions (Ghodsian et al., 1997) and/or blocked scheduling (Shea & Morgan, 1979) in the training design. A logical argument seems to follow: Constant practice conditions should lead to successful attainments in training because constant practice induces higher performance. These successes should lead to high levels of self-efficacy.
Thus, constant practice should lead to higher levels of self-efficacy than variable practice conditions. The same argument can be made for a blocked practice schedule: Blocked scheduling should lead to high performance levels during training. The high performance should lead to high levels of self-efficacy. Thus, blocked scheduling should lead to higher levels of self-efficacy than random scheduling. The combination of blocked scheduling and constant practice, as in the constant practice condition, should exaggerate the effect on self-efficacy level.

**Hypothesis 3.** The individuals in the constant practice condition will have higher self-efficacy level than those individuals in the variable practice condition.

**A Training Design Paradox**

Research on training designs has shown that inducing difficulties in training, through such things as variable practice and/or spacing, will increase transfer (Schmidt & Bjork, 1992). Variable practice and random spacing are only two of many design features that have been found to increase transfer; however, the combination of these features will be the focus of this present study. Further, research on training has shown that successes during training increase self-efficacy. In addition, high self-efficacy levels have been found to increase transfer. However, difficulty leads to a lower number of successes, thereby potentially lowering an individual’s level of self-efficacy and subsequent ability to transfer. Thus, the paradox arises: designing training to increase transfer (e.g., by increasing task variation) can serve to lower a person’s self-efficacy. A conceptual model is presented to depict the effect of training design on learning and subsequent transfer and the effect of training design on self-efficacy and subsequent transfer. Referring to Figure 1, the paradox lies in links 1 and 2.
Figure 1. A Conceptual Model of the Impact of the training Design on Learning, Self-Efficacy and Subsequent Transfer Outcomes.
To resolve this conflicting research and the paradox existing between links 1 and 2, a self-efficacy generalization curve is proposed. Just as Hull (1943) and others applied a generalization gradient in learning, a generalization gradient of self-efficacy is possible. Recall from earlier that self-efficacy can vary along the dimensions of level and generality (Bandura, 1997). As stated previously, self-efficacy level has been proposed to be higher in those conditions that allow for similarity among tasks, i.e. constant and blocked conditions. Self-efficacy generalization is based on experience with variety related to a task. Thus, it is proposed that self-efficacy generalization will be higher in those conditions that allow for variety with a task (e.g., conditions that provide variable practice or random scheduling). A combination of variable practice and random scheduling, as in the variable practice condition, should exaggerate the effect on self-efficacy generalization.

Hypothesis 4. The individuals in the variable practice condition will have higher self-efficacy generalization than those individuals in the constant practice condition.

Taking into account both self-efficacy level and generality to generate the self-efficacy generalization gradient, it is proposed that those individuals in the constant practice condition will have higher self-efficacy that will lead to a higher curve (high level) with narrower generalization (low generality); while individuals in the variable practice condition will have lower self-efficacy that will lead to a lower curve (low level) with broader generalization (high generality; see Figure 2). It is further proposed that the generality of self-efficacy is more important than the level of self-efficacy in increasing transfer. That is, designing for transfer means including difficulty, as in the variable
Figure 2. A Generalization Gradient of Self-Efficacy for the Blocked Constant and Random Variable Practice Conditions.
practice condition, in order to form a broader self-efficacy generalization curve.

Self-efficacy level is based upon past experience with similar tasks. The identical elements strategy, referred to above (e.g., Ford et al, 1998), is comparable to exposing an individual to a task and then testing him or her on an identical or similar task. Increased similarity in tasks leads to increased levels of self-efficacy. This self-efficacy level will be related to the performance on the job; such that, confidence derived from practice with a certain task during training will be related to performance on similar tasks once on the job. However, this identical elements strategy is more specifically referring to self-efficacy level and its relatedness to near transfer performance and is not taking into consideration the importance of self-efficacy generalization and its relatedness to far transfer performance. Self-efficacy generalization is based upon past experience with a variety of tasks. Increased variability in tasks leads to increased generalization of self-efficacy. This self-efficacy generalization will also be related to performance on the job, such that confidence derived from practice with a variety of tasks during training will be related to performance on a variety of tasks once on the job.

**Hypothesis 5.** Self-efficacy level will be positively related to near transfer performance. Specifically, high self-efficacy levels will be related to high performance levels on a near transfer test.

**Hypothesis 6.** Self-efficacy generalization will be positively related to far transfer. Specifically, a broader self-efficacy generalization will be related to high performance levels on far transfer tests.

**Method**

**Participants**
Participants were eighty-two undergraduate students (36 men, 46 women), who received experimental credit in a psychology course for participating.

**Experimental Task**

The choice of task for this experiment was based upon several factors. First, the task had to be one in which the participants had no familiarity. Because past experience is known to affect self-efficacy, the only experience that the participants should have with the task was the practice they engaged in during this study. Second, the task had to be complex enough so that learning could actually occur and so that differences in performance could be discerned.

For these reasons, the task used in this experiment was a computer Naval Air Defense simulation presented on an IBM compatible microcomputer (Hollenbeck, Sego, Ilgen, & Major, 1997; Quiñones, 1995). An individual was to command a US Naval vessel and make decisions on a series of “targets”. In regard to the target, the individual was asked to take a defensive position (Ignore, Monitor, Warn, Ready, Defend; see Appendix 1) depending on the nine target attributes (speed, altitude, size, angle, IFF, direction, direction, corridor status, radar type, range; see Appendix 2).

The level of threat for a particular target depended on the values of the nine attributes. The values ranged from non-threatening to somewhat threatening to very threatening (see Appendix 3). For example, speed ranged in value from 100 to 800 mph (with 100-275 mph being non-threatening, 325-500 mph being somewhat threatening, and 600-800 mph being very threatening). Three interactions among six of the nine attributes existed helping to determine the level of threat. If one of the attributes in the interaction was non-threatening, then the interaction itself was non-threatening. For
example, speed and direction made up one interaction. If speed was in the non-threatening range, then the interaction of speed and direction was non-threatening. The individual was required then to not only know the level of threat (i.e., its value) associated with each attribute, but also the rules regarding which attributes combined for an interaction (see Appendix 3).

Each decision had to be made within an allotted amount of time. After each decision was made, the individual was given feedback (the outcome) as to the accuracy of his/her judgment. There were five possible outcomes for each trial of the simulation (hit, near miss, miss, incident, disaster). The outcome depended on the distance between the individual’s decision and the correct decision. The participant received a “hit” for a trial if the decision was correct. If the decision was one level away from the correct decision, then the participant received a “near miss”. For example, a near miss resulted if the participant chose “ignore” when the correct decision was “monitor”, which was one level away. If the decision was two levels away from the correct decision, then the participant received a “miss”. A decision that was three levels away from the correct decision resulted in an “incident”. Finally, a decision that was four levels away from the correct decision resulted in a “disaster”. Point values were awarded for each of the outcomes, such that a hit was equal to 2 points, a near miss equal to 1 point, a miss equal to 0 points, an incident equal to -1 point, and a disaster was equal to -2 points.

**Experimental Manipulations**

The experiment had one independent measure, the practice condition, in which type and scheduling of practice were manipulated to form the two practice conditions.
**Type of practice.** When looking through studies on variability of practice, the question arose: what exactly was variable practice. More specifically, what was it that should be variable during the practice. While some studies varied speed (Catalano & Kleiner, 1984; Wrisberg & Ragsdale, 1979), other studies varied the distance (Magill & Reeve, 1978; Margolis & Christina, 1981), and yet other studies varied the number of tasks (Duncan, 1958).

To date as of the author's knowledge, no one has looked at what components of the task should be varied for the most effective transfer. Though it has been noted that variable practice can be operationally defined in several ways (Husak & Reeve, 1979). In this study, variability of practice was operationalized as the number of attributes randomly assigned values by the computer. While some of the attributes were assigned a value randomly by the computer (i.e., these attributes were changing), the other attributes were controlled. The attributes controlled in the task referred to the attributes that the experimenter held at a fixed value (see Appendix 4). All fixed values were in the somewhat threatening range. Thus, it was then important for the participant to focus not on the controlled attributes, but on the changing attributes and their relationship to the other attributes to determine the level of threat for a target. In the constant practice condition, the number of attributes varied by the computer was 3. In the variable practice condition, the number of attributes varied by the computer was either 3 or 6. For example, in the variable practice condition 6 attributes, IFF, Size, Radar, Speed, Angle, and Altitude, were assigned values randomly by the computer while 3 attributes, Direction, Range, and Corridor Status, were held at the fixed values of 15 degrees, 75 miles, and 15 miles respectively.
The fact that only some attributes were changing was analogous to part task learning. In part learning, the task is broken down into components, only a few of which are focused on at a time (Goldstein, 1993). During the practice session, only a certain number of the attributes needed to be considered (part), though the participants actually had to measure all nine attributes to determine which attributes were relevant (whole). Because all nine attributes had to be measured by the participants, the difficulty was expected to be the same for the two practice conditions.

**Scheduling of practice.** Scheduling of practice was operationalized as the order in which the practice trials were given during the practice session. In the constant practice condition, all the trials with a specific set of attributes were practiced before moving on to practice trials with other sets of attributes. For example, participants in this condition viewed all the trials with Direction, Range, and Corridor Status held at fixed values and IFF, Size, Radar, Speed, Angle, and Altitude assigned values randomly by the computer before viewing the trials with Speed, Angle, and Altitude held at fixed values and IFF, Size, Radar, Direction, Range, and Corridor Status varied randomly by the computer. In the variable practice condition, the attributes were practiced in a random order such that the same set of attributes was never practiced in two sequential trials. For example, participants in this condition viewed the trials with Direction, Range, and Corridor Status held at fixed values (IFF, Size, Radar, Speed, Angle, and Altitude assigned values randomly by the computer) and the trials with Speed, Angle, and Altitude held at fixed values (IFF, Size, Radar, Direction, Range, and Corridor Status assigned values randomly by the computer) intermingled.

**Practice Conditions**
The extreme combination between type and scheduling of practice resulted in two practice conditions. An example of the attributes that were then randomly assigned values by the computer is shown in Table 1 for the practice conditions. An example of the attributes that were controlled by the experimenter is shown in Table 2 for the two practice conditions.

**Constant practice condition.** The number of attributes (3) assigned random values by the computer remained the same throughout the practice session (constant practice). The specific set of attributes being assigned values by the computer changed; however, all the trials with the specific set of attributes were practiced before beginning trials with the other sets of attributes (blocked scheduling). The set of attributes referred to the specific attributes assigned values by the computer at that time. As shown in Table 1, the set of attributes changed from the first sixteen trials to the second sixteen trials.

**Variable practice condition.** In this practice condition, the number of attributes (either 3 or 6) assigned random values by the computer varied throughout the practice session. The set of attributes was practiced in a random order, such that the same set of attributes was never practiced in two sequential trials. Further, the trials with sets of 3 attributes assigned values by the computer were interspersed with the trials with sets of 6 attributes assigned values by the computer. Table 1 shows how the set of attributes changed from one trial to the next as well as how the number of attributes assigned values by the computer changed from one trial to the next trial, i.e., from 3 to 6.

**Measures**

**Self-efficacy level.** Self-efficacy level was represented by six different measures: maximum self-efficacy level, maximum self-efficacy strength, maximum self-efficacy
Table 1

**Example of Attributes Randomly Assigned Values by the Computer.**

<table>
<thead>
<tr>
<th>Type</th>
<th>Blocked</th>
<th>Random</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>I Sp An</td>
<td>(first 16 trials)</td>
</tr>
<tr>
<td></td>
<td>Si D C</td>
<td>(second 16 trials)</td>
</tr>
<tr>
<td></td>
<td>Rd Al Rg</td>
<td>(third 16 trials)</td>
</tr>
<tr>
<td>Variable</td>
<td>I Sp An, I Si Rd Sp An Al, Si D C, I Si Rd D Rg C, Si D C, etc. (48 trials)</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Al = Altitude; An = Angle; C = Corridor Status; D = Direction; I = IFF; Rd = Radar; Rg = Range; Si = Size; Sp = Speed.
### Table 2

**Example of Attributes Controlled by the Experimenter.**

<table>
<thead>
<tr>
<th>Type</th>
<th>Blocked</th>
<th>Random</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>Si Rd D Rg Al C (first 16 trials)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I Rd Sp An Rg Al (second 16 trials)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I Si Sp D C An (third 16 trials)</td>
<td></td>
</tr>
<tr>
<td>Variable</td>
<td>Si Rd D Rg Al C, D Rg C, I</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rd Sp An Rg Al, Sp An Al, I</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rd Sp An Rg Al, etc. (48 trials)</td>
<td></td>
</tr>
</tbody>
</table>

**Note.** Al = Altitude; An = Angle; C = Corridor Status; D = Direction; I = IFF; Rd = Radar; Rg = Range; Si = Size; Sp = Speed.
predicted, sum of self-efficacy level, sum of self-efficacy strength, and sum of self-efficacy predicted. Previous research has looked into different ways of measuring this construct (Maurer & Pierce, 1998). Self-efficacy level was measured by summing the number of yes ratings for achieving various levels of points for a particular number of attributes being controlled. For example, when 3 attributes were controlled, the participant was asked to answer whether he/she could obtain X points for 10 trials. For each set of points, he/she answered yes or no. The “yes” answers were added together for the sum (see Appendix 5). Self-efficacy strength was the sum of confidence ratings (0% = no confidence, 100% = high confidence) for achieving various levels of points during a session for a particular number of attributes controlled. Self-efficacy predicted was the number participants indicated when asked to predict how many points they could achieve in 10 trials with a particular number of attributes controlled (held at fixed values).

The maximum self-efficacy level was computed by taking the maximum level across all number of attributes controlled. For example, when 4 attributes were controlled, the participant answered “yes” for all the point values up to 15-17 points. If this was the highest number of points that the participant answered “yes” to across all the number of attributes controlled (e.g., when 1, 2, 3, 5, 6, 7, 8, or 9 attributes were controlled), then this level was the maximum. The maximum self-efficacy strength was computed by taking the maximum strength across all number of attributes controlled. The maximum self-efficacy predicted was computed by taking the maximum predicted score across all number of attributes controlled. The sum of self-efficacy level was computed by summing the self-efficacy level across all number of attributes controlled. The sum of self-efficacy strength was computed by summing the self-efficacy strength across all
number of attributes controlled. The sum of self-efficacy predicted was computed by
summing the self-efficacy predicted across all number of attributes controlled. The self-
efficacy level measure was completed in between the training session and the transfer
test.

**Self-efficacy generalization.** Self-efficacy generalization was measured with
standard deviation. Standard deviation level, standard deviation strength, and standard
development predicted were computed by taking the score on each number of attributes
controlled (the value from the self-efficacy level, self-efficacy strength, and self-efficacy
predicted respectively) and using the negative standard deviation across all these values;
such that, a smaller standard deviation meant a broader generalization. This measure was
also taken between the training session and the transfer test.

**Training performance.** The number of points for a trial was based upon the
accuracy of the judgment made. Participants' training performance was assessed by
summing the total number of points attained for all trials during the practice session.
Then, to compute the performance accuracy, the total number of points obtained was
divided by the total number of points possible.

**Transfer performance.** The number of points for a trial was based upon the
accuracy of the judgment made, just as in the training performance measure. Participants' transfer performance was assessed by summing the total number of points attained for all
trials during the transfer test. More specifically, near transfer was measured by the
number of points attained on those trials identical to those practiced during training. Far
transfer was measured by the number of points attained on those trials that had not been
previously practiced in training. Each transfer test was then divided by the total number of points possible to compute the transfer performance accuracy scores.

For all the practice conditions, near transfer was tested on trials in which 3 attributes were varied by the computer and 6 attributes were controlled by the experimenter. This transfer measure was referred to as near transfer in analyses. Far transfer tests were the same for all conditions. They were those trials in which 2, 5, or 8 attributes were assigned values randomly by the computer and 7, 4, or 1 attribute(s) were held fixed by the experimenter, respectively. The far transfer measures were named in relation to the near transfer test. For example, as the near transfer test had 3 cues varying, the transfer test with 2 cues varying was a distance of one away from the near transfer test. As such, this transfer test was called transfer distance (+1). The transfer test in which 5 cues were varying was a distance of two away from the near transfer test, and as such, was called transfer distance (+2). Finally, the transfer test with 8 cues varying was a distance of five away from the near transfer test, and as such, was termed transfer distance (+5).

Individual difference measures. A measure of general self-efficacy ($\alpha = .85$; Sherer, Maddux, Mercandante, Prentice-Dunn, Jacobs, & Rogers, 1982; see Appendix 6) and a measure of general cognitive ability (Wonderlic, 1992) were given before the training session began. The use of these measures as covariates was necessary in order to control for any prior differences in the participants’ self-efficacy or cognitive ability.

Procedure

Participants were given a brief introduction to the experiment during which time they were given premeasures. Following the completion of these measures, the
participants were given a packet with a description of the rules and values of all attributes. They were told that X number of attributes would be changing while the other attributes would remain at fixed values. They also were told to measure all nine attributes since they would not know which attributes changed. Further, they were told that their scores would be reflective of the accuracy with which they judged each target.

The participants were randomly assigned to one of the experimental conditions: the constant practice condition, or the variable practice condition. Each participant completed the experiment individually. Participants in the constant practice condition received training on 3 attributes changing, 6 attributes controlled. Participants in the variable practice condition received training on both 3 attributes changing, 6 attributes controlled and 6 attributes changing, 3 attributes controlled. Participants in both conditions practiced the computer task for a total of 48 trials. Following the training session, participants were given a task self-efficacy measure. After completion of the self-efficacy measure, the participants were tested on a transfer task. All participants were tested on the number of changing attributes with which they practiced during training and were also tested on numbers of changing attributes with which they had not previously practiced.

Analyses

To test the first hypothesis, a regression, with training performance as the dependent measure, practice condition as the independent measure, and general cognitive ability as a covariate, was conducted. To test the second hypothesis, a regression was conducted with transfer performance as the dependent measure, practice condition as the independent measure, and general cognitive ability as a covariate. This covariate allowed
for the consideration of the influence of training on the participants’ performance controlling for the impact of an important individual difference (cognitive ability).

Byrnes (1995) has argued for the control of cognitive ability in situations in which "the speed of information processing could affect performance" (p. 7). As the task in this experiment was in fact limited in time, the use of general cognitive ability as a covariate seemed appropriate. Moreover, to ensure that the assumption of homogeneity of slopes was not violated, the interaction between general cognitive ability and practice condition was entered into the regression model for the first and second hypotheses. Finally, the effect of gender was considered as a potential covariate for these analyses.

The third hypothesis was tested by conducting a regression with self-efficacy level as the dependent measure, practice condition as the independent measure, and both general self-efficacy and general cognitive ability as covariates. Similarly, to test the fourth hypothesis, a regression, with self-efficacy generalization as the dependent measure, practice condition as the independent measure, and both general self-efficacy and general cognitive ability as covariates, was conducted. Again, the purpose of these covariates was to control for individual differences (i.e., self-efficacy and cognitive ability) that might be influencing self-efficacy, thereby isolating the effect of training condition on self-efficacy. Again, the interactions between general cognitive ability and practice condition and between general self-efficacy and practice condition were entered into the regression model to ensure the assumption of homogeneity of slopes was not violated. Finally, gender was considered as a covariate for these analyses.

A correlation analysis was conducted on the self-efficacy level measure and the near transfer measure to test the fifth hypothesis. This hypothesis was also tested by
conducting a regression using near transfer as the dependent measure, self-efficacy level as the independent measure, and both self-efficacy generalization and training condition as the covariates. Similarly, a correlation analysis was conducted on the self-efficacy generalization measure and the far transfer measures to test the sixth hypothesis. In addition, a regression was conducted using each of the three far transfer measures (transfer distance (+1), (+2), and (+5)) as the dependent measures, self-efficacy generalization as the independent measure, and both self-efficacy level and training condition as the covariates to test this hypothesis.

Results

All outliers more than three standard deviations away from the mean were replaced with the grand mean. Most of the measures approached a normal distribution. However, the training performance accuracy variable was slightly negatively skewed and thus, was transformed. As the transformation did not change the results of the analyses, all analyses were conducted using the original measures.

Table 3 presents the descriptive statistics for the dependent measures in hypotheses 1 thru 4, and Table 4 presents these descriptive statistics with covariates (e.g., general cognitive ability, general self-efficacy). The effects of the analyses run on hypotheses 1 - 4 covarying out general cognitive ability are summarized in Table 5. The detailed analyses for each of the hypotheses are discussed in the subsequent sections.

Overall Performance Trends

From Figure 3, one can see that the training performance accuracy of the conditions increased over the blocks of training. The training accuracies appear to increase differently for the two practice conditions ($F(2,160) = 12.95, p < .001$). The
Table 3

A summary of the dependent measures' means and standard errors for the practice conditions.

<table>
<thead>
<tr>
<th></th>
<th>Mean(^a)</th>
<th>SD(^a)</th>
<th>Mean(^b)</th>
<th>SD(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training performance</td>
<td>.724</td>
<td>.067</td>
<td>.716</td>
<td>.062</td>
</tr>
<tr>
<td>Near Transfer</td>
<td>.807</td>
<td>.104</td>
<td>.762</td>
<td>.095</td>
</tr>
<tr>
<td>Transfer distance (+1)</td>
<td>.837</td>
<td>.092</td>
<td>.787</td>
<td>.100</td>
</tr>
<tr>
<td>Transfer distance (+2)</td>
<td>.711</td>
<td>.124</td>
<td>.757</td>
<td>.120</td>
</tr>
<tr>
<td>Transfer distance (+5)</td>
<td>.676</td>
<td>.123</td>
<td>.739</td>
<td>.106</td>
</tr>
<tr>
<td>Self-efficacy level</td>
<td>-.403</td>
<td>5.01</td>
<td>.403</td>
<td>5.16</td>
</tr>
<tr>
<td>Self-efficacy generalization</td>
<td>.464</td>
<td>2.72</td>
<td>-.464</td>
<td>2.43</td>
</tr>
</tbody>
</table>

Note. \(^a\) coded 1 = constant practice condition, \(^b\) coded 2 = variable practice condition.
Table 4

A summary of the dependent measures’ means and standard errors for the practice conditions with the covariates.

<table>
<thead>
<tr>
<th></th>
<th>Mean(^a)</th>
<th>SD(^a)</th>
<th>Mean(^b)</th>
<th>SD(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training performance(^c)</td>
<td>.720</td>
<td>.091</td>
<td>.720</td>
<td>.091</td>
</tr>
<tr>
<td>Near transfer(^c)</td>
<td>.801</td>
<td>.136</td>
<td>.768</td>
<td>.136</td>
</tr>
<tr>
<td>Transfer distance (+1)(^c)</td>
<td>.834</td>
<td>.136</td>
<td>.790</td>
<td>.136</td>
</tr>
<tr>
<td>Transfer distance (+2)(^c)</td>
<td>.709</td>
<td>.172</td>
<td>.760</td>
<td>.172</td>
</tr>
<tr>
<td>Transfer distance (+5)(^c)</td>
<td>.674</td>
<td>.163</td>
<td>.741</td>
<td>.163</td>
</tr>
<tr>
<td>Self-efficacy level(^d)</td>
<td>-.540</td>
<td>6.83</td>
<td>.540</td>
<td>6.83</td>
</tr>
<tr>
<td>Self-efficacy generalization(^d)</td>
<td>.546</td>
<td>3.54</td>
<td>-.546</td>
<td>3.54</td>
</tr>
</tbody>
</table>

Note. \(^a\) coded 1 = constant practice condition, \(^b\) coded 2 = variable practice condition; \(^c\) with general cognitive ability as a covariate, \(^d\) with general cognitive ability and general self-efficacy as covariates.
Table 5

Summary table of the effect of practice condition on the dependent measures with general cognitive ability as a covariate.

<table>
<thead>
<tr>
<th></th>
<th>General Cognitive Ability</th>
<th>Practice Condition $^a$</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training performance</td>
<td>.262**</td>
<td>-.001</td>
<td>.069*</td>
</tr>
<tr>
<td>Near Transfer</td>
<td>.259**</td>
<td>-.161</td>
<td>.113**</td>
</tr>
<tr>
<td>Transfer distance (+1)</td>
<td>.115</td>
<td>-.224**</td>
<td>.076**</td>
</tr>
<tr>
<td>Transfer distance (+2)</td>
<td>.076</td>
<td>.207*</td>
<td>.041</td>
</tr>
<tr>
<td>Transfer distance (+5)</td>
<td>.085</td>
<td>.288**</td>
<td>.078**</td>
</tr>
<tr>
<td>Self-efficacy level</td>
<td>.091</td>
<td>.121</td>
<td>.025</td>
</tr>
<tr>
<td>Self-efficacy generalization</td>
<td>-.201*</td>
<td>-.231**</td>
<td>.074*</td>
</tr>
</tbody>
</table>

Note. ** $p < .05$, * $p < .10$; $^a$ coded 1 = constant practice condition, 2 = variable practice condition.
Figure 3. *Training Performance in Blocks as a Function of Practice Condition.*
trend appears to be linear, though slightly different for two conditions. This pattern is reflected in the training block linear by condition interaction ($F(1, 80) = 18.933, p < .001$).

In looking at the trends as shown in Figure 4, two observations become apparent. First, the constant practice condition dropped below the initial training performance level in transfer whereas the variable condition never drops below its initial training level in transfer (even in the transfer test where it performs the lowest). To test whether the training performance was significantly different from the transfer distance (+5), a paired comparison was made for each condition. Specifically, the constant condition’s performance accuracy was worse in the transfer distance (+5) test ($M = .676$) than during training ($M = .724, t(40) = 2.40, p = .021$). However, the variable condition’s performance accuracy was better in the transfer distance (+5) test ($M = .740$) than during training ($M = .716, t(40) = -1.37, p = .180$), though this difference was not significant.

Second, it appears from Figure 4 that the variable practice condition’s performance accuracy was lower in the near transfer and in the transfer distance (+1), but higher in the transfer distance (+2) and (+5) than the constant practice condition. Thus, it seems that the farther the transfer distance, the better the variable practice condition performed relative to the constant practice condition. This pattern is reflected in the interaction between transfer distance linear and condition ($F(1, 80) = 14.71, p < .001$). Figure 5 shows that the means were in fact in the expected direction with the variable condition ($M = -.07, SD = .483$) having a higher performance mean (weighted by the linear contrast) than the constant practice condition ($M = -.52, SD = .456$).
Figure 4. Training and Transfer Performance as a Function of Practice Condition.
Figure 5. Linear Contrast of Transfer Distance by Condition Interaction.
Finally, the effect of gender on performance accuracy was considered. A Multivariate Analysis of Variance (MANOVA) revealed that the effect of gender on the performance accuracy measures was non-significant ($F(5, 74) = 1.33, p > .05$). Thus, gender was not considered as a covariate in the analyses with performance accuracy as the dependent measure.

**Training Performance**

In Hypothesis 1, I predicted that the constant condition would outperform the variable condition during the training session. An analysis of covariance was conducted covarying out the differences in general cognitive ability (as measured by the Wonderlic) from training performance accuracy. First, to ensure that the homogeneity of slopes assumption was not violated, the interaction between general cognitive ability and practice condition on training performance was tested ($\beta = -0.824, p = .254$). As the assumption was not violated, the analysis of covariance followed. The overall model explained 6.9% of the variance in training performance. The effect for the covariate general cognitive ability on training performance was significant ($\beta = 0.262, p = .022$). The difference between the constant practice condition ($M = .720, SD = .091$) and the variable practice condition ($M = .720, SD = .091, p = .995$) in training performance was non-significant. Thus, Hypothesis 1 was not supported.

**Transfer Performance**

In Hypothesis 2, I predicted that the variable condition would outperform the constant condition in the transfer session. Transfer performance was tested using four measures. A regression model was tested for each of these four measures: near transfer, transfer distance (+1), transfer distance (+2), transfer distance (+5). Again, analyses of
covariance were conducted covarying out the differences in general cognitive ability from transfer performance accuracy.

**Near transfer.** In order to ensure that the assumption of homogeneity of slopes was not violated, the interaction between general cognitive ability and practice condition on near transfer performance was tested ($\beta = 0.121$, $p = .864$). Because the assumption was not violated, the analysis of covariance proceeded. The overall model explained 11.3% of the variance in near transfer performance. The effect for the covariate general cognitive ability on near transfer performance was significant ($\beta = 0.259$, $p = .020$). The difference between the constant condition ($M = .801$, $SD = .136$) and the variable condition ($M = .768$, $SD = .136$, $p = .144$) in near transfer performance was non-significant. Thus, this finding added no support to Hypothesis 2.

**Transfer distance (+1).** Once more, to make certain that the assumption of homogeneity of slopes was not violated, the interaction between general cognitive ability and practice condition was examined ($\beta = 0.464$, $p = .521$). Since the assumption was not violated, the analysis of covariance was conducted. The overall model explained 7.6% of the variance in transfer distance (+1) performance. The effect for the covariate general cognitive ability on transfer distance (+1) performance was non-significant ($\beta = 0.115$, $p = .304$). The difference between the constant condition ($M = .834$, $SD = .136$) and the variable condition ($M = .790$, $SD = .136$, $p = .047$) in transfer distance (+1) performance was significant. However, the constant condition performed better than the variable condition, which was not the expected direction. Thus, this finding added no support to Hypothesis 2.
Transfer distance (+2). Again, to test that the assumption of homogeneity of slopes was not violated, the interaction between general cognitive ability and practice condition on transfer distance (+2) performance was examined ($\beta = -0.583, p = .427$). As the assumption was not violated, the analysis of covariance continued. The overall model explained 4.1% of the variance in transfer distance (+2) performance. The effect for the covariate general cognitive ability on transfer distance (+2) performance was non-significant ($\beta = 0.076, p = .506$). The difference between the variable condition ($M = .760, SD = .172$) and the constant condition ($M = .709, SD = .172, p = .072$) in transfer distance (+2) performance was marginally significant. The variable condition performed better than the constant condition as expected. Thus, partial support was found for Hypothesis 2.

Transfer distance (+5). Finally, the interaction between general cognitive ability and practice condition on transfer distance (+5) performance was tested to check that the assumption of homogeneity of slopes was not violated ($\beta = -0.817, p = .256$). Since the assumption was not violated, the analysis of covariance was conducted. The overall model explained 7.8% of the variance in transfer distance (+5) performance. The effect for the covariate general cognitive ability on transfer distance (+5) performance was non-significant ($\beta = 0.085, p = .450$). The difference between the variable condition ($M = .741, SD = .163$) and the constant condition ($M = .674, SD = .163, p = .012$) in transfer distance (+5) performance was significant. The variable condition did perform better than the constant condition. Thus, partial support was found for Hypothesis 2.
Overall, partial support was found for Hypothesis 2 as two (transfer distance (+2), transfer distance (+5)) of the four far transfer measures followed the prediction that the variable condition would outperform the constant condition.

**Self-efficacy**

The nine self-efficacy measures were factor analyzed using a Principal Components Factor Analysis with a Varimax Rotation. The first factor was termed self-efficacy level consisting of the six measures intended to capture this component of self-efficacy (Eigen value = 4.45; standardized $\alpha = .92$). These measures included the sum of self-efficacy level, the sum of self-efficacy strength, the sum of self-efficacy predicted, the maximum of self-efficacy level, the maximum of self-efficacy strength, and the maximum of self-efficacy predicted. The second factor was named self-efficacy generalization as it consisted of the three measures meant to assess this component of self-efficacy (Eigen value = 2.58; standardized $\alpha = .84$). These measures included standard deviation of self-efficacy level, standard deviation of self-efficacy strength, and standard deviation of self-efficacy predicted. These two factors accounted for 78.10% of the variance. All further analyses were conducted on the two composite measures.

As mentioned previously, the effect of gender on self-efficacy was explored. A MANOVA revealed that the effect on gender on the self-efficacy measures was significant ($F(2, 77) = 4.42, p = .015$). As such, gender was considered as a covariate in the analyses with self-efficacy as a dependent measure.

**Self-efficacy level.** In Hypothesis 3, the constant condition was predicted to have higher self-efficacy level than the variable condition. An analysis of covariance was conducted covarying out the effects of cognitive ability, general self-efficacy, and gender
from the self-efficacy level measure. First, the interactions between general self-efficacy and practice condition ($\beta = -.662$, $p = .473$), between general cognitive ability and practice condition ($\beta = 0.004$, $p = .996$), and between gender and practice condition ($\beta = -.052$, $p = .915$) were examined to ensure that the assumption of homogeneity of slopes was not violated. As the assumption was not violated, the analysis of covariance was conducted. The overall model accounted for $16.8\%$ of the variance in self-efficacy level.

The results showed a significant effect for the covariate general self-efficacy on self-efficacy level ($\beta = .300$, $p = .009$), a non-significant effect for the covariate general cognitive ability on self-efficacy level ($\beta = .110$, $p = .316$), and a non-significant effect for the covariate gender on self-efficacy level ($\beta = -.155$, $p = .169$). The variable condition ($M = .540$, $SD = 6.83$) did not significantly differ from the constant condition ($M = -.540$, $SD = 6.83$, $p = .323$) in self-efficacy level. Thus, Hypothesis 3 was not supported.

**Self-efficacy generalization.** In Hypothesis 4, the variable condition was predicted to have higher self-efficacy generalization than the constant condition. An analysis of covariance was conducted covarying out the effects of cognitive ability, general self-efficacy, and gender from the self-efficacy generalization measure. Once again, to make certain that the assumption of homogeneity of slopes was not violated, the interactions between general self-efficacy and practice condition ($\beta = .687$, $p = .491$), between general cognitive ability and practice condition ($\beta = .016$, $p = .982$), and between gender and practice condition ($\beta = 0.335$, $p = .500$) were tested. Their non-significance meant that no violation of the assumption had occurred, and therefore, the analysis of covariance proceeded. The overall model explained $8.4\%$ of the variance in self-efficacy
generalization. The results showed a non-significant effect for the covariate general self-efficacy on self-efficacy generalization (β = .007, p = .951), a significant effect for the covariate general cognitive ability on self-efficacy generalization (β = -.230, p = .042), and a significant effect for the covariate gender on self-efficacy generalization (β = .238, p = .040). The difference between the variable condition (M = -.546, SD = 3.54) and the constant condition (M = .546, SD = 3.54, p = .059) on self-efficacy generalization was marginally significant. The variable condition had broader self-efficacy generalization than the constant condition. Thus, partial support was found for Hypothesis 4.

**Self-efficacy and Transfer**

**Self-efficacy level.** Next, to test the relationship between self-efficacy level and near transfer (Hypothesis 5), a Pearson product-moment correlation was conducted (see Table 6). The relationship between self-efficacy level and near transfer was non-significant (r = -.04, p = .705). Thus, Hypothesis 5 was not supported.

As a different method of testing this relationship, an analysis of covariance was conducted predicting near transfer from self-efficacy level covarying out the effect of self-efficacy generalization and the effect of training condition. First, to ensure that the homogeneity of slopes assumption was not violated, the interactions between self-efficacy level and self-efficacy generalization (β = .175, p = .166) and between self-efficacy level and training condition (β = -.476, p = .181) were examined. As there was no violation of the assumption, the analysis of covariance was performed. The overall model accounted for 6.9% of the variance in near transfer performance. The effect for the covariate training condition on near transfer was marginally significant (β = -.209, p = .067). The effect for the covariate self-efficacy generalization on near transfer was non-
Table 6

**Correlations between the self-efficacy measures and transfer measures.**

<table>
<thead>
<tr>
<th></th>
<th>Self-efficacy level</th>
<th>Self-efficacy generalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near Transfer</td>
<td>-.04</td>
<td>.11</td>
</tr>
<tr>
<td>Transfer distance (+1)</td>
<td>.05</td>
<td>.06</td>
</tr>
<tr>
<td>Transfer distance (+2)</td>
<td>.16</td>
<td>-.35**</td>
</tr>
<tr>
<td>Transfer distance (+5)</td>
<td>.21</td>
<td>-.16</td>
</tr>
</tbody>
</table>

*Note.* **p < .01**
significant ($\beta = .072, p = .523$). Further, the effect for self-efficacy level on near transfer was non-significant ($\beta = -.021, p = .853$). Thus, no support was found Hypothesis 5.

**Self-efficacy generalization.** Finally, to test the relationship between self-efficacy generalization and far transfer (Hypothesis 6), a Pearson product-moment correlation was conducted between self-efficacy generalization and each of the three far transfer measures: transfer distance (+1), transfer distance (+2), and transfer distance (+5) (see Table 6). The relationships between self-efficacy generalization and transfer distance (+1) ($r = .06, p = .592$) and between self-efficacy generalization and transfer distance (+5) ($r = -.16, p = .152$) were non-significant. The relationship between self-efficacy generalization and transfer distance (+5), though, was in the predicted direction with the broader the self-efficacy generalization (indicated by a smaller standard deviation), the higher the transfer performance. However, the relationship between self-efficacy generalization and transfer distance (+2) performance was significant ($r = -.35, p < .01$) and in the predicted direction with the broader the self-efficacy generalization (indicated by a smaller standard deviation), the higher the transfer performance. Thus, Hypothesis 6 was partially supported.

As a different method of testing this relationship, an analysis of covariance was conducted for each of the three far transfer measures using training condition and self-efficacy level as covariates in the analyses. First, to check that the homogeneity of slopes assumption was not violated, the interactions between self-efficacy level and self-efficacy generalization ($\beta = .026, p = .836$) and between self-efficacy generalization and training condition ($\beta = -.300, p = .395$) were examined. As there was no violation of the assumption, the analysis of covariance were performed. The overall model accounted for
6.9% of the variance in transfer distance (+1) performance. The effect for the covariate training condition on transfer distance (+1) was significant ($\beta = -0.255$, $p = 0.025$). The effect for the covariate self-efficacy level on transfer distance (+1) performance was non-significant ($\beta = 0.075$, $p = 0.494$). Further, the effect for self-efficacy generalization on transfer distance (+1) performance was non-significant ($\beta = 0.020$, $p = 0.858$).

Again, the interactions between self-efficacy level and self-efficacy generalization ($\beta = 0.171$, $p = 0.157$) and between self-efficacy generalization and training condition ($\beta = -0.137$, $p = 0.680$) were examined to make certain that the homogeneity of slopes assumption was not violated. Because the assumption was not violated, the analysis of covariance was conducted. The overall model accounted for 15.5% of the variance in transfer distance (+2). The effect for the covariate training condition on transfer distance (+2) was non-significant ($\beta = 0.121$, $p = 0.256$). The effect for the covariate self-efficacy level on transfer distance (+2) performance was non-significant ($\beta = 0.131$, $p = 0.216$). However, the effect for self-efficacy generalization on transfer distance (+2) was significant ($\beta = -0.317$, $p = 0.004$).

Lastly, the interactions between self-efficacy level and self-efficacy generalization ($\beta = 0.124$, $p = 0.318$) and between self-efficacy generalization and training condition ($\beta = -0.215$, $p = 0.528$) were tested to ensure that the homogeneity of slopes assumption was not violated. Since the assumption was not violated, the analysis of covariance was performed. The overall model accounted for 11.8% of the variance in transfer distance (+5) performance. The effect for the covariate training condition on transfer distance (+5) was significant ($\beta = 0.234$, $p = 0.034$). The effect for the covariate self-efficacy level on transfer distance (+5) performance was marginally significant ($\beta = $
.183, p = .091). The effect for self-efficacy generalization on transfer distance (+5)
performance was non-significant (β = -.104, p = .339). Thus, partial support was found
for Hypothesis 6.

Discussion

Previous studies have investigated the effect of practice design on transfer finding
that the constant practice condition outperforms the variable practice condition during
training and further that the variable practice condition outperforms the constant practice
condition on transfer tests (Hall & Magill, 1995). Other studies have examined the effect
of self-efficacy on transfer finding that higher self-efficacy leads to increased transfer
(Gist et al., 1991). However, the type of practice (variable) that leads to better transfer
may lead to lower self-efficacy because of the increased difficulty leading to lower
successes. Thus, the paradox arises: designing training to increase transfer (e.g., by
increasing task variation) can serve to lower a person’s self-efficacy. The purpose of the
present study was to examine this possible paradox between the effect of the training
design and the effect of self-efficacy on transfer.

Summary of findings

Training performance. The constant practice condition was predicted to perform
better than the variable practice condition during training. The present study found no
difference between the two practice conditions in training performance. Though this
finding is inconsistent with previous studies (e.g., Catalano & Kleiner, 1984), there are a
couple of explanations as to why this effect was not present.

One possible explanation lay in the fact that the finding of variable practice (even
with random spacing) leading to detrimental training performance is not robust. There
have been several studies unable to find this effect (Zelaznik, 1977; Margolis & Christina, 1981). Even the classic study by Kerr and Booth (1978) did not observe the variable practice condition performing worse in training than the constant practice condition. Another possible explanation stems from the manipulation of variability. Specifically, there has been no consensus on how to operationalize variability. As such, there was some difficulty in deciding upon how to manipulate variability of practice in the present study. While some studies have operationalized variability by fluctuating distance (e.g., Zelaznik, 1977), other studies have investigated variability by changing speed (e.g., Catalano & Kleiner, 1984). The present study manipulated variability by varying the number of attributes that changed. The inconsistent definition of variability leads to multiple ways in which variability can be operationalized and thus, could be the reason for the non-robust effect of variability leading to detrimental training performance. And more relevant to the present study, the operationalization of variability may have led to the lack of a difference between the practice conditions in training performance.

Transfer performance. The variable condition did perform better than the constant condition on two of the four transfer tests. Although the variable condition did not outperform the constant condition on all of the transfer tests as was predicted, the pattern is especially interesting. The pattern on the transfer tests shows that the variable condition never returns to its initial training performance level while the constant condition returns to its initial training performance level and even goes below this initial level. So while the variable condition did not perform better on all the transfer tests, this condition did have a smaller range in performance levels than the constant condition making for a more consistent performance across the transfer tests.
In previous research, experimenters have found that variable practice and random spacing lead to better transfer performance. The present results are only partially consistent with previous findings. Not only do the explanations apply that were mentioned above (e.g., weak effect, manipulation of variability), but there is also another explanation for the partial support. The present study used multiple tests of transfer whereas previous studious have often only used one type of transfer test. It could be that the degree of transfer (i.e., varying from near to far) may influence the effect. That is, the present experiment used near and far transfer tests while previous studies, which have found an effect, have mainly used far transfer tests (e.g., Catalano & Kleiner, 1984; Hall & Magill, 1995; Margolis & Christina, 1981). Similarly, the support in the present study was found in those transfer tests that were far transfer, especially the transfer test (single cue) that was the most dissimilar from the original training trials. Moreover, Newell and Shapiro (1976) and Lee et al. (1985) divided their transfer tests into “inside” the range that was practiced and “outside” the range that had been practiced during training. The variable practice condition only performed better during the outside transfer test. The present study conforms to the finding in the Newell and Shapiro (1976) and the Lee et al. (1985) studies: the variable condition outperforms the constant condition in the test (transfer distance (+5)) that is outside the range practiced by both conditions, but does not outperform the constant group in the test (near transfer) that is inside the range practiced by both conditions. These results can be taken as evidence for the claim that the degree of transfer makes a difference in the effect of type of practice on performance.

Self-efficacy as a dependent measure. Previous research has found that self-efficacy is enhanced in those training conditions that lead to successful performance
(Bandura, 1982; Gist, 1986; Gist, 1989). The present study found no evidence of self-efficacy level being enhanced by a specific practice condition as predicted. There are three explanations that could possibly account for why there was no effect of the training condition on self-efficacy level. The first reason results from the similar performances of the two conditions during training. The logic for the third hypothesis stemmed from the expectation that the constant condition would lead to better performance (a source of self-efficacy), and therefore, to a higher self-efficacy level (Bandura, 1977). As there was no significant effect of the practice condition on training performance, it follows that there was no significant effect of the practice condition on self-efficacy level. In other words, as neither condition leads to this source of self-efficacy (i.e., performance accomplishments), it follows then that neither condition would lead to better self-efficacy level.

The direct test of the effect of performance on self-efficacy leads to another inconsistency with past research (e.g., Martocchio & Judge, 1997), as the training performance did not impact self-efficacy level ($\beta = .172$, $p = .122$). Given that performance during training did not influence self-efficacy level, a second explanation follows. Participants could have thought failure during training was expected as they were just learning the task. As such, their confidence level would not have been influenced by any failure that would have occurred during training. Further, there was no basis of comparison for the trainees to know how they were performing. Thus, the trainees may not have realized they were performing poorly (i.e., performance could not influence their self-efficacy if the trainees did not realize how they were performing).

Finally, as a third explanation, self-efficacy level may not be the component of self-
efficacy that the training design impacts. Previous researchers have looked at self-efficacy, but they have either not broken it down into its components (i.e., using a scale to measure general self-efficacy) or have only looked at one component of self-efficacy as representative of the whole construct. For example, Gist (1989), while investigating the impact of training design on self-efficacy, used self-efficacy strength as her measure of trainees' self-efficacy.

However, the present study did find support for self-efficacy generalization being broader in the variable condition with general cognitive ability, general self-efficacy, and gender as covariates. This is consistent with the prediction and is also consistent with previous research that depicts training design can influence self-efficacy (Eden & Aviram, 1993). It may be the case that self-efficacy generalization is the component of self-efficacy that is impacted by training design and thus, a necessary component to measure.

**Self-efficacy as an independent variable.** The present study breaks down the components of self-efficacy and transfer in order to understand their relationship. Specifically, this study seeks to determine whether the relationships between self-efficacy level and near transfer and between self-efficacy generalization and far transfer exist. Self-efficacy level was not related to near transfer; however, self-efficacy generalization was related to far transfer but for only one of the three far transfer measures. The inconsistent pattern results in weak evidence for the existence of such a relationship between self-efficacy and transfer; nevertheless, it does offer some support.

A possible explanation for the weak relationship between self-efficacy and transfer found in this study comes from the possible existence of a strong relationship
between training performance and transfer performance. To test this relationship, a regression was conducted predicting transfer performance from training performance covarying out the effects of self-efficacy level and self-efficacy generalization. The covariate self-efficacy level did not have an effect on transfer distance (+2) performance ($\beta = .133$, $p = .217$) whereas the covariate self-efficacy generalization did have an effect on transfer distance (+2) performance ($\beta = -.336$, $p = .002$). Training performance did not have an effect on transfer distance (+2) performance ($\beta = .035$, $p = .742$). The covariates self-efficacy level and self-efficacy generalization did not have an effect on transfer distance (+5) performance ($\beta = .173$, $p = .121$; $\beta = -.134$, $p = .221$; respectively). Again, training performance did not have an effect on transfer distance (+5) performance ($\beta = .156$, $p = .159$). The covariates self-efficacy level and self-efficacy generalization did not have an effect on near transfer performance ($\beta = -.082$, $p = .455$; $\beta = .128$, $p = .240$; respectively) or transfer distance (+1) performance ($\beta = .021$, $p = .851$; $\beta = .080$, $p = .472$; respectively). However, training performance had a significant effect on near transfer performance ($\beta = .267$, $p = .011$), and a significant effect on transfer distance (+1) performance ($\beta = .223$, $p = .050$). Thus, in explaining transfer performance, the training performance cannot be ignored as it appears to be related to transfer performance and, in some cases, appears to be more important than self-efficacy in predicting transfer performance.

**Future research**

In this study, several questions are left unanswered as well as brought to light. First, in an effort to synthesize all the research that has been conducted to date on the type of practice effect, a meta-analysis should be performed. A meta-analysis reviewing this
research area might shed more light on whether or not variable practice consistently leads to better transfer.

As mentioned previously, there is no concrete definition of "variable" practice. Future research should explore the definition of variability. Specifically, research should investigate what type of variable practice (not only what component of the task is varied, but also how that component is varied) leads not only to a decrease in training performance but also to an increase in transfer performance. In another effort to clarify this area of research, the type of task used in these studies should be considered. Much of the research (e.g., Catalano & Kleiner, 1984) on this topic has used tasks involving motor skills while the task used in the present study was computer-based. A future research question could address whether the type of practice effect is dependent on the task.

Once more, in regard to practice, the degree of transfer is an issue that should be more thoroughly investigated. Previous research (e.g., Hall & Magill, 1995) has hinted at the idea that degree of transfer matters when experimenters use novel, "inside", or "outside" transfer tests. The present study provided an initial glimpse into the degree of transfer question. However, further research should look into this question in more detail in order to establish whether the variability effect is restricted to far transfer tests.

Another question that developed from the results of the study is whether attributions made by the participants are important, specifically, whether the trainee attributes the failure to being in training (external) or to himself/herself (internal). The attributions are particularly important as they may or may not affect the self-efficacy of the trainee. As such, research should be conducted to investigate the type of attributions made by the trainee during training about his or her performance in order to understand
how the training is viewed. Future studies should also investigate whether giving trainees more information about their performance (i.e., comparison with others’ performances) would affect the self-efficacy levels differently. In other words, if the trainee knows that his/her performance is worse than others’ performances, then the effect of the training condition on self-efficacy could be significantly impacted.

**Theoretical Implications**

The current study has a number of important theoretical implications. First, the proposed paradox between the two major transfer paradigms may not exist as originally thought as the training design did not lead to lower self-efficacy levels. However, it could be that the similarity in training performances by the practice conditions precluded the ability to investigate the paradox thoroughly. This similarity in performances could be a result of the type and scheduling of practice effect not being robust, or it could be the result of the task used in the study, which did not allow for the most effective manipulation of variability. Thus, the proposed paradox should not be ruled out as existing in the literature.

Secondly, the present study shows support for variable practice and random spacing (the variable practice condition) leading to better performance on transfer tests. This study also shows that this effect may not hold true for all transfer tasks, but in fact, may be dependent upon the degree of transfer (i.e., whether the test is near or far transfer). Thus, experiments should not constrict transfer tasks, but broaden those given after training to gain a better understanding of the effect that variable practice and random scheduling have on transfer tests.
And finally, in addition to adding to the literature on the components needed in the design of training, the present study adds to the literature on self-efficacy. Specifically, this study gives an initial look into the construct of self-efficacy generalization. Bandura (1997) has mentioned the importance of the three constructs of self-efficacy, but little research has investigated these components empirically. The current study adds to this literature by actually measuring the self-efficacy generalization component. The study also looks into the effect that training design has upon self-efficacy generalization and into the effect that self-efficacy generalization has upon transfer performance.

Practical Implications

Two key practical implications result from the findings of the present study. First, as noted by Ghodsian et al. (1997), trainers should not focus on performance during training, as it is not indicative of the performance that will occur in transfer situations. Trainers should instead focus on performance during transfer tests, as this performance will yield a better measure of the performance likely to occur back on the job. And in line with the focus on transfer tests, trainers should use those techniques (e.g., variability, random scheduling) during training that will lead to an increase in far transfer performance.

Further, trainers should not look only at trainees’ confidence for a specific incident during training, but should also consider the trainees’ confidence across incidents that may not have taken place during training. This generalization of confidence (i.e., self-efficacy) becomes important, as most employees are not asked to perform one specific task but often to perform a spectrum of tasks, and thus need to have a generalized
self-efficacy for the complete spectrum. Therefore, trainers should provide methods
during training that are likely to increase the generalization of self-efficacy.

Limitations

The present study did in fact have some limitations. The main limitation of the
study pertains to the operationalization of variability (i.e., determining how to make a
component of the task variable). Manipulating variability by varying the number of
attributes that remained fixed may not have been the most effective way to manipulate
this construct. As such, this limitation may have had a significant impact on the results as
the operationalization of variability influenced the performance and in turn self-efficacy
of the participants.

A second limitation results from the task used in this study. Specifically, the task
itself made the manipulation of variability difficult in such a way that the manipulation
was not as clean as the researcher would have liked. Further, for a given task,
determining which component should be varied is an important question with little
empirical research. Thus, in the present study, the component varied in this computer task
may have not been the best one for optimizing transfer.

Conclusion

The present study sought to investigate an apparent paradox in the literature,
designing for an increase in transfer may lead to a decrease in self-efficacy. While the
training design did not in fact affect self-efficacy level, it did impact the self-efficacy
generalization of the trainees. Further, there was a relationship between far transfer and
self-efficacy generalization. Thus, self-efficacy generalization seems to serve as an
important component in relation to both training design and transfer. In conclusion, the
message that should be taken from this present study: designing for transfer can lead not only to greater transfer but also to broader self-efficacy generalization.
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Appendix 1

DESCRIPTION OF DECISION ALTERNATIVES

IGNORE: and never
This means that the carrier should devote no further attention to the target
instead focus on other possible targets in the area. An individual should
ignore a target that might possibly attack.

MONITOR:
A carrier can only monitor a few targets, thus monitoring diminishes the
individual’s overall patrol capacity.

WARN: itself
This means that the carrier should send a message to the target identifying
and alerting the target. Keep in mind that warn will never be the absolutely
correct response. However, sending a message of Warn when the correct
decision is Defend is much better than sending a decision of Ignore.

READY: weapons on
This means to steer the ship in a defensive position and set defensive
automatic. A ship in this position is rarely vulnerable to an attack. This
stance should not be taken on non-threatening targets since the weapons
are set to automatic and can mistakenly fire. A ship in this position cannot
readily use offensive measures on the target.

DEFEND: This is “weapons away” and means to attack the target. A Defend decision
cannot be aborted once initiated. This is only an appropriate response
when you feel the attack is imminent.
Appendix 2

**CHARACTERISTICS OF TARGETS**

The target can be measured on nine attributes, which are listed below along with the ranges of possible values on the attributes:

1. **SPEED:** 100 to 800 miles per hour (mph)
2. **ALTITUDE:** 5,000 to 35,000 feet
3. **SIZE:** size of target ranging from 50 to 50 meters
4. **ANGLE:** -15 (rapid descent) to +15 degrees (rapid ascent)
5. **IFF:** "Identification Friend or Foe". This is a radio signal that identifies whether an aircraft is civilian, para-military, or military, ranging from .2 Mhz (an airliner) to 1.6 Mhz (a fighter aircraft)
6. **DIRECTION:** from +40 degrees (passing far to the east or west of the carrier) or 00 degrees (coming straight to the carrier)

7. **CORRIDOR STATUS:** a corridor is a 20 mile lane open to commercial air traffic. Status is expressed in terms of miles from the center of the corridor, ranging from 1 mile (in the middle of it) to 50 miles (way outside of it)
8. **RADAR TYPE:** (weather
   the kind of radar possessed by the aircraft ranging from Class 1 radar only) to Class 9 (weapons radar)
9. **RANGE:** distance of the aircraft from the carrier ranging anywhere from 20 to 200 miles
Appendix 3

DETERMINING THE LEVEL OF THREAT

In general, the degree to which an incoming target is threatening depends on its standing on the nine attributes. There are six rules to remember in determining the danger associated with any target:

(a) all else being equal, in terms of IFF, military targets are more threatening than civilian targets (see attribute #5)
(b) all else being equal, in terms of SIZE, small objects are more threatening than large objects (see attribute #3)
(c) all else being equal, in terms of RADAR, targets with weapons radar are more threatening than targets with weather radar (see attribute #8)
(d) SPEED and DIRECTION go together, so that fast targets coming in straight are most threatening (see #1 and #6 above). Speed alone and direction alone mean nothing. There is nothing to fear if fast targets are not headed toward the carrier. There is nothing to fear from slow targets headed directly toward the carrier.
(e) ANGLE and RANGE go together, so that descending targets that are close are especially threatening (see #4 and #9 above). Angle alone and range alone mean nothing. Descending targets that are far way, or close targets that are on their way up are not threatening.
(f) ALTITUDE and CORRIDOR STATUS go together, so that low flying targets that are way outside the corridor are especially threatening (see #2 and #7 above). Altitude alone and corridor status alone mean nothing. There is nothing to fear from high flying targets well outside the corridor or low flying targets in the middle of the corridor.

RANGE OF ATTRIBUTES

The following chart will help you determine the level of threat associated with the different values of the nine attributes.

<table>
<thead>
<tr>
<th>Degree of Threat</th>
<th>Non-Threatening</th>
<th>Somewhat Threatening</th>
<th>Very</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>100-275 mph</td>
<td>325-500 mph</td>
<td>600-800 mph</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>----------------</td>
<td>----------------</td>
<td></td>
</tr>
<tr>
<td><strong>Altitude</strong></td>
<td>35,000-27,000 ft</td>
<td>23,000-17,000 ft</td>
<td>13,000-5000 ft</td>
</tr>
<tr>
<td><strong>Size</strong></td>
<td>65-43 m</td>
<td>37-23 m</td>
<td>17-10 m</td>
</tr>
<tr>
<td><strong>Angle</strong></td>
<td>+15 to +18 dgs</td>
<td>+3 to -3 dgs</td>
<td>-8 to -15 dgs</td>
</tr>
<tr>
<td><strong>IFF</strong></td>
<td>.2 to .6 Mhz</td>
<td>.9 to 1.1 Mhz</td>
<td>1.4 to 1.8 Mhz</td>
</tr>
<tr>
<td><strong>Direction</strong></td>
<td>30 to 22 dgs</td>
<td>18 to 12 dgs</td>
<td>8 to 0 dgs</td>
</tr>
<tr>
<td><strong>Corridor St.</strong></td>
<td>0 to 8 mi</td>
<td>12 to 18 mi</td>
<td>22 to 30 mi</td>
</tr>
<tr>
<td><strong>Radar Type</strong></td>
<td>Class 1 &amp; 2</td>
<td>Class 5</td>
<td>Class 8 &amp; 9</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>200 to 110 mi</td>
<td>90 to 60 mi</td>
<td>40 to 1 mi</td>
</tr>
</tbody>
</table>
Appendix 4

For each of the nine attributes, there will be trials during which the value of some attributes will be “fixed” by the experimenter. So another efficient strategy for determining the threat level is to know the point at which an attribute is being held at a fixed value. If you know the attribute is at its fixed value, then you will know that it is in the somewhat threatening range.

If you measure an attribute and the computer reads the below “fixed” value, this will be your clue to keep measuring attributes to find the ones that are changing (not held at their fixed value). Since the attributes with fixed values are always somewhat threatening, it will be important for you to determine the level of threat associated with each of the changing attributes and then to determine from the combination rules the level of threat for a target.

Fixed Values

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>413 mph</td>
</tr>
<tr>
<td>Altitude</td>
<td>20,000 ft</td>
</tr>
<tr>
<td>Size</td>
<td>30 m</td>
</tr>
<tr>
<td>Angle</td>
<td>0 dgs</td>
</tr>
<tr>
<td>IFF</td>
<td>1.0 Mhz</td>
</tr>
<tr>
<td>Direction</td>
<td>15 dgs</td>
</tr>
<tr>
<td>Corridor St.</td>
<td>15 mi</td>
</tr>
<tr>
<td>Radar Type</td>
<td>Class 5</td>
</tr>
<tr>
<td>Range</td>
<td>75 mi</td>
</tr>
</tbody>
</table>
Appendix 5

Subject Number: 

Number of Attributes Controlled: 

Instructions: Please indicate whether you could obtain a certain number of points with this number of attributes being controlled by the experimenter over a total of ten targets by marking Y (for yes) or N (for No). Also, indicate your confidence in being able to achieve a certain number of points. At the point you answer no, your confidence level should be at 0%. Do this for each increment of points.

For example: If three attributes are controlled, such as Direction, Range, and Corridor Status, they will be held at fixed values of 15 degrees, 75 miles, and 15 miles respectively. The other six attributes, IFF, Size, Radar, Speed, Angle, and Altitude, will be assigned values randomly by the computer.

<table>
<thead>
<tr>
<th>Points (%)</th>
<th>Yes/No</th>
<th>Confidence (0 – 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 – 20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 – 17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 – 14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 – 11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 – 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 – 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 – 2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Your predicted score in 10 trials for this number of attributes controlled: 

Appendix 6

General Self-Efficacy Scale

INSTRUCTIONS: Please read each of the following statements carefully. Using the scale below, indicate your level of agreement with the following statements. Do not answer how you think you are expected to answer. Answer in an honest fashion.

1 = Strongly Disagree
2 = Disagree
3 = Neither Disagree or Agree
4 = Agree
5 = Strongly Agree

1. When I make plans, I am certain I can make them work.
2. One of my problems is that I cannot get down to work when I should.
3. If I can't do a job the first time, I keep trying until I can.
4. When I set important goals for myself, I rarely achieve them.
5. I give up on things before completing them.
6. I avoid facing difficulties.
7. If something looks too complicated, I will not even bother to try it.
8. When I have something unpleasant to do, I stick to it until I finish it.
9. When I decide to do something, I go right to work on it.
10. When trying to learn something new, I soon give up if I am not initially successful.
11. When unexpected problems occur, I don't handle them well.
12. I avoid trying to learn new things when they look difficult for me.
13. Failure just makes me try harder.
14. I feel insecure about my ability to do things.
15. I am a self-reliant person.
16. I give up easily.
17. I do not seem capable of dealing with most problems that come up in life.