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## Effective Timing Of Feedback During Scenario Based Team Training Within A Simulated Environment

Randolph Astwood  
*University of Central Florida*

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EFFECTIVE TIMING OF FEEDBACK DURING SCENARIO BASED TEAM  
TRAINING WITHIN A SIMULATED ENVIRONMENT

by

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A dissertation submitted in partial fulfillment of the requirements  
for the degree of Doctor of Philosophy  
in the Department of Psychology, Industrial and Organizational  
in the College of Sciences  
at the University of Central Florida  
Orlando, Florida

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2009

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## ABSTRACT

Scenario based training (SBT) allows organizations to train the competencies necessary for effective performance in an environment that replicates critical aspects of the transfer or operational setting. One of the most salient training features that can be delivered during SBT is feedback. Task feedback may be provided to trainees either during a training scenario (immediately following actions) or between training scenarios (after action review). However, little is known regarding the effects of immediate versus delayed feedback given to teams. Prior research on training individuals suggests that immediate feedback improves performance as assessed immediately after training (acquisition performance), however delayed feedback improves performance after time has passed (retention performance). Moreover, several individual training studies have found that trainee goal orientation moderates the influence of instructional features such as goal difficulty and content organization. I hypothesized that team member goal orientation would also moderate the influence of feedback timing on team performance. Three facets of goal orientation were assessed. Learning goal orientation refers to the extent to which individuals strive towards the mastery of skills for the sake of continuous improvement. Prove goal orientation refers to the extent to which individuals strive to demonstrate their own competence to others. Finally, avoid goal orientation refers to the extent to which individuals seek to avoid demonstrating their incompetence to others.

Participants were 160 undergraduate psychology students assigned to 80 two-person teams. These teams were trained and tested using a simulated military task called the Forward Observer Personal Computer-based Simulator. Teams received 36 minutes

of training prior to performing a skill acquisition test on day one of the experiment. One week later teams returned to perform a skill retention test. Teams were randomly assigned to receive immediate feedback during their team training scenarios or delayed feedback following each training scenario.

Results indicated that the timing of feedback had no impact on acquisition performance. As predicted, however, teams that had received delayed feedback outperformed those that had received immediate feedback on the retention test. Moreover, the positive impact of delayed feedback on retention performance was greatest for teams that scored higher on a measure of state learning goal orientation on the day of their training. This interaction was mediated by the team's perception of the instrumentality of the feedback provided to them. Theoretical and practical implications, as well as, limitations and directions for future research are discussed.

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## LIST OF ACRONYMS/ABBREVIATIONS

AAR	After Action Review
AGO	Avoid Performance Goal Orientation
FAER	Failure-Focused After Event Review
FO	Forward Observer
FOPCSim	Forward Observer Personal Computer-based Simulator
FSAER	Failure-and Success-Focused After-Event Review
KSAs	Knowledge, Skills, Abilities
LGO	Learning Goal Orientation
PGO	Prove Performance Goal Orientation
SBT	Scenario Based Training

## CHAPTER ONE: INTRODUCTION

In order to be productive and excel in today's market, organizations must be willing to maintain and enhance their employee's knowledge, skills, and abilities (KSAs). Training is one of the most prevalent methods for developing and enhancing an individual's competencies. It was estimated in 2000 that U.S. organizations with 100 or more employees budgeted to spend \$54 billion on formal training ("Industry Report," 2000). The U.S. military spends an estimated \$17 billion each year on training (House Committee on Veterans Affairs, 2004). Furthermore, training provides employees with systematic learning events that help increase organizational productivity. From this perspective, training can be defined as the systematic process in which attitudes, concepts, knowledge, rules or skills are acquired as the result of improved performance (Goldstein, 1991). The development of effective training remains an important goal for many organizations, especially team training.

In today's complex global economy organizations must be willing to adapt and change as the environment around them fluctuates. In order to meet the complex demands of the environment many organizations have flattened their hierarchical structures in favor of teams and multi-team systems (Salas, Stagl, & Burke, 2004). It has long been recognized that teams hold value in organizations when trying to surmount the challenges presented by chaotic context (Lewin, 1951). However, issues arise concerning the best strategies and methods that should be used to train teams to be effective. Literature supports the claim that an individual's team skills can be improved by focusing on specific components of a team's performance during the debrief/after action review

(AAR) (Smith-Jentsch, Zeisig, Acton, & McPherson, 1998). Furthermore, advances in technology have allowed a number of instructional strategies to be utilized to train teams (e.g., intelligent tutoring systems and computer based training).

The use of scenario based training (SBT) as an instruction strategy for teams has recently been intensified due to advances in technology. SBT provides trainees with an integrated series of events which allows multiple practice opportunities and provides developmental feedback while immersed in a dynamic training environment (Cannon-Bowers, Burns, Salas, & Pruitt, 1998). SBT in simulators allows one to train competencies in an environment that emulates critical aspects of the transfer or operational setting (Oser, Cannon-Bowers, Salas, & Dwyer, 1999). Moreover, several types of training interventions can be utilized in simulation (e.g., feedback, cueing, and scenario modification).

One of the most important training interventions that can be delivered in simulation is feedback. Traditionally, task feedback is provided to trainees after the completion of simulation scenarios (i.e., trainees are provide with delayed feedback during the debrief session). However, due to state of the art advances in simulations, it has become technologically feasible to deliver feedback in real-time (i.e., immediate feedback). Unfortunately, the research on the timing of feedback has been mixed. As a result, few guidelines exist to direct us in choosing and implementing effective feedback during SBT in simulators, especially at the team level.

The temporal contiguity and task interruption perspectives are two competing theories concerning the timing of feedback. On the one hand, the temporal contiguity perspective proposes that a trainee's actions should be associated with cues in the

environment at the time the actions were made (Corbett, Koedinger, & Anderson, 1997; Guthrie, 1935). This perspective suggests providing immediate feedback would help to improve the links between the consequences for an action and the cues that are present in the environment at the time that action was made. On the other hand, the task interruption perspective suggests that providing immediate feedback actually interferes with learning (Schmidt, 1991; Schmidt & Bjork, 1992). The task interruption perspective suggests that in order for feedback to be most effective, especially during complex or novel tasks, feedback should be delayed. The theory of transfer appropriate processing suggests that the closer the training environment is to the operational environment the greater the transfer of the requisite competencies to the operational environment (Morris, Bransford, & Franks, 1977). One implication of the theory of transfer appropriate processing is that the same training features that foster initial learning (i.e., acquisition of requisite competencies) during training may not foster long term retention of those same competencies. In order to better understand the relationship between the timing of feedback and training outcomes it may be necessary to take a closer look at factors that influence the training process.

As Baldwin and Ford (1988) suggested in their framework for understanding the transfer of training process, not all trainees react in the same manner to the same training features. Thus, trainee characteristics may moderate the relationship between feedback timing and the outcomes of simulation based team training. One trainee characteristic that seems particularly relevant is goal orientation. Goal orientation refers to an individual's situational or dispositional goal preference in achievement situation (Payne, Youngcourt, & Beaubien, 2007). Goal orientation consists of two main components; learning goal

orientation (LGO) and performance goal orientation. Recently, researchers have argued that performance goal orientation consist of two dimensions; prove performance goal orientation (PGO) and avoid performance goal orientation (AGO) (Elliot & Harackiewicz, 1996; VandeWalle, 1997). Individuals with a LGO seek to develop their ability by acquiring and mastering new skills (Dweck, 1986). Although AGO and PGO are subcomponents of performance goal orientation evidence has shown that AGO and PGO differ across training outcomes (Elliot & Harackiewicz, 1996). Individuals with an AGO tend to avoid situations in which one's lack of ability may be exposed to others (Elliot & Harackiewicz, 1996; VandeWalle, 1997). Those with a PGO tend to approach situations in which their competence can be demonstrated (VandeWalle, 1997; Elliot & Harackiewicz, 1996). In prior research, goal orientation has been shown to influence the manner in which individuals respond to features of the training environment including feedback. However, to date, little research has been performed regarding team level goal orientation and its influence on various training features (e.g., feedback timing).

The present experiment extends prior research in three important ways. First, while a number of studies have investigated the effects of delayed versus immediate feedback on learning at the individual level, there has been no prior published research investigating the effects of feedback timing on learning during simulation based team training. The second way this study contributes to the literature is by investigating the moderating effects of team level goal orientation on the relationship between feedback timing and performance during simulation based team training. Lastly, while a number of studies have investigated the effects of learning and performance goal orientations, far fewer have separately investigated the subcomponents of “prove” and “avoid” within

performance goal orientation. Particularly few studies have investigated prove and avoid performance goal orientation within a team performance context. A model depicting the relationships investigated in this study is presented in Figure 1.

The model suggests that immediate feedback should have a positive impact on acquisition phase team performance, while delayed feedback should have a negative impact on acquisition team performance. Additionally, this model suggests that immediate feedback should have a negative effect on retention phase team performance and delayed feedback should have a positive effect on retention phase team performance. Lastly, the model suggests that team level goal orientation (i.e., LGO, AGO, and PGO) should moderate the relationship between feedback timing and acquisition and retention phase team performance.



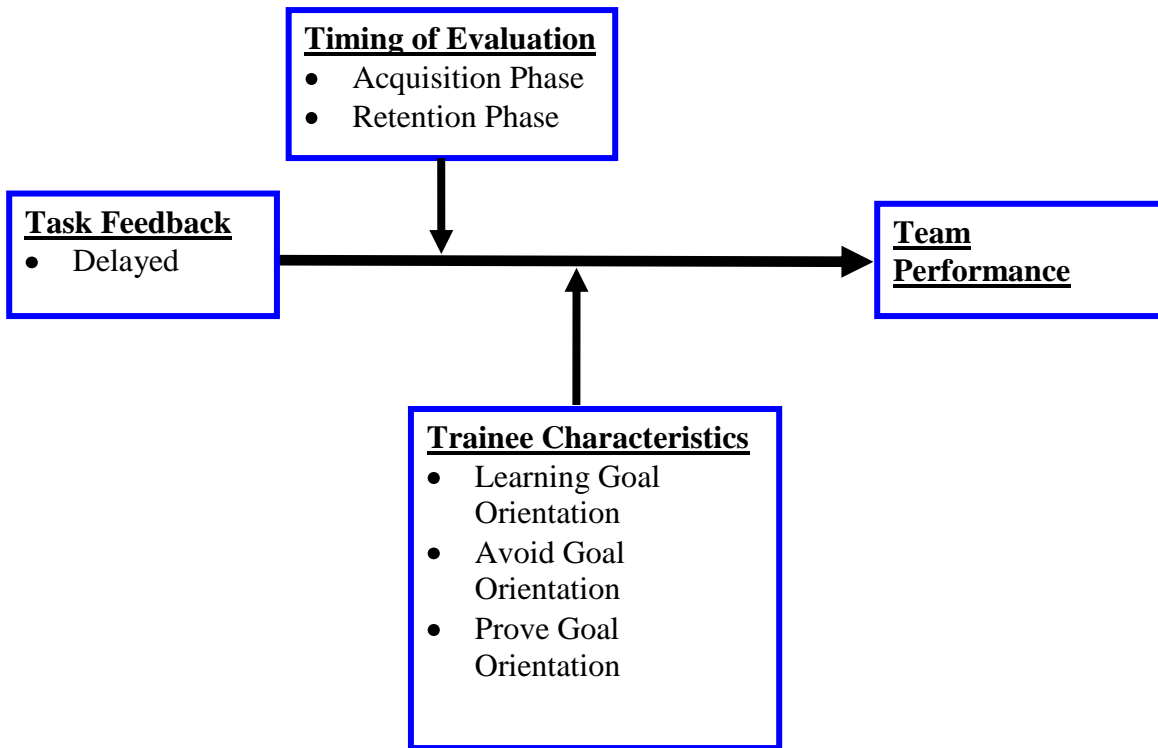


Figure 1: Proposed Model

## CHAPTER TWO: LITERATURE REVIEW

### Scenario Based Training and Simulations

Effective training environments facilitate the ability of the trainee to acquire and maintain the competencies (i.e., KSAs) necessary to perform a task (Oser et al., 1999). Furthermore, these environments must support all phases of training development (e.g., planning, execution, and analysis), performance measurement, and feedback (Oser et al., 1999). SBT provides all of these requirements allowing trainees the opportunity to develop the competencies necessary for performance in complex environments (Cannon-Bowers & Bell, 1997; Means, Salas, Crandell, & Jacobs, 1995). SBT provides enhanced training capabilities and significantly reduces the requirement for training resources (Oser et al., 1999).

Moreover, the use of computers in conjunction with the presentation of scenarios allows a high level of stimulus control and structured repetition (Oser, Cannon-Bowers, Dwyer, & Miller, 1997). Scenarios allow the instructor to manipulate and prearrange the presentation of and the relationship between critical scenario features (Oser et al., 1999). Furthermore, within an SBT setting it is possible to concentrate on higher orders skills associated with performance in complex environments (Oser et al., 1999). For example, during an SBT environment, a team could be presented with scenarios that would require situational awareness, problem solving, and execution of decisions.

SBT can be combined with high or low fidelity simulations. A simulator can be a method for training, analysis, or testing in which real-world and conceptual systems are reproduced by a model or where real-world systems are used (Piplani, Mercer, & Roop, 1994). Coupling SBT and simulation techniques can serve to increase experimental

realism, mundane realism, and psychological fidelity (Salas et al., 2004). Senge (1990) suggest that during a simulation a micro-world is developed that mirror the features of the actual performance environment. Micro-worlds support the adoption of strategies, which would be considered either too risky or costly to engage in reality (Salas et al., 2004).

Simulators encourage team risk taking and experimentation because they create an environment characterized by psychological safety (Edmondson, 2002). Synthesizing SBT with simulation technology produces a flexible approach that allows team members to receive immediate, continuous, and dynamic feedback regardless of co-location (Salas et al., 2004). The face validity of simulation based training in aviation has been so convincing that it is mandated by commercial airlines and required for all private pilots by insurers (Messenger, Rumsfeld, Carroll, Combes, & Chen, 2002). Furthermore, because of the need for efficient and effective techniques that will allow distributed training amongst multi-disciplinary teams the military is increasing its interest in SBT and simulation.

Although SBT in simulators has many training advantages it is important to remember that trainers and instructional system designers must not focus solely on the technology. In addition to providing trainees with realistic and fun simulator systems to play, trainers and instructional system designers must also focus on creating good instruction. As Salas and Cannon-Bowers (1997) note, technology by itself does not guarantee that effective learning will occur. So the question remains, how do trainers and instructional system designers create effective instructional environments within simulations? Furthermore, several types of training interventions can be delivered in simulation (e.g., feedback, cueing, and scenario modification). It is important that trainers

and instructional systems designers improve the implementation of these interventions in order to reap the full benefits of SBT in simulators.

### Feedback

There are a number of training interventions that may be utilized within simulators. One of the most studied and salient of these interventions is feedback. There are numerous definitions of feedback in the literature. For example, Salmoni, Schmidt, and Walter (1984) define feedback as external information meant to promote learning. Alexander, Schallert, & Hare (1991) define feedback as information a learner can confirm, add to, overwrite, tune, or restructure in memory, whether that information is domain knowledge, metacognitive knowledge, cognitive strategies or tactics, or beliefs about self and task.

Feedback impacts the training experience in multiple ways. Eitelman, Owens, Fowlkes, Walwanis Nelson, and Atkinson (2006) note that feedback is the salient feature that distinguishes training from practice. Furthermore, feedback helps maintain mutual performance monitoring and supports team situational awareness (Salas et al., 2000). Feedback is central to the learning process (Ilgen, Fisher, & Taylor, 1979). However, it is also important to note that feedback does not always increase performance and can have detrimental effects on performance. For instance, Kluger and DeNisi (1996) discovered in their meta-analysis that over one third of feedback interventions reduced performance.

There are a number of dimensions in which feedback can vary: 1) the content of the feedback statement (e.g., process, outcome, normative, environmental), 2) the feedback sign (e.g., positive or negative feedback), 3) the modality for delivering the feedback (e.g., orally, written, graphically), 4) the amount of feedback given (e.g., one

sentence versus multiple paragraphs), and 5) the timing (e.g., delayed or immediate). Each of these dimensions can impact the effectiveness of the feedback (Kozlowski, Bell, & Mullins, 2000). Since one of the objectives of providing feedback is to ultimately improve the trainee's performance, it is critical to determine the most appropriate ways of providing feedback that will optimize learning and performance (Van Duyne, 2002). However, despite the wide use of the various feedback dimensions during training, few guidelines exist on choosing when and how to implement feedback effectively during team SBT within simulations. The present study was designed to isolate the effects of feedback timing during a team training simulation exercise. Specifically, this study seeks to isolate the effects of immediate and delayed feedback during the initial learning (i.e., acquisition) and maintenance (i.e., retention) phases of a team simulation based training task. Therefore, all other aspects of feedback were held constant during this study.

#### *Feedback Timing at the Individual Level*

Salas et al. (2000) suggest that feedback during a SBT should be: a) organized around learning objectives and critical events; b) derived from observations made on the measures of performance; c) supported with meaningful demonstrations of performance; d) interactive and involve input from participants; and e) archived to support and update the historical performance data and existing skill inventories. In a SBT approach feedback is traditionally given during the post-scenario debrief/AAR and is based on the learning objectives of the scenario (Salas, Burke, & Cannon-Bowers, 2000). However, the temporal contiguity perspective suggests that one's decision or action should be linked with cues in the environment at the time the action was made (Corbett, Koedinger, & Anderson, 1997; Guthrie, 1935). Guthrie (1935) noted that stimulus and response links

are created due to their simultaneous happening in time. This perspective suggests providing feedback during an action would help make cue-strategy associations or the links between the context in the environment and the decision that was made. In other words, a trainee must first recognize the cues present in the environment, and then make links between those cues and the consequences of any resulting action or decision taken.

A number of studies concerning the timing of feedback at the individual level have concluded that immediate feedback results in better post training (i.e., acquisition) test performance than delayed feedback (Azevedo & Bernard, 1995; Bangert-Drowns, Kulik, Kulik, & Morgan, 1991; Corbett & Anderson, 1991). Corbett and Anderson (1991) suggest that immediate feedback accelerates the acquisition of skills without any detrimental effects on learning. Specifically, they found that it took participants significantly less time to complete a set of programming exercises with immediate feedback than with delayed feedback. Bangert-Drowns et al. (1991) conducted a meta-analysis using 40 studies and 58 effect sizes and concluded that immediate feedback resulted in better achievement test performance than delayed feedback. In addition, Azevedo and Bernard (1995) compared the effect sizes of computer-based instruction with delayed and immediate feedback and concluded that immediate feedback was a better instructional strategy than delayed feedback.

Although there has been support for the notion of the usefulness of immediate feedback on task performance; there has also been mixed findings. An alternative perspective argues that immediate feedback may serve as a task interruption which may actually hinder learning (Schmidt, 1991; Schmidt & Bjork, 1992). Winstein and Schmidt (1990) citing the results of a number of others studies, many which were studies using

motor learning tasks, suggest that feedback that is delivered at a reduced occurrence (i.e., delayed feedback) is more effective than recurrent feedback. While studying computer based instruction, Rankin and Trepper (1978) discovered that students performed better on a knowledge test, which was given 24 hours after instruction, when provided with delayed feedback versus immediate feedback. What's more, it has been suggested that task interruption is most problematic for tasks that require high cognitive demand (e.g., military tasks). For example, Munro, Fehling, and Towne (1985) found that immediate feedback interfered with the real-time demands of a radar monitoring task, therefore causing detriments in performance. The theory of transfer appropriate processing suggests that training environments that require participants to engage in the same type of cognitive processes that are required in the transfer environment will facilitate greater learning. Immediate feedback in training interrupts these processes and thus should inhibit the development of transfer appropriate cognitive processes. In other words, the paradox of the theory of transfer appropriate processing is that certain training features (e.g., immediate feedback) that foster the initial acquisition of requisite competencies and processes during training may not foster long term retention and generalization of those same competencies and processes. As I have discussed there have been a number of studies and two major competing theories regarding the effects of feedback timing on training performance. However, all of the studies that have been discussed up to this point have taken place at the individual level of analysis. Next, I will review the literature regarding these effects at the team level of analysis.

### *Feedback Timing at the Team Level*

When feedback is given to an individual trainee that trainee must sort out and make sense of the feedback provide to them. Individual trainees must then engage in various self-regulatory behaviors on their own (e.g., self monitoring). For example, when an individual trainee develops a strategy that they plan to implement in a future training task, based on feedback provided to them earlier, the trainee must generate and implement that strategy without the benefit of a teammate. However, teamwork involves members giving and accepting feedback from others (e.g., an instructor) and one another (Gaddy & Wachtel, 1992; McIntyre & Salas, 1995). The process of giving and receiving feedback in a team training environment can take place during and between training exercises. During the team debrief trainees can discuss feedback amongst each other; generate and implement ideas, strategies, and goals for future tasks together.

The theory of transfer appropriate processing suggests that the closer the training environment is to the operational environment the greater the transfer of the requisite competencies and processes to the operational environment (Morris, Bransford, & Franks, 1977). Based on the theory of transfer appropriate processing it would seem that delayed feedback is most beneficial in a team context. During training teammates must learn how to pick up the implicit cues necessary for effective team performance (e.g., implicit coordination). In the operational environment teammates will not have the luxury of being told that they “missed” an opportunity to assist a teammate until after the event is over. Therefore, it would seem that providing delayed feedback during training would be more aligned with the operational environment. Smith-Jentsch et al. (1998) discovered that trainees’ team skills can be improved by focusing on specific components of a team’s



performance during the debrief or AAR. In other words, providing individuals with delayed feedback related to specific areas of their team's performance can improve team skills. It is suggested that the benefit of this approach is that it helps teams accurately diagnose problems, focus their practice during training on specific goals, and generalize lessons learned to new tasks (Smith-Jentsch et al., 1998).

Even at the team level differing theoretical perspectives regarding the timing of feedback exist. It's been recommended that teams must be provided with immediate feedback about their performance during training (Briggs & Johnston, 1967; Duncan et al., 1996). One could expect the sooner a team receives feedback on their performance the faster they would be able to learn those behaviors necessary for effective team performance. In addition, it can be assumed that as a team receives immediate feedback regarding their performance in a simulated SBT environment, team members would readjust or correct their communication and coordination to be more effective, therefore improving upon the teams' performance during training.

#### *Feedback Timing Based on Training Cycle: Acquisition versus Retention*

Determining the effectiveness of the timing of feedback, at both the individual and team level, may be dependent upon the stage of the training cycle in which performance is evaluated. On one hand, the acquisition phase of training can be considered the learning or practice phase of training. Schmidt and Bjork (1992) suggest that during this phase learning refers to the "set of processes occurring during the actual practice on the task of interest" (p. 209). On the other hand, the retention phase of training involves the processes that are used after practice and prior to a retention test (Schmidt & Bjork, 1992). The retention phase of training can be considered the stage of

training in which skills or processes learned during the acquisition phase are transferred or generalized to variations of the training context or domain.

Schmidt and Bjork (1992) reviewed a number of experiments from motor and verbal tasks relating to feedback during skill acquisition. These studies each concluded that immediate feedback resulted in more effective performance than did delayed feedback during the acquisition phase; however the reverse was true when retention was tested. It was concluded that frequent, immediate feedback becomes part of the task and therefore performance is disrupted in retention when the feedback is removed or altered (Schmidt & Bjork, 1992). In addition, it was suggested that frequent, immediate feedback makes performance too variable and prevents the learning of a consistent representation of the task necessary to sustain performance on a later retention test (Schmidt & Bjork, 1992). Schmidt, Young, Swinnen, and Shapiro (1989) performed a study in which the acquisition of a motor task was examined using an immediate and blocked (delayed) feedback group. They found that students in the immediate feedback group acquired the task more quickly; however, they performed worse during the no-feedback performance post-tests. These conclusions are similar to the argument that immediate feedback may serve as a task interruption and can actually obstruct learning.

Morris, Bransford, and Franks (1977) have suggested that those processes required on a transfer task should be practiced during training (i.e., the theory of transfer appropriate processing). As mentioned previously, the theory of transfer appropriate processing suggests that the closer the training environment is to the operational environment, in terms of supporting the acquisition of necessary KSAs and processes, the greater the transfer of the requisite KSAs and processes to the operational environment

(Morris, Bransford, & Franks, 1977). Transfer appropriate processing, especially in the context of SBT simulations, supports the notion that delayed feedback is more beneficial than immediate feedback “as the presentation of immediate feedback during task performance, by definition, changes the task in some way” (Bolton, 2006, p. 16). Furthermore, trainees may become dependent on immediate feedback during the scenario to guide their actions and disregard the important cues represented in the training environment (Druckman & Bjork, 1991). “Thus, when the feedback is removed, the trainee is unable to react to the important cues in the environment, as the feedback prohibited them from learning the very skills necessary to perform in the operational environment” (Bolton, 2006, p. 16). Consequently, Druckman and Bjork (1991) suggest that a further benefit of delayed feedback is that it may create the need for the trainee to be more active and watchful during training.

It has been suggested that one of the benefits of delayed feedback is that it allows trainees to make errors and learn from these errors. Keith and Frese (2005) note that research using error management training has shown the value of errors in improving performance after, as opposed to, during training. That is, error management training seeks to improve transfer of training performance, not acquisition/training performance. In contrast, error avoidant training seeks to provide step-by-step instructions to prevent errors from occurring, similar to immediate feedback. In an experiment where the two types of training were compared, Keith and Frese (2005) found that error management training led to better adaptive transfer performance than did error avoidant training. In addition, Bell and Kozlowski (2008) compared the effects of exploratory learning to proceduralized instruction. Exploratory learning, similar to error management training,

provides trainees with little guidance and explicitly encourages them to engage in experimentation with the task (Bell & Kozlowski, 2008). They found that those trainees who received exploratory learning, compared to proceduralized instruction, performed more poorly during training but exhibited higher levels of adaptive transfer (Bell & Kozlowski, 2008). Adaptive transfer involves a trainee using their existing knowledge base to change a learned procedure, or create a solution to a completely new problem (Ivancic & Hesketh, 2000). These results suggest that encouraging trainees to make and learn from their mistakes, such as with delayed feedback, can aid in the retention and transfer of training.

The potential negative effects of performance support features during practice have also been demonstrated in the research on behavior role modeling. Two of the main components of behavior role modeling are (a) providing trainees with the opportunity to practice targeted behaviors and skills, and (b) providing feedback to trainees following practice. In a recent meta-analytic review of behavior role modeling training Taylor, Russ-Eft, and Chan (2005) found that during behavior role modeling retention aids and displays of learning points, given prior to or during modeling, were associated with smaller gains in skill development and declarative knowledge through training. This suggests that providing aids during training can interfere with learning. These conclusions are similar to the argument that providing immediate feedback (i.e., task related information) during training may serve as a task interruption and can obstruct learning. Based on the research discussed above I make two hypotheses regarding the timing of feedback during team simulation based training.

***Hypothesis 1: Teams receiving immediate feedback will perform better on an acquisition test than will teams receiving delayed feedback.***

*Hypothesis 2: Teams receiving delayed feedback will perform better on a retention test than will teams receiving immediate feedback.*

### Trainee Characteristics

Baldwin and Ford (1988) suggest in their framework for understanding the transfer of training process that trainee characteristics moderate the impact of training design on learning (i.e., acquisition) and retention. Trainee characteristics can include trainees' task ability, general mental ability, interests, demographics, personality, and motivation. One trainee characteristic that has recently gotten a lot of attention in the literature regarding learning and performance is goal orientation. Goal orientation has been shown to influence the manner in which individuals respond to training features. Although most studies have investigated goal orientation within individuals, several recent studies have found that goal orientation of team members influence team learning and performance (Bunderson & Sutcliffe, 2003; DeShon, Kozlowski, Schmidt, Milner, & Wiechman, 2004; LePine, 2005; Porter, 2005). The following provides a historical overview of the goal orientation construct and its effects on learning and performance at the individual, as well as, team level of analysis.

### *Goal Orientation*

Goal orientation refers to a person's situational or dispositional goal preference in achievement situations (Payne, et al., 2007). Initial research on goal orientation demonstrated that is composed of two distinct dimensions, learning (also known as mastery) goal orientation (LGO) and performance goal orientation (Ames & Archer, 1988; Button et al., 1996; Colquitt & Simmering, 1998; Heyman & Dweck, 1992; Phillips & Gully, 1997). "Mastery orientation is a dedication to increasing one's

competence on a task” (Fisher & Ford, 1998, p.6). Learners with a performance goal orientation focus on task performance, comparisons with others, and seek to prove their ability on the task to others (Fisher & Ford, 1998).

It was suggested that the two goal orientations are not mutually exclusive. It seems possible that one can be more oriented towards one dimension of goal orientation, or equally neutral in both. Button et al. (1996) gives an example of divers who must train to perfect progressively more difficult dives and surpass their competitors in order to be successful at advanced levels. Button et al. (1996) notes that individuals with higher levels of performance goal orientation are believed to respond poorly to failure, while LGO individuals are inclined to perceive feedback as an opportunity to gather information and become better. LGO is not assumed to be the mirror opposite of those who possess a performance goal orientation (i.e., LGO individuals are not believed to respond positively to failure). Instead, they respond in a qualitatively different manner. If the two goal orientations were on opposite ends of a continuum, such qualitative differences would not likely occur (Button et al., 1996).

Researchers have discovered that performance goal orientation should be broken down into two separate dimensions. VandeWalle (1997), while developing and validating a three factor model of goal orientation, provided a pattern of correlates with other variables and factor analytic evidence in support of two performance goal orientation dimensions. Performance goal orientation is defined as both the desire to avoid negative judgments and the desire to gain positive judgments about one’s ability (Heyman & Dweck, 1992). Thus, an avoid dimension (avoiding negative judgments) and a prove dimension (gaining positive judgments) for performance goal orientation has been

conceptualized (VandeWalle, 1997; Elliot & Harackiewicz, 1996). In a recent meta-analysis, Payne et al. (2007) discovered a small positive correlation between the LGO and the prove dimension of goal orientation (i.e., PGO). The authors note that these results indicate that researchers should not always presume these two dimensions will associate differently to various outcomes. Furthermore, the researchers found that LGO was negatively associated with AGO and that individuals who are high in PGO are also likely to be high AGO (Payne et al., 2007).

Historically three theoretical perspectives on the root causes for the three orientations have been proposed: a referent perspective, an approach/avoid perspective, and an entity versus incremental theory of intelligence (i.e., the implicit theory of intelligence). All three perspectives were developed while studying achievement motivation in children. The referent perspective was hypothesized by Nicholls (1975, 1976, 1978) while he was studying how children set extremely high or low task goals. He believed that individuals have two conceptions of success, external referent or self-referent, and these conceptions play an important role in achievement motivation and goal setting. External referent refers to situations where individuals compare their performance to others (ego involvement). Self-referent describes situations where individuals compare themselves to their previous performance (task performance). LGO individuals are influenced by a self-referent because they want to be able to learn tasks for themselves. PGO and AGO individuals are influenced by external referents.

The approach/avoid perspective was hypothesized by Dweck (1986). Individuals with learning dispositions tend to “approach” situations in which they may be unsuccessful and view it as an opportunity for discovering new problem solving

approaches and developing their ability further (VandeWalle, 1997). In other words, individuals with learning dispositions approach tasks with the objective of learning for the sake of learning. Individuals with performance dispositions attempt to gain favorable judgments and avoid negative judgments from others about their ability. Therefore, individuals with performance dispositions tend to “avoid” situations and tasks in which they will be unsuccessful and “approach” situations in which they can demonstrate their ability to perform tasks successfully compared to others. Approach and avoid goal orientations have also been linked to motivation dispositions. For example, Elliot and Thrash (2002) discovered that sensitivity to the behavioral inhibition system, propensity to respond to inhibitory cues of frustration and uncertainty, was positively related to avoid achievement goals. Furthermore, they found that behavioral activation sensitivity, the tendency to pay attention to opportunities to approach rewards, was positively related to approach achievement goals. Elliot and Harackiewicz (1996) suggests that those with an AGO focus on avoiding incompetence, while LGO and PGO individuals are approach oriented in their quest to achieve competence or gain favorable evaluations.

Finally, Dweck (1986) proposed that the goals that individuals adopted were determined by their beliefs about the stability of intelligence (i.e., the implicit theory of intelligence). Individuals who believe that intelligence and ability are fixed and uncontrollable were expected to adopt performance goals. These individuals hold an entity theory of intelligence. Individuals who hold an entity theory of intelligence view ability as difficult to improve, therefore these individuals are predisposed to attempt to validate and demonstrate the ability they do possess. Those who believe intelligence is adaptable adopt learning goals. These individuals hold an incremental theory of ability



and intelligence; they view it as a flexible attribute that can be continuously developed through effort and experience. Because they believe ability can be developed, they are more predisposed to hold goals for developing ability rather than merely demonstrating their current ability level.

In summary, both LGO and PGO seemed to be influenced by an underlying mechanism of approach orientation. However, they differ in their referent focus. PGO and AGO seem to share the focus on an external referent. Conversely, they differ in that PGO is an approach-oriented disposition whereas AGO is an avoid-oriented disposition. This may explain the fact that PGO is positively related to both LGO and AGO despite the fact that LGO and AGO are negatively related to each other.

#### *Learning Goal Orientation*

Research tends to agree that individuals with a LGO seem to engage in behaviors that allow them to be very adaptive in various performance activities. On one hand, individuals with a LGO tend to feel challenged and continue to endeavor in the face of the negative feedback that is likely to occur during a difficult or novel task (LePine, 2005). For instance research has shown that LGO enhances self-efficacy (Kozlowski, Gully, Smith, Nason, & Brown, 1995; Phillips & Gully, 1997; Towler & Dipboye, 2001) and that those higher on LGO tend to engage in greater self-regulatory behaviors (Button et al., 1996; Ford et al., 1998; Schmidt & Ford, 2003; VandeWalle, Brown, Cron, & Slocum, 1999). In addition, research has shown that LGO is positively related to problem solving (Towler & Dipboye, 2001). On the other hand, individuals with a performance goal orientation tend to employ behaviors that make them maladaptive during novel or difficult tasks (LePine, 2005). Elliot, McGregor, and Gable (1999) investigated the extent

to which LGO, AGO, and PGO were predictors of study strategies and academic performance. The authors discovered that LGO positively predicted persistence, effort, and deep processing (i.e., critical thinking). However, both AGO and PGO positively predicted surface learning strategies (i.e., memorization and rehearsal) as opposed to deep processing.

The studies discussed to this point have all focused on the individual level of analysis. What does the published literature have to say regarding LGO at the team level of analysis? Porter (2005) has suggested that teams consisting of members who are high on LGO should react positively to achievement situations, even when performance measures indicate that they have performed poorly. Teams high in LGO may perform better because they are more likely to persist in exploring alternative ways of approaching a new or difficult task (LePine, 2005). Smith-Jentsch, Rhodenizer, and Reynolds (2000) discovered that team members who were higher in LGO engaged in more team self-corrective behaviors. Porter (2005) found that mean level of LGO in teams was positively related to backing up behavior. In addition it is possible that teams who are higher in LGO may perform better because they become more energized by the fact that they can actively engage in a discussion with other teammates on strategies to improve the team's performance. In other words, high LGO teams may "approach" situations in which they can openly discuss, with their teammates, the team's failures in order to have an opportunity to discover new team strategies and improve their team's ability.

In general, research suggests that LGO should have a positive impact on performance during team training. However, the whole picture has yet to be painted. As

noted earlier Baldwin and Ford (1988) suggest that in order to understand training outcomes one must also look at how trainee characteristics (e.g., LGO) moderate the impact of training design on acquisition and retention. LePine (2005) found in his study that goal difficulty interacted with team members' goal orientation to have an effect on team adaptation. Specifically, he found that the relationship between goal difficulty and team adaptation was more positive for teams consisting of members high in LGO. Smith-Jentsch, Milanovich, and Merket (2001) investigated the interaction between guided team self-correction and LGO. Guided team self-correction is an instructional strategy that has four features. First, a facilitator asks team members a series of open-ended questions designed to seek group evaluation and problem solving. Second, the facilitator promotes and supports participation both in the pre and debrief. Third, both the pre-and debrief are arranged around an expert model of effective teamwork. Lastly, the facilitator aids team members in setting explicit learning oriented goals for improvement (Smith-Jentsch et al., 1994). The authors discovered that LGO interacted with guided team self-correction and its effects on team self-correction behaviors. In other words, teammates who were higher on LGO responded more positively to the guided team self-correction method.

One could assume that those teams high in LGO should do better on a novel SBT task than those low in LGO. Acquisition performance should be higher for teams higher in LGO whether they receive immediate or delayed feedback because they should be more likely to use the previous feedback as an opportunity to learn effective strategies and processes. High LGO individuals are better problem solvers (Towler & Dipboye, 2001), persist in the face of negative feedback (LePine, 2005), express a stronger motivation to learn (Towler & Dipboye, 2001), and engage in greater self-regulatory

behaviors (Bell & Kozlowski, 2008; Button et al., 1996; Ford et al., 1998; VandeWalle, Brown, Cron, & Slocum, 1999). Additionally, high LGO teams should react positively to achievement situations (Porter, 2005); persist in exploring alternative ways of approaching a difficult or new task (LePine, 2005); back up behaviors (Porter, 2005) and engage in greater team self-corrective behaviors (Smith-Jentsch, Rhodenizer, & Reynolds, 2000).

In summary, prior research suggests that high LGO teams should be more effective learners than will low LGO teams. Moreover, such teams are expected to be better able to benefit from the positive effects of delayed feedback since the opportunity it presents for self-regulatory activity plays to the strengths of LGO individuals and teams. It follows that my next two hypotheses stated;

***Hypothesis 3:*** *High LGO teams will perform better on the acquisition test than low LGO teams overall.*

***Hypothesis 4:*** *Team composition with respect to LGO, will moderate the relationship between feedback condition (immediate or delayed) and acquisition performance. Specifically, the slope of the relationship between LGO and acquisition performance will be more steeply positive for teams in the delayed feedback condition than for those in the immediate feedback condition (see Figure 2).*

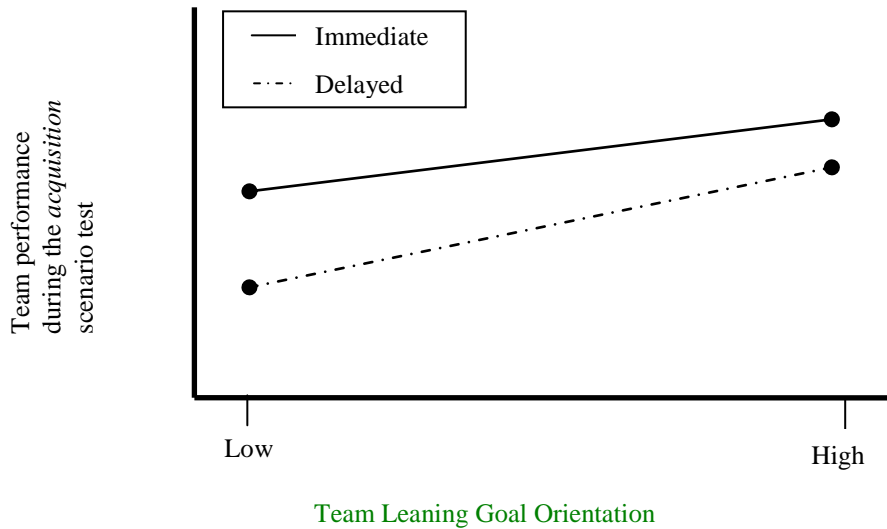


Figure 2: Moderating Effect of LGO on Feedback and Acquisition Test Performance

Low LGO teams during the retention test should perform poorly, regardless of the feedback condition, for the same reasons as low LGO teams during the acquisition test. They will fail to use the previous feedback as an opportunity to learn effective strategies and processes. Again, high LGO teams should persist in the face of negative feedback (LePine, 2005), be better problem solvers (Towler & Dipboye, 2001), react positively to achievement situations (Porter, 2005), and persist in exploring alternative ways of approaching a difficult or new task (LePine, 2005). Additionally, high LGO teams should engage in greater back up behaviors (Porter, 2005) and greater team self-corrective behaviors (Smith-Jentsch, Rhodenizer, & Reynolds, 2000). What's more the potential benefit of delayed feedback is that it allows for the development of self-regulatory processes (Button et al., 1996; Ford et al., 1998; Schmidt & Ford, 2003; VandeWalle, Brown, Cron, & Slocum, 1999). For example, delayed feedback allows trainees to make errors and learn from these errors (Ellis & Davidi, 2005; Keith & Frese (2005); it creates the need for the trainee to be more active and watchful during training (Druckman &

Bjork, 1991); it allows trainees the opportunity to view trends and see the bigger picture during training.

Towler and Dipboye (2001) examined the effects of trainer expressiveness, organization, and trainee goal orientation on various training outcomes. They found that high LGO individuals, in an inexpressive (i.e., monotone) and disorganized lecture, scored higher on a delayed problem solving test than those in an inexpressive and organized lecture. Towler and Dipboye (2001) suggest that the rationale for this finding is that the inexpressive and organized lecture was unchallenging and, as a result, “was detrimental to high LGO trainees who seek and prefer challenge” (p. 671). This supports the idea that high LGO teams will respond more positively to delayed feedback since it is more challenging and it requires them to engage in greater team self-regulatory behaviors. In turn, this supports the idea that delayed feedback is best for improving retention. Thus high LGO teams, because they engage in greater self-regulatory behaviors than low LGO teams, should be better equipped to benefit from the delayed feedback they received prior to the retention test. This should occur because delayed feedback, unlike immediate feedback, allows for the development of self-regulatory processes and behaviors.

***Hypothesis 5: High LGO teams will perform better on the retention test than low LGO teams overall.***

***Hypothesis 6: Team composition with respect to LGO will moderate the relationship between feedback condition (immediate or delayed) and retention performance. Specifically, the slope of the relationship between LGO and retention will be more steeply positive for those teams receiving delayed feedback than for teams receiving immediate feedback (see Figure 3).***

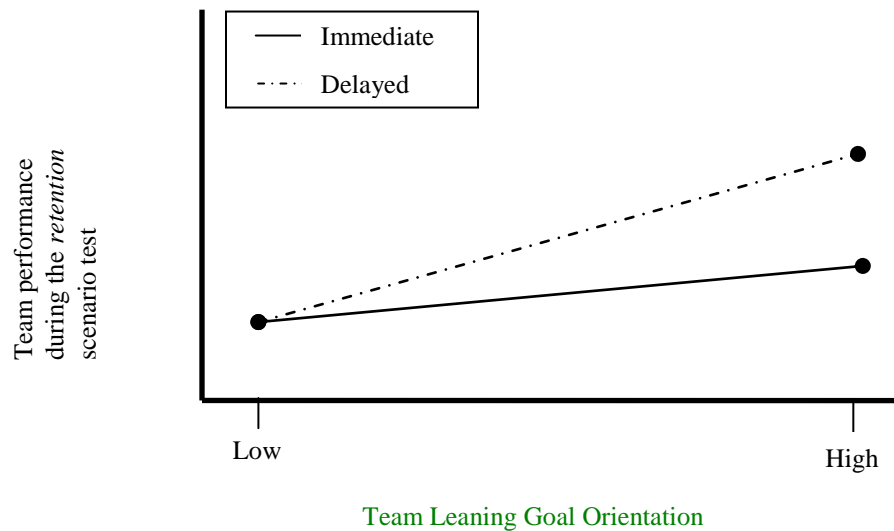


Figure 3: Moderating Effect of LGO on Feedback and Retention Test Performance

*Performance Goal Orientation*

LePine (2005) suggested that during novel tasks teams who have a high performance orientation may perform poorly because, in the face of unforeseen change and subsequent performance decrements, members will tend to withdraw from, instead of investing in, the effort or self-regulatory behaviors necessary for performance improvements. Research has also found that performance goal orientation reduces self-efficacy (Dweck & Leggett, 1988; Phillips & Gully, 1997). Yeo and Neal (2004) found that individuals with a low performance goal orientation learned at a faster rate than those with a high performance goal orientation. The suggested reason for this effect was that high performance goal oriented individuals are more likely to avoid challenges, be focused on proving themselves to others, and withdraw from the task in the face of obstacles (Yeo & Neal, 2004). In addition, Bell and Kozlowski (2002) while examining the relationship between goal orientation and performance in a radar task found cognitive ability moderated the relationship between performance goal orientation and

performance. Specifically, performance goal orientation was positively related to low ability individual's performance but negatively related to high ability individual's performance. However, all of these studies suffered from the same flaw. The authors failed to break down performance goal orientation into its subcomponents; AGO and PGO. Payne et al. (2007) reminds us that although PGO and AGO are related, their outcomes can be different. Results from Payne et al.'s (2007) meta-analysis seem to indicate that AGO is consistently and negatively related to self-regulatory constructs (e.g., specific self-efficacy). However, PGO was found to be virtually unrelated to self-regulatory constructs (Payne et al., 2007).

*Avoid goal orientation.*

Based on Dweck's (1986) approach/avoid perspective high AGO teams, in an attempt to avoid looking bad, should be less likely to discuss failures amongst teammates. In turn, high AGO teams will fail to adequately recognize salient performance strategies and withdraw from self-regulatory behaviors that are needed for long term performance success. Schmidt and Ford (2003) studied the effects of LGO, AGO, and a metacognitive training intervention on metacognitive activity and learning. The authors found that AGO moderated the relationship between the metacognitive intervention and metacognitive activity. On the one hand, for trainees low in AGO the intervention led to greater declarative knowledge and metacognitive activity. On the other hand, trainees high in AGO reported lower levels of declarative knowledge and metacognitive activity when provided with the metacognitive intervention. This lends support to the notion that high AGO teams should not only fail to benefit from delayed feedback but may actually have their retention performance hindered by delayed feedback since they will fail to engage in



beneficial self-regulatory behaviors which in turn should lead to poorer training performance and acquisition of learned skills.

Elliot et al. (1999) found that AGO positively predicted surface learning strategies (i.e., memorization and rehearsal) and disorganization and negatively predicted deep processing and exam performance. It may also be the case that high AGO teams may experience anxiety due to being evaluated during the training, especially in a situation where their failures may be discussed. Consequently, higher levels of anxiety should interfere with learning during training. Because of increased levels of anxiety, in an attempt to avoid being evaluated negatively, high AGO teams should be less likely to have reflected on their performance and thus should do more poorly on an acquisition test.

High AGO teams should also respond more negatively to receiving immediate feedback than delayed feedback during an acquisition test. In general receiving feedback should be an anxiety provoking event for high AGO teams. Each time a high AGO team is given immediate feedback an anxiety provoking event will occur and this in turn will interfere with learning during training and performance on the next scenario. However, high AGO teams who receive delayed feedback should have fewer anxiety provoking events during actual training and therefore smaller decrements in learning and performance because they will receive feedback only once at the completion of all the acquisition training scenarios.

***Hypothesis 7: High AGO teams will perform more poorly on the acquisition test than low AGO teams overall.***

***Hypothesis 8: Team composition with respect to AGO will interact with feedback condition (immediate or delayed) to predict acquisition performance. Specifically, the slope of the relationship between AGO and acquisition performance will be more steeply***

negative for teams receiving immediate feedback than for teams receiving delayed feedback (see Figure 4).

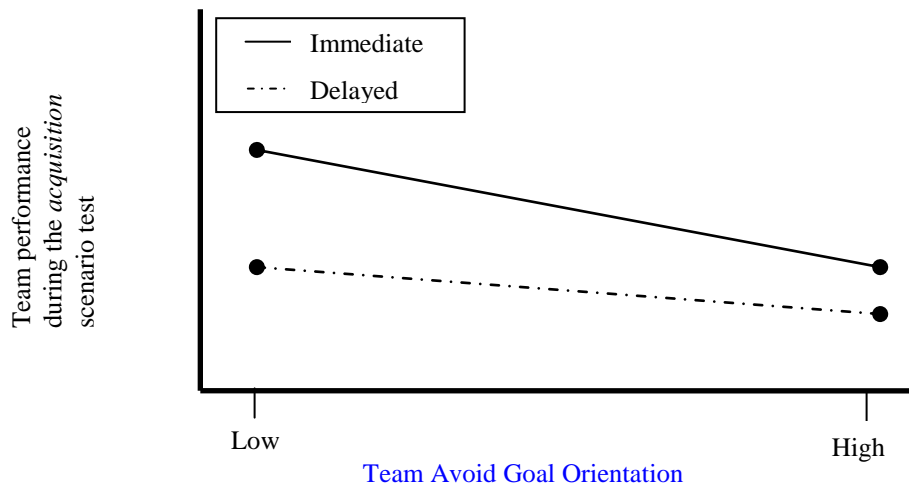


Figure 4: Moderating Effect of AGO on Feedback and Acquisition Test Performance

As mentioned previously high AGO teams will fail to adequately recognize salient performance strategies, withdraw from self-regulatory behaviors that are needed for long term performance success, and have increased levels of anxiety that should interfere with learning during training. Because of these three things high AGO teams should be less likely to have learned during training and thus should do more poorly on a retention test. I would also expect that teams high in AGO in the immediate feedback condition would respond more negatively during the retention test than those teams in the delayed feedback condition. Recall that receiving feedback should be an anxiety provoking event for high AGO teams and that each time a high AGO team is given immediate feedback an anxiety provoking event will occur. Anxiety will interfere with learning during training and thus performance on the retention test will also be negatively affected. However, high AGO teams who received delayed feedback during acquisition

training should have had fewer anxiety provoking events and therefore smaller decrements in learning and performance during the retention test.

**Hypothesis 9:** *High AGO teams will perform more poorly on the retention test than low AGO teams overall.*

**Hypothesis 10:** *Team composition with respect to AGO will interact with feedback condition to predict retention performance. Specifically, the slope of the relationship between AGO and retention will be more steeply negative for teams receiving immediate feedback than for teams receiving delayed feedback (see Figure 5).*

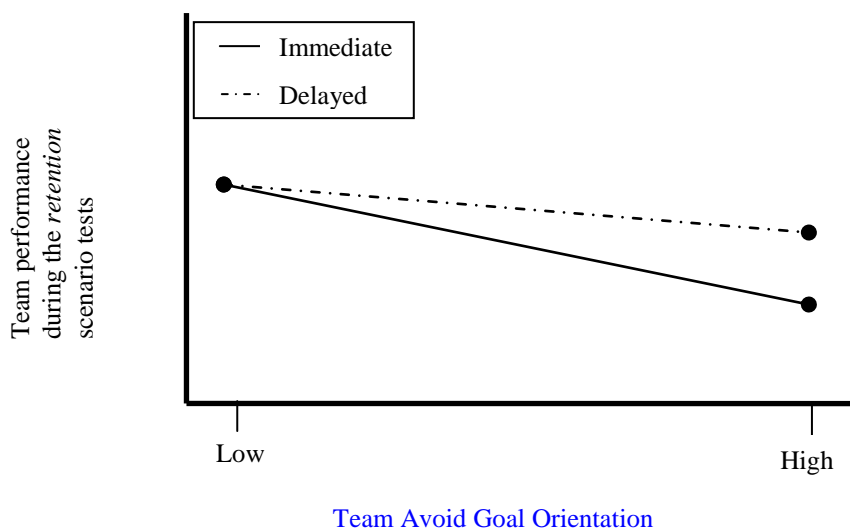


Figure 5: Moderating Effect of AGO on Feedback and Retention Test Performance

*Prove goal orientation.*

Dweck (1986) proposed that individuals who hold an entity theory of intelligence view ability and intelligence as difficult to improve, therefore these individuals are predisposed to attempt to validate and demonstrate the ability they do possess. Therefore it is assumed that those individuals or teams who are high in PGO tend to hold an entity view of intelligence. In support of this assumption Payne et al., 2007 discovered a small positive correlation between PGO and the entity theory of intelligence in their goal

orientation meta-analysis. Although high PGO individuals believe that ability is difficult to improve they believe that they can actively affect others perceptions of their ability. Fullick, Smith-Jentsch, and Miller (in preparation) discovered that PGO was positively correlated with self-monitoring, a form of self-regulatory behavior, and directiveness, a component of assertiveness. Therefore it seems that high PGO individuals participate in tasks, not for the sake of learning, but in order to demonstrate their competence. The mechanism's in which their competence is demonstrated is through self-monitoring and impression management behaviors. For example, analyses by LePine (2005) found that difficult goals were problematic for teams high on performance orientation because those teams tended to focus on how the team was doing relative to their goal and did not share the necessary information for developing appropriate learning strategies.

Elliot et al. (1999) found that PGO positively predicted persistence, effort, and exam performance. However, they also found that PGO was related to surface learning strategies but not learning strategies that require deeper processing and understanding. Brown (2001) found that when controlling for main effects, a significant interaction between performance goal orientation and self-efficacy was found to predict practice. Learners who made the least use of practice were those with a high performance orientation and low learning self-efficacy; learners with high performance orientation and high self-efficacy made more extensive use of their practice. In other words, high performance goal oriented people persisted on tasks in which they were confident they could successfully complete (i.e., task that they are relatively familiar with). Although the subcomponents of performance goal orientation were not specifically measured the results from these studies seem to refer to PGO.

One could assume that during novel or difficult tasks those teams high in PGO should perform more poorly than teams low in PGO because high PGO teams will most likely employ maladaptive behaviors during these tasks (LePine, 2005). Furthermore, high PGO teams may be more likely to use surface strategies that maximize acquisition performance but do not lead to the deeper processing and learning necessary for retention performance. High PGO teams in the delayed feedback condition during the acquisition phase should be even more likely to employ these maladaptive behaviors during novel or difficult tasks. High PGO teams approach situations that will allow them to demonstrate their competence. Immediate feedback should facilitate performance during the acquisition phase because it provides guidance toward correct behaviors during the acquisition phase of training. Teams that are higher in PGO, in an attempt to feel good about their performance, should approach situations in which they can discuss successful rather than unsuccessful events amongst teammates. Neglecting to discuss unsuccessful events should cause high PGO teams to fail to adequately recognize salient performance strategies that are needed for long term performance success.

High PGO teams hold an entity theory of intelligence and therefore view ability as difficult to improve these individuals should attempt to validate and demonstrate the ability they do possess. High PGO teams, in the delayed feedback condition, most likely would not like the uncertainty of not knowing how they performed and thus may be preoccupied with figuring out how well they did, missing the lessons they were supposed to be learning as a result. In addition, those teams high in PGO should not respond well to poor performance similar to teams high in AGO. Although delayed feedback allows for the development of self-regulatory processes it should also result in greater errors during

acquisition training. Because of the greater number of errors high PGO teams should be demotivated and more susceptible to withdrawing from beneficial self-regulatory behaviors during acquisition training. Therefore, I expect that high PGO teams would respond better to immediate feedback because it allows them to adjust their behavior and maximize their performance during training. However, this training strategy will only be beneficial in the short term. This training strategy should not work as well for high PGO teams during retention test because they will have failed to adequately recognize and learn the underlying strategies of the task (i.e., high PGO teams will have only superficially learned the task in order to meet the immediate demands of the task).

***Hypothesis 11:*** *Team composition with respect to PGO, will moderate the relationship between feedback condition (immediate or delayed) and acquisition performance. Specifically, the slope of the relationship between PGO and acquisition performance will be positive for teams who received immediate feedback but negative for teams who received delayed feedback (see Figure 6).*

***Hypothesis 12:*** *High PGO teams will perform more poorly on the retention test than low PGO teams overall.*

***Hypothesis 13:*** *Team composition with respect to PGO will interact with feedback condition to predict retention performance. Specifically, the slope of the relationship between PGO and retention will be more steeply negative for teams receiving delayed feedback than for teams receiving immediate feedback (see Figure 7).*

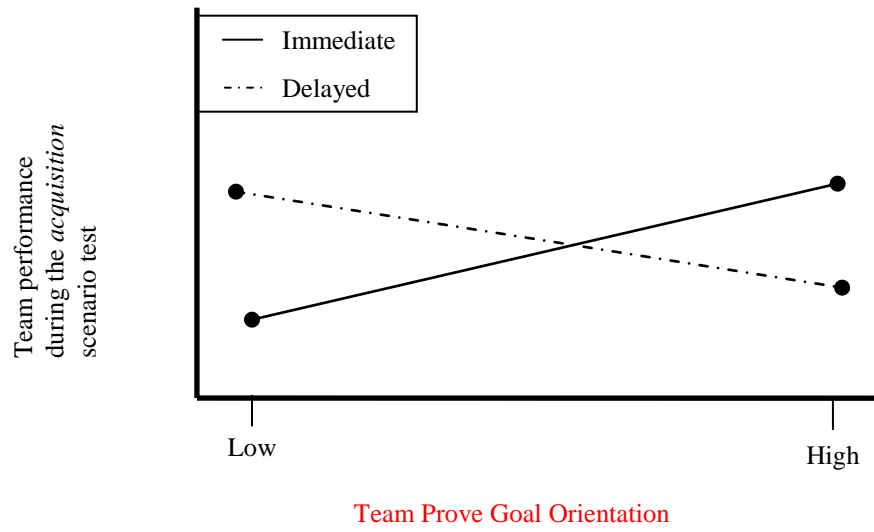


Figure 6: Moderating Effect of PGO on Feedback and Acquisition Test Performance

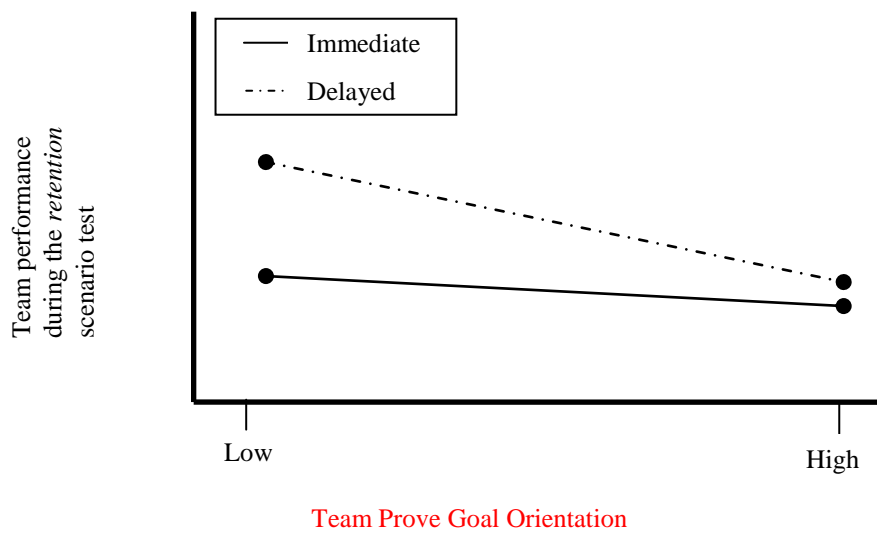


Figure 7: Moderating Effect of PGO on Feedback and Retention Test Performance

In summary, the use of SBT in simulations as an instruction strategy for teams has been intensified due to advances in technology. Advances in simulation SBT has also led to the use of various training interventions. One of the most salient training interventions that can be delivered in simulation SBT is feedback. Traditionally, trainees are provided with delayed feedback during the debrief session. Recently, it has become technologically feasible to deliver immediate feedback during the simulation exercise. Unfortunately, research on the timing of feedback has been mixed and few guidelines exist to direct us in choosing and implementing effective immediate feedback during SBT in simulators, especially at the team level.

The task interruption and temporal contiguity theories are two competing viewpoints regarding the timing of feedback. The task interruption theory suggests that providing immediate feedback actually interferes with learning (Schmidt, 1991; Schmidt & Bjork, 1992). This theory suggests that in order for feedback to be most effective, especially during complex or novel tasks, feedback should be delayed. The temporal contiguity perspective proposes that a trainee's actions should be associated with cues in the environment at the time the actions were made (Corbett, Koedinger, & Anderson, 1997; Guthrie, 1935). This perspective suggests providing immediate feedback would help to improve the links between the consequences for an action and the cues that are present in the environment at the time that action was made. Finally, Schmidt and Bjork (1992) suggests that immediate feedback results in better performance than delayed feedback during the acquisition phase; however the reverse is true when retention is tested. In addition, goal orientation is a trainee characteristic that has been shown to



moderate the relationship between training features and the learning processes and outcomes.

The purpose of this experiment is to investigate the whether team composition, in terms of goal orientation, moderates the effects of feedback timing on acquisition and retention of skills trained in an SBT environment. Based on review and synthesis of the timing of feedback literature, I propose that teams receiving immediate feedback will perform better on an acquisition test than will teams receiving delayed feedback, but the reverse will be true for a retention test. I also hypothesize that high LGO teams will be better able to reap the benefits of delayed feedback on acquisition and retention tests, teams high in AGO will be less able to benefit from immediate feedback on acquisition and retention tests, and teams high in PGO will benefit more from immediate feedback in terms of acquisition performance.

## CHAPTER THREE: METHODOLOGY

### Participants

Participants included undergraduate students recruited using the University of Central Florida's undergraduate psychology research recruitment program Sona Systems. Participants must have been 17 years of age or older to partake in this study. The only anticipated risk was for those participants that had a history of seizures when playing typical video or computer games. Therefore, participants with a history of seizures were screened and were unable to participate.

A power analysis was performed to determine the number of participants needed to have sufficient power to reject the null hypothesis at an alpha level of .01. Using the procedures described by Cohen and Cohen (1983) power was set at .90, signifying a 90% chance of correctly rejecting the null hypothesis, and effect size was set at .41 as reported in Kluger and DeNisi (1996). The power analysis revealed 67 teams would be needed to reject the null hypothesis for an equation involving seven variables (9.58 participants per variable). However, in order to increase the probability of finding significance, I chose to add 13 more teams. This resulted in a total of 80 teams (160 participants). The calculations for this power analysis are presented in Table 1.

Table 1: Power Analysis Calculations

<b>Power Analysis Equation</b>	<b><math>n^* = L/f^2 + k + 1</math></b>
<b><math>L</math></b>	<b>24.24</b>
<b><math>f^2 = R^2 / 1 - R^2</math></b>	<b>.41</b>
<b><math>K</math></b>	<b>7</b>
<b><math>n^*</math> (number of teams)</b>	<b><math>24.24/.41 + 7 + 1 = 67.12</math></b>

Participant's ages ranged from 17 to 28 years old. Class standing for the sample included 100 Freshmen, 19 Sophomores, 13 Juniors, 18 Seniors, and 10 participants that were rated as Other. Reported grade point average for the sample ranged from 1.25 to 4.0. The sample consisted of 71 males (44.4%) and 89 females (55.6%). In total there were 16 male/male teams, 27 female/female teams, and 37 male/female teams. In the immediate feedback condition there were 8 male/male teams, 19 female/female teams, and 13 male/female teams. In the delayed feedback condition there were 8 male/male teams, 8 female/female teams, and 24 male/female teams. Two of the 80 teams did not complete the retention test, one in each feedback condition. Therefore, there were a total of 39 teams that received immediate feedback and 39 teams that received delayed feedback that completed the retention test (i.e., there were 78 total two person teams that completed the retention test scenario).

### Design

The research design is a two-way mixed model design with two levels of the between subjects variable (immediate or delayed feedback) and two levels of the within subjects variable (acquisition or retention performance). Participants were randomly assigned to one of two feedback conditions, immediate or delayed.

### Measures

#### *Manipulation Check*

I used a manipulation check questionnaire to evaluate the effectiveness of my feedback timing manipulation. The manipulation check consisted of a self-report questionnaire in which participants were asked to indicate when they received feedback

during the three training scenarios, during each scenario or after each scenario (see Appendix A). In support of the manipulation, all 160 participants were able to correctly identify when, during or after each training scenario, they received feedback.

### *Goal Orientation*

I conceptualized goal orientation similarly to Button et al. (1996) as a “somewhat stable composition characteristic that may be influenced by situational characteristics” (p. 28). Trait LGO, AGO, and PGO was captured using VandeWalle’s (1997) 13-item work domain goal orientation instrument (see Appendix A). The first five items were used to assess LGO. Items 6-9 assessed PGO and items 10-13 were used to assess AGO. Scale points ranged from 1 (*strongly disagree*) to 6 (*strongly agree*). Participant’s scale responses ranged from 1.8 to 6 for trait LGO, 1.5 to 6 for trait PGO, and 1 to 5.25 for trait AGO. In the current study, reliability (coefficient alpha) was .89 for trait LGO, .79 for trait PGO, and .83 for trait AGO.

State goal orientation was measured after participants’ completion of their training and feedback but prior to the acquisition test. State LGO, AGO, and PGO was measured using a 12-item modified version of VandeWalle’s instrument (see Appendix A). Items were modified to reflect participants’ responses to the specific task of this study. For example, one of the trait LGO items read, “I enjoy challenging and difficult tasks at work where I’ll learn new skills.” The corresponding state LGO item read, “I enjoy challenging and difficult tasks during the scenario where I’ll learn new skills.” Scale points from 1 (*strongly disagree*) to 6 (*strongly agree*). Items 1-4 assessed LGO, items 5-8 assessed PGO, and items 9-12 assessed AGO. Participant’s scale responses ranged from 1 to 6 for state LGO, 1 to 6 for state PGO, and 1 to 5 for state AGO.

Coefficient alphas for the state goal orientation measures were .92 for state LGO, .87 for state PGO, and .86 for state AGO.

#### *Teammate Familiarity*

Teammate familiarity was assessed using two items from a self-report questionnaire (see Appendix A). First, participants were asked if they knew their teammate. If participants responded yes, they were then asked to indicate how long they know their teammate. Teammate familiarity ranged from 0 months to 232 months (19 years and 4 months). Forty six teams (58%) had teammates that were unfamiliar with each other. Of the 34 teams that had teammates who knew each other, 16 of those teams (20%) were familiar with each other for more than a year.

#### *Positive and Negative Affectivity*

Positive and negative affectivity were measured in order to investigate its' role as a possible mediator between the interaction of feedback timing and goal orientation and team performance. Positive and negative affectivity was measured via self-report prior to the acquisition test (see Appendix A). The scale consisted of 20 words that described different feelings and emotions (e.g., interested or jittery). Ten items measured positive affect and 10 items measured negative affect. Participants were asked to indicate to what extent they felt "this" way at the present moment from 1 (*Not at all*) to 5 (*Extremely*). Participant's scale responses ranged from 1 to 5 for positive affect and 1 to 2.5 for negative affect. Coefficient alphas were .92 for positive affect and .69 for negative affect.

#### *Instrumentality of Feedback*

Instrumentality of feedback was assessed via a five-item self-report questionnaire (see Appendix A). Instrumentality of feedback was measured in order to investigate its'

role as a possible mediator between the interaction of feedback timing and goal orientation and team performance. Participants were asked to think about the feedback they received and circle the number on the scale that matched their level of agreement or disagreement with the statements, (1 = *strongly disagree* to 6 = *strongly agree*). Item 1 read, “The feedback I received was easy to understand.” Item 2 read, “The feedback I received could have been more useful.” Item 3 read, “It seemed like I received the same feedback over and over.” Item 4 read, “I ignored and made no attempt to use the feedback I received.” The final item of this questionnaire was a free response item and read, “I have the following additional comments I would like to make concerning the feedback I was provided with during this experiment.” Participant’s responses ranged from 1 to 6 for instrumentality of feedback items 1, 2, and 3. Participant’s responses ranged from 1 to 5 for instrumentality of feedback item 4.

### *Team Performance*

The dependent variable measured during post-training scenarios was the team’s target prioritization accuracy. Accuracy of target prioritization was calculated by taking the number of “correct” prioritizations made during a post-training scenario divided by the “total” number of prioritizations made during that scenario. For example, if a team made 6 correct prioritizations during a scenario out of a total of 10 prioritizations their target prioritization accuracy was 60%. Accuracy of target prioritizations ranged from 10% to 100% for both the acquisition and retention scenario test. The average accuracy of target prioritizations for the acquisition and retention scenario tests were .45 ( $SD = .18$ ) and .50 ( $SD = .20$ ) respectively.

## Experimental Platform and Task

The simulator test-bed that was used was a modified version of the Forward Observer Personal Computer-based Simulator (FOPCSim) developed at the Naval Postgraduate School. FOPCSim replicates the task training of a “call for fire” from artillery and mortar assets that is performed by forward observers. FOPCSim is a simulation of the tasks performed by the Forward Observer (FO). The FO is one of many members of the Fire Support Team (FiST). The FO’s main task is to perform a call for fire with a marine mortar or artillery unit. The call for fire was a three step process:

1. FO located targets.
2. FO identified targets.
3. FO communicated the position and type of target to the artillery or mortar unit.

The goal of the FO was to disable as many enemy targets as possible before they got too close to the FO’s position. There were two types of FOs; Artillery and Mortar. The Artillery FO fired and adjusted artillery on targets. Mortar FO fired and adjusted mortars on targets. Participants played an experimental version of FOPCSim Mortar and Artillery. During the task participants encountered three types of targets; T-72 battle tanks, ZSU radar tanks, and bunkers. Munitions for the artillery and mortar unit included VT, ICM and HE/Quick. ICM was the only munitions capable of destroying T-72’s, VT was used to destroy ZSU tanks, and HE/Quick was 100% effective for destroying Bunkers (see Table 2).

Table 2: Munition Effectiveness for FOPCSim Task

Target Types	Munition Types		
	ICM	VT	HE/Quick
<b>T-72</b>	<b>100%</b>	10%	10%
<b>ZSU</b>	10%	<b>100%</b>	10%
<b>Bunker</b>	10%	10%	<b>100%</b>

Artillery and Mortar FO’s worked together in order to accomplish the call for fire task by splitting up the targets based on each FO’s capabilities. In general, the interdependency of the FO task was compensatory in nature (i.e., each team members’ inputs were averaged in order to come to a team outcome). The FO’s split tasks based on the target prioritization and engagement rules.

*Engagement Rules Based on Range*

1. Mortar FO engaged all targets within 100-1,000 meters.
2. Artillery FO engaged all targets within 1,001-2,000 meters.

*Target Prioritization Rules*

Target missions were conducted in accordance with the following rules:

1. Neutralize targets engaging your position.
2. Neutralize the nearest moving target within your position.
3. Neutralize the nearest stationary T-72 that is not engaging you.
4. Neutralize the nearest stationary ZSU.
5. Neutralize the nearest stationary bunker.
6. Do not neutralize targets beyond 2,000 meters from your position or less than 100 mils of your position.



The munitions for the Mortar FO had a shorter range than the munitions for the Artillery FO. Therefore, the Mortar FO engaged T-72s, ZSUs, and bunkers only when they were within 100-1,000 meters. The Artillery FO engaged T-72s, ZSUs, and bunkers when they were located more than 1,001 meters.

#### Procedure

Participants learned the military call for fire task within FOPCSim. Specifically, participants were asked to participate in a series of training sessions that taught them to effectively perform the call for fire task within FOPCSim. Throughout the experimental session, participants were asked to fill out several questionnaires and forms concerning their performance within the simulator.

The procedure included the administration of the consent form (see Appendix A), demographic form (see Appendix A), and “trait” goal orientation scale (see Appendix A) upon participant’s arrival. Following completion of the consent, demographic, and goal orientation forms initial training on FOPCSim began. The training contained information about the task they were to perform. Specifically, participants reviewed a 20 minute demonstration that provided information such as the rules of the game, the simulation screen, tools to use for obtaining data, symbology, and buttonology. Next, participants took a short (five minutes) knowledge test to determine if they understood what they reviewed. Finally, participants played two 10 minute buttonology practice scenarios with experimenter coaching. Participant teams were then randomly assigned to one of the two feedback conditions within FOPCSim.

### *Training Conditions*

Teams then proceeded through the training in which they played three 10 minute training scenarios. Feedback was given based on the appropriate condition. In the immediate feedback condition participants received outcome feedback after each call for fire. Each feedback message was given via a pop up box in the bottom left hand corner of the screen and was displayed for 15 seconds. Participants were able to continue to play the simulation while the feedback was displayed (i.e., the simulation did not pause while participants received feedback). The delayed feedback condition received outcome feedback at the completion of each training scenario. Participants in the delayed feedback condition had 15 seconds multiplied by the number of feedback messages to review their summary feedback based on their performance. This was done to insure that both groups spent an equal amount of time reviewing the feedback. Following the completion of each training scenario (e.g., at the end of the feedback session for the delayed condition), prior to the next training scenario, participants in both conditions were given 2 minutes to discuss what happened during the training scenario and the feedback that was provided for that scenario. However, teams in both conditions were “not” given the actual feedback to review during this time period.

There are a number of ways in which the content of feedback can vary (e.g., process or outcome feedback). It has been thought that the content of feedback can influence an individual’s goal orientation. In fact, Van Duyne (2002) found evidence that the content of feedback given to a trainee can influence the temporal stability of goal orientation. Therefore, I held the content of the feedback constant during my study (i.e., all teams’ received only outcome feedback). Specifically, performance based outcome

feedback was delivered via text either during or after each training scenario. Feedback was based on correct prioritization, identification, munition type, range, and accuracy (see Table 3).

Table 3: Feedback Example

Mission # 2, Target # 215	
X	<b>Prioritization-</b> The mission was performed on a target that was not the highest priority target. Check prioritization rules.
X	<b>Identification-</b> The target is not a ZSU. Check target pictures/descriptions.
√	<b>Munition-</b> The correct munition, HE/Quick, for a Bunker, was chosen.
√	<b>Range-</b> Mortar correctly engaged this target.
X	<b>Accuracy-</b> Munition rounds were 200 meters from the target. Use the compass and laser ranger finder to project the targets location.

Following the completion of the three training scenarios participants were administered the “state” goal orientation questionnaire and the positive/negative affectivity questionnaire (see Appendix A), took a five minute break, and then played a 10 minute scenario. This scenario was considered the acquisition phase post-test. It is important to reiterate that no feedback was given during or after this scenario test. After the acquisition phase post-test participants completed a feedback manipulation check questionnaire (see Appendix A) and a feedback reactions questionnaire (see Appendix A). After completing the feedback forms participants were dismissed and allowed a 1 week break.

Following the one week break participants proceeded into the retention phase of the training evaluation which consisted of a 10 minute testing scenario. Although similar (i.e., participants will be performing the same type of tasks); the retention scenario was not a replication of the acquisition testing scenario. As was the case with the acquisition testing scenario, participants did not receive feedback during the retention testing

scenario. Following the retention phase scenario participants were debriefed on the purpose of the study, allowed to ask questions, and then were excused. An overview of the experimental procedures is provided in Table 4.

Table 4: Experimental Procedures

Activity	Time	Materials/Measures
<b>Task Familiarization</b>		
Consent and Demographic Forms	10 min	Consent Form, Demographic Form, "Trait" Goal Orientation Scale
Test bed Familiarization	25 min	Test bed training, Knowledge test
Buttonology Practice	25 min	
Break	5 min	
<b>Acquisition Phase</b>		
Training Scenario	10 min	Immediate Feedback Condition had 15 seconds to review each feedback message. Delayed Feedback Condition had 15 seconds multiplied by the number of feedback messages to review feedback.
Scenario Discussion	2 min	
Training Scenario	10 min	Immediate Feedback Condition had 15 seconds to review each feedback message. Delayed Feedback Condition had 15 seconds multiplied by the number of feedback messages to review feedback.
Scenario Discussion	2 min	
Training Scenario	10 min	Immediate Feedback Condition had 15 seconds to review each feedback message. Delayed Feedback Condition had 15 seconds multiplied by the number of feedback messages to review feedback.
Scenario Discussion	2 min	
Goal Orientation Form	5 min	"State" Goal Orientation and Positive/Negative Affectivity Scale
Break	5 min	
Testing Scenario	10 min	10 minute scenario-No Feedback
Feedback Forms	10 min	Feedback Manipulation Check, Feedback Reactions Questionnaire
Day 1 Total	2 hours 11 minutes	
Break	1 week	
<b>Retention Phase (no feedback)</b>		
Testing Scenario	10 min	10 minute scenario-No Feedback
Debrief	10 min	
Day 2 Total	20 min	

## CHAPTER FOUR: RESULTS

### Descriptive Data

Table 5 presents the means, standard deviations, and intercorrelations among the study variables. Trait and state goal orientation, positive and negative affectivity, instrumentality of feedback, acquisition test performance, and retention test performance were all team level variables. All team level variables in this study were conceptualized using an aggregate construct (i.e., the mean). For example, teams were characterized with respect to the mean level of members' goal orientation. While there are multiple ways of indexing team constructs the mean is the most commonly used method in the published literature (Barrick, Stewart, Neubert, & Mount, 1998).

#### *Correlations amongst Goal Orientation Variables*

Consistent with prior research, LGO, PGO, and AGO exhibited low to moderate intercorrelations, with a positive correlation among trait LGO and trait PGO  $r(78) = .30$ ,  $p < .01$ , a negative correlation between trait LGO and trait AGO  $r(78) = -.27$ ,  $p < .01$ , and a small positive correlation between trait PGO and trait AGO  $r(78) = .11$ ,  $p > .05$ . State goal orientation intercorrelations were similar. The correlation between state LGO and state PGO was  $r(78) = .41$ ,  $p < .01$ . Amongst state LGO and state AGO the correlation was  $r(78) = -.19$ ,  $p > .05$ . There was a moderate positive correlation between state PGO and state AGO was  $r(78) = .50$ ,  $p < .01$ . Intercorrelations between similar trait and state goal orientation variables were all significant. The correlation among trait LGO and state LGO was  $r(78) = .45$ ,  $p < .01$ . The correlation between trait PGO and state PGO was  $r(78) = .35$ ,  $p < .01$  and the correlation between trait AGO and state AGO was  $r(78) = .45$ ,  $p < .01$ .

There were four significant correlations between the goal orientation variables and positive affectivity. However, there was only one significant correlation between the goal orientation variables and negative affect. State LGO was moderately related to positive affect  $r(78) = .44, p < .01$ . Trait PGO and positive affect was correlated  $r(78) = .29, p < .01$ , while state PGO and positive affect was related  $r(78) = .41, p < .01$ . State LGO had a small negative relationship with negative affect  $r(78) = -.27, p < .05$ .

#### *Correlates of Acquisition and Retention Performance*

There were no significant correlations between the study variables and acquisition scenario performance. There were a few significant correlations between the study variables and retention scenario performance that were moderate in size. The correlation between retention performance and feedback condition was  $r(76) = .32, p < .01$ . There were also significant correlations between retention performance and mortar sex  $r(76) = -.35, p < .01$  (i.e., males outperformed females during the retention scenario test) and retention performance and teammate familiarity  $r(76) = .42, p < .01$ . There was also a moderate positive correlation among retention performance and state PGO  $r(76) = .34, p < .01$ . Finally, there was a moderate positive correlation between retention performance and positive affect  $r(76) = .36, p < .01$ .

Table 5: Means, Standard Deviations, and Intercorrelations

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Feedback	1.5	.50	-														
2. Mortar Sex	1.53	.50	-.25*	-													
3. Artillery Sex	1.59	.50	-.08	.12	-												
4. Teammate Familiarity	57.46	152.02	.13	.00	.11	-											
5. Trait LGO	4.84	.68	.08	-.15	-.10	-.06	(.89)										
6. Trait PGO	4.26	.63	-.07	.01	-.16	.21	.30**	(.83)									
7. Trait AGO	2.82	.84	.02	.09	.11	.24*	-.27*	.11	(.79)								
8. State LGO	4.48	.80	.02	-.23	-.13	.07	.45**	.29**	-.12	(.92)							
9. State PGO	3.29	.94	.06	-.34**	.04	.31**	.10	.35**	.11	.41**	(.86)						
10. State AGO	2.29	.72	.06	-.03	.05	.22	-.13	.11	.45**	-.19	.50**	(.87)					
11. Positive Affect	3.12	.67	.09	-.36**	-.20	.16	.15	.29**	.03	.44**	.41**	.09	(.92)				
12. Negative Affect	1.33	.26	.02	.07	.11	-.14	-.14	-.03	.11	-.27*	.04	.20	.08	(.69)			
13. Instrumentality of Feedback	2.94	.92	.00	.10	-.23*	.09	.05	.08	.01	.04	-.13	-.08	.10	-.02	-		
14. Acquisition Performance	.45	.18	.00	-.05	-.16	.03	.10	-.01	-.17	.15	.02	-.06	.19	-.11	-.20	-	
15. Retention Performance	.50	.20	.32**	-.35**	-.08	.42**	-.07	-.06	.08	.21	.34**	.10	.36**	-.10	-.19	.15	-
N			80	80	80	80	80	80	80	80	80	80	80	80	80	80	78

Note. Feedback is a dummy code where 1 = *immediate feedback*, 2 = *delayed feedback*. Sex is a dummy code where 1 = *male*, 2 = *female*. Instrumentality of Feedback is reverse coded. ( ) = coefficient alpha

\* $p \leq .05$  \*\* $p \leq .01$



## Tests of the Hypotheses

### *Mixed-model ANOVA Analysis*

A mixed-model Analysis of Variance (ANOVA) was conducted to determine whether the effect of feedback timing differed depending on the evaluation criteria (i.e., acquisition or retention phase of training) (see Table 6). The results revealed a significant main effect for feedback condition,  $F(1, 76) = 4.62, p < .05$ , with teams receiving delayed feedback condition performed significantly better than those in the immediate feedback condition. The average accuracy of target prioritizations across the two scenarios was .51 ( $SD = .19$ ) for teams that received delayed feedback during the training scenarios compared to .44 ( $SD = .18$ ) for teams that received immediate feedback during the training scenarios. However, this main effect must be qualified by the significant interaction of feedback condition with the within-subjects factor (acquisition or retention),  $F(1, 76) = 4.75, p < .05$ . Inspection of the means indicated that feedback condition had a significantly greater impact on retention performance than it did on acquisition performance. In fact, the mean for acquisition performance for those who received immediate feedback ( $M = .45, SD = .18$ ) was identical to the mean for those who received delayed feedback ( $M = .45, SD = .18$ ). However, teams that received delayed feedback ( $M = .56, SD = .20$ ) had significantly better target prioritization accuracy compared to those teams who received immediate feedback ( $M = .43, SD = .18$ ) during the retention scenario test,  $t(76) = -2.94, p < .01$ . Thus, Hypothesis One was not supported, however Hypothesis Two was supported. In addition, teams which received delayed feedback had a significant increase in target prioritization accuracy from the acquisition test to the retention test,  $t(38) = -2.47, p < .01$ . In other words, teams which

received delayed feedback had an 11% improvement in performance from time 1 to time 2.

Table 6: Analysis of Variance for Feedback Timing on Scenario Performance

Source	<i>Df</i>	<i>F</i>	<i>P</i>
Between Subjects			
Feedback	1	4.62	.02*
Error	76	(.04)	
Within Subjects			
A&R Performance	1	2.54	.06
A&R Performance	1	4.72	.02*
X Feedback			
Within-group error	76	(.03)	

Note. Values enclosed in parentheses represent mean square errors. A&R Performance = Acquisition and Retention Scenario Performance.

\* $p < .05$

Table 7: Acquisition and Retention Scenario Performance Means and Standard Deviations

	Feedback Condition	Mean	SD	N
Acquisition Scenario Percent Correct Prioritizations	Immediate	.45	.18	40
	Delayed	.45	.18	40
	Total	.45	.18	80
Retention Scenario Percent Correct Prioritizations	Immediate	.43	.18	39
	Delayed	.56	.20	39
	Total	.50	.20	78

### *Regression Analyses*

My remaining hypotheses involving team-level goal orientation were tested using multiple regression analyses (see Table 8). I had collected both trait and state measures of goal orientation. However, state goal orientation is theoretically considered more proximal to learning outcomes and thus should have the strongest relations in this study. Consistent with this notion, analyses involving trait measures did not yield significant results. Thus, I will report tests of my hypotheses using the state goal orientation measures only. Teammate familiarity and teammate sex were included in the regression models due to their relations with my dependent measures.

First, acquisition performance was regressed on feedback condition, the three state goal orientation variables, mortar participants' and artillery participants' sex, and teammate familiarity, as well as product terms reflecting the interaction of feedback condition and each of the three state goal orientation measures, the interaction of feedback condition and teammate familiarity, and the interaction of the mortar participants' and artillery participants' sex (see Table 8). As can be seen in Table 8, none of the predictor variables were significant predictors of acquisition performance. Thus, Hypotheses 3, 4, 7, 8, and 11 were not supported. Second, retention performance was regressed on the same set of predictor variables. Neither state LGO,  $\beta = -.53$ ,  $t(65) = -1.44$ ,  $p > .05$ , state AGO,  $\beta = -.27$ ,  $t(65) = -.76$ ,  $p > .05$ , or state PGO,  $\beta = .56$ ,  $t(65) = 1.20$ ,  $p > .05$ , were significant predictors of retention performance. Thus, Hypotheses 5, 9, and 12 were not supported. Mortar FO sex,  $\beta = .55$ ,  $t(65) = 1.69$ ,  $p < .05$  and Artillery FO Sex,  $\beta = .68$ ,  $t(65) = 2.24$ ,  $p < .05$  were significant predictors of team performance during the retention scenario (i.e., males outperformed females when playing either the

Mortar or Artillery FO positions). Additionally, significant interactions were found for the product terms of state LGO and feedback condition,  $\beta = 1.32$ ,  $t(65) = 1.79$ ,  $p < .05$ , Mortar FO Sex and Artillery FO Sex,  $\beta = -1.20$ ,  $t(65) = -2.59$ ,  $p < .01$ , and teammate familiarity and feedback condition,  $\beta = 1.18$ ,  $t(65) = 2.51$ ,  $p < .01$ . However, retention performance was not predicted by the interaction of feedback condition with either state AGO,  $\beta = .30$ ,  $t(65) = .54$ ,  $p > .05$ , or state PGO,  $\beta = -.69$ ,  $t(65) = -.99$ ,  $p > .05$ , failing to find support for Hypotheses 10 and 13. In support of Hypothesis 6, the positive impact of delayed feedback on retention performance was greatest for teams higher in state LGO. The pattern of this interaction is depicted in Figure 8. The interaction between Mortar FO Sex and Artillery FO Sex suggests that teams in which the mortar position was played by a male and the artillery position by a female performed the best during the retention scenario test, where as teams with females in the mortar and artillery positions performed the worst during the retention scenario test (see Figure 9). Additionally, the interaction between teammate familiarity and feedback condition indicates that the positive impact of delayed feedback was greatest for teams that were more familiar with each other.

Table 8: Regression Results Predicting Acquisition and Retention Scenario Performance

Acquisition Test Performance				Retention Test Performance			
Predictors	<i>B</i>	<i>SE B</i>	$\beta$	Predictors	<i>B</i>	<i>SE B</i>	$\beta$
Feedback (FB)	.29	.33	.81	Feedback (FB)	-.33	.27	-.83
State LGO	.12	.11	.55	State LGO	-.13	.09	-.53
State PGO	.01	.12	.04	State PGO	.12	.10	.56
State AGO	-.01	.12	-.03	State AGO	-.07	.10	-.27
M Sex	-.03	.16	-.08	M Sex	.22*	.13	.55*
A Sex	-.05	.15	-.13	A Sex	.27*	.12	.68*
Team Fam	.00	.00	-.42	Team Fam	.00	.00	-.71
FB X State LGO	-.06	.07	-.91	FB X State LGO	.10*	.06	1.32*
FB X State PGO	-.01	.07	-.17	FB X State PGO	-.06	.06	-.69
FB X State AGO	.01	.08	.04	FB X State AGO	.04	.07	.30
M Sex X A Sex	.00	.09	.02	M Sex X A Sex	-.20**	.08	-1.20**
FB X Team Fam	.00	.00	.50	FB X Team Fam	.00**	.00	1.18**

Note. M Sex = Mortar Sex. A Sex = Artillery Sex. Team Fam = Teammate Familiarity. Feedback is a dummy code where 1 = *immediate feedback*, 2 = *delayed feedback*. Sex is a dummy code where 1 = *male*, 2 = *female*. Beta is the standardized regression coefficient, and significance levels are based on directional, one-tailed *t* tests. Acquisition Test  $R^2 = .28$ . Retention Test  $R^2 = .50$  ( $p < .01$ ).  $R^2$  significance levels are based on *F* tests.

\* $p \leq .05$  \*\* $p \leq .01$

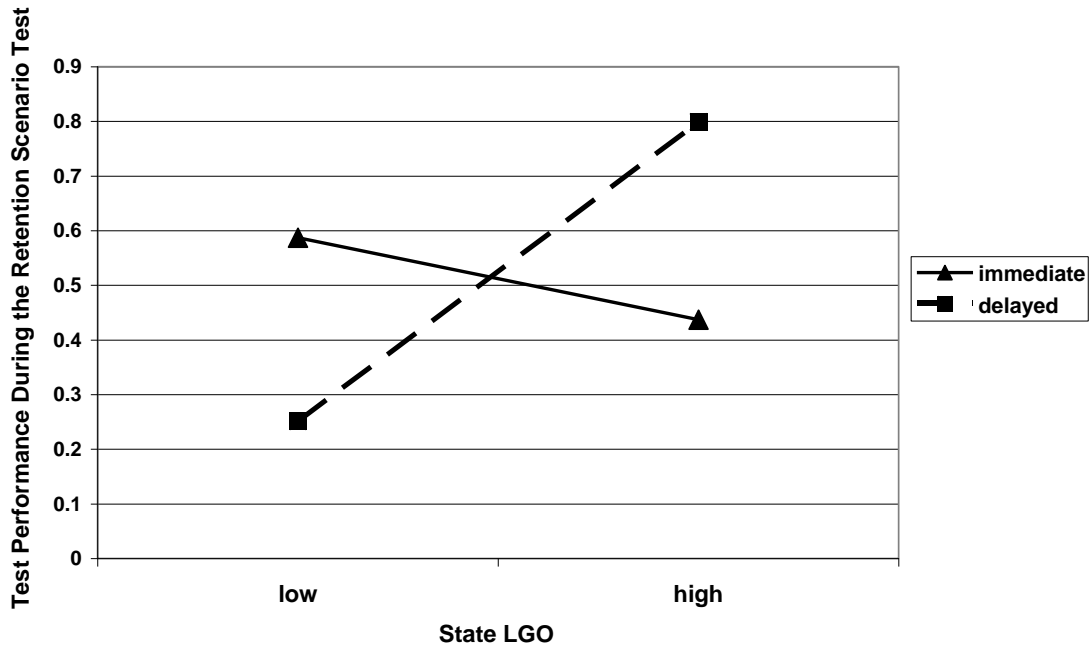


Figure 8: Moderating Effect of State LGO on Feedback and Retention Test Performance

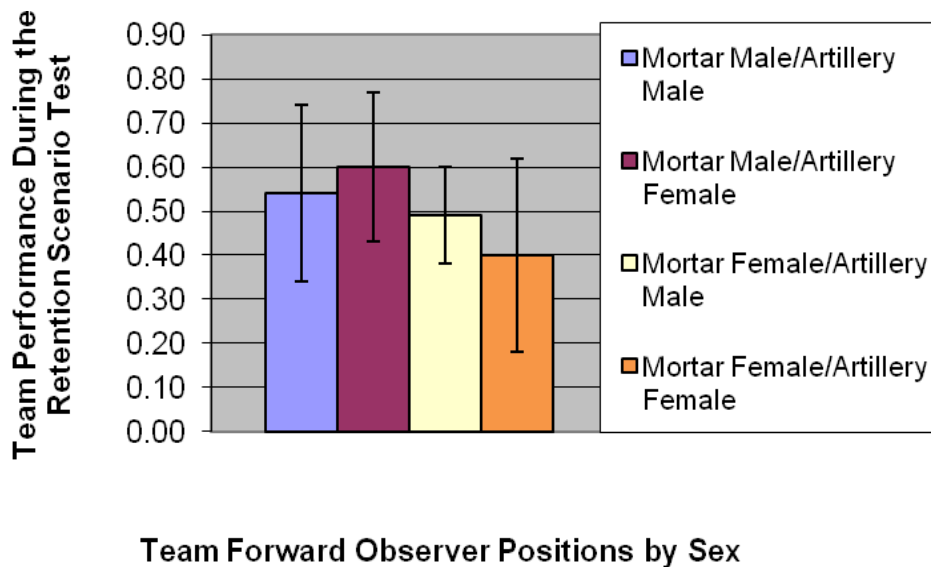


Figure 9: Retention Scenario Test Performance Based on Forward Observer Sex

### Exploratory Analyses: Mediation Tests

In my original model I did not specifically predict that the relationships between the antecedents (i.e., the interaction between feedback timing and goal orientation) and acquisition team performance and retention team performance were mediated by other variables of interest (see Figure 1). However, based on attitude theory it did seem plausible that certain variables could mediate this relationship. Attitude theory suggests that there are three components of attitudes; behavioral, affective, and cognitive. Each one of these components influences training and learning outcomes. For example, it is plausible that the beneficial effect of the interaction between feedback timing and goal orientation on team performance is only possible if the team is in a good mood (i.e., high positive affectivity). Conversely, if the team is in a poor mood (i.e., high negative affectivity) it is possible that the effect of the interaction between feedback timing and goal orientation on team performance may not be realized. To test for mediation on my original model three variables theoretically stood out: positive affect, negative affect, and the team's instrumentality of the feedback. These variables represent the affective and cognitive components of attitudes respectively.

Baron and Kenny (1986) suggest four criteria in order to test the possible mediation effect of a variable on a particular relationship. First, the independent variable must significantly predict the dependent variable. Second, the independent variable must significantly predict the potential mediator variable. Third, the potential mediator variable must significantly predict the dependent variable. Lastly, when the independent variable and the mediator variable are included in the regression model together, only the mediator variable significantly predicts the dependent variable. I conducted three separate

regression analyses to test mediation based on this criteria. Positive affectivity, negative affectivity, and team's instrumentality of the feedback (i.e., team's perceived feedback usefulness) were regressed on feedback timing, the three state goal orientation variables, and the interaction between feedback timing and the three state goal orientation variables. Table 9 provides a summary of these analyses.

#### *Positive and Negative Affectivity Mediator Tests*

As can be seen in Table 9, feedback timing, state goal orientation, and the interactions between feedback timing and state goal orientation did not significantly predict positive affectivity or negative affectivity at either step. Therefore, based on Barron and Kenny's (1986) second criteria positive and negative affectivity are not mediators of the relationship between the interaction of feedback timing with goal orientation and acquisition team performance or retention team performance.

#### *Instrumentality of Feedback Mediator Tests*

The regression analysis revealed that the interactions between feedback condition and state LGO,  $\beta = 1.57$ ,  $t(72) = 1.69$ ,  $p < .05$ , feedback condition and state PGO,  $\beta = -1.91$ ,  $t(72) = -2.24$ ,  $p < .05$ , and feedback condition and state AGO,  $\beta = 1.85$ ,  $t(72) = 2.63$ ,  $p < .01$  significantly predicted the team's instrumentality of the feedback, thus fulfilling Baron and Kenny's (1986) second requirement (see Table 9). The forms of these relationships are presented in Figures 10, 11, and 12. In my previous regression analyses I found that there were no significant predictors of acquisition scenario performance. Therefore, I focused my mediation tests on retention scenario performance. During the previous regression analysis the product term between feedback condition and state LGO,  $\beta = 1.32$ ,  $t(65) = 1.79$ ,  $p < .05$ , significantly predicted team performance during the



retention scenario, thus fulfilling Barron and Kenny's (1986) first requirement (see Table 8). Next, retention performance was regressed on feedback condition, the three state goal orientation variables, mortar participant and artillery participants' sex, teammate familiarity, team's instrumentality of the feedback, as well as, the product terms reflecting the interaction of feedback condition and each of the three state goal orientation measures, the interaction of feedback condition and teammate familiarity, and the interaction of the mortar participants' and artillery participants' sex (see Table 10). The analysis revealed that the team's instrumentality of feedback,  $\beta = .18$ ,  $t(64) = 1.87$ ,  $p < .05$ , significantly predicted team retention test performance, while the interaction between feedback condition and state LGO,  $\beta = 1.01$ ,  $t(64) = 1.36$ ,  $p > .05$  was no longer significant. These results fulfill Baron and Kenny's third and fourth criteria for mediation. In total, these results suggest that instrumentality of feedback mediates the relationship between the interaction of feedback timing with goal orientation and retention team performance. The final model is depicted in Figure 13.

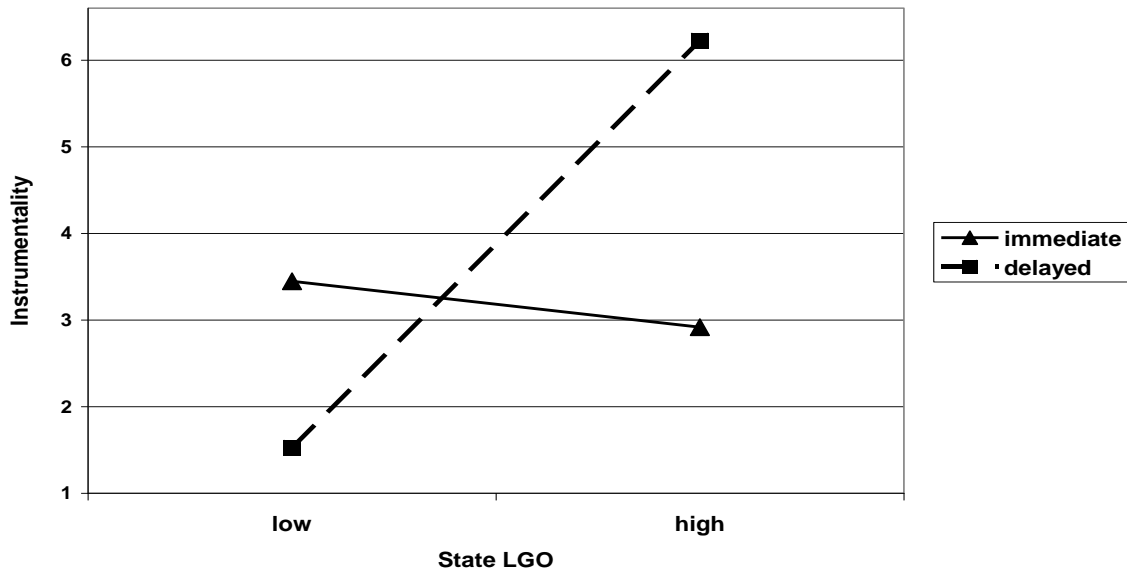


Figure 10: Moderating Effect of State LGO on Feedback and Instrumentality of Feedback

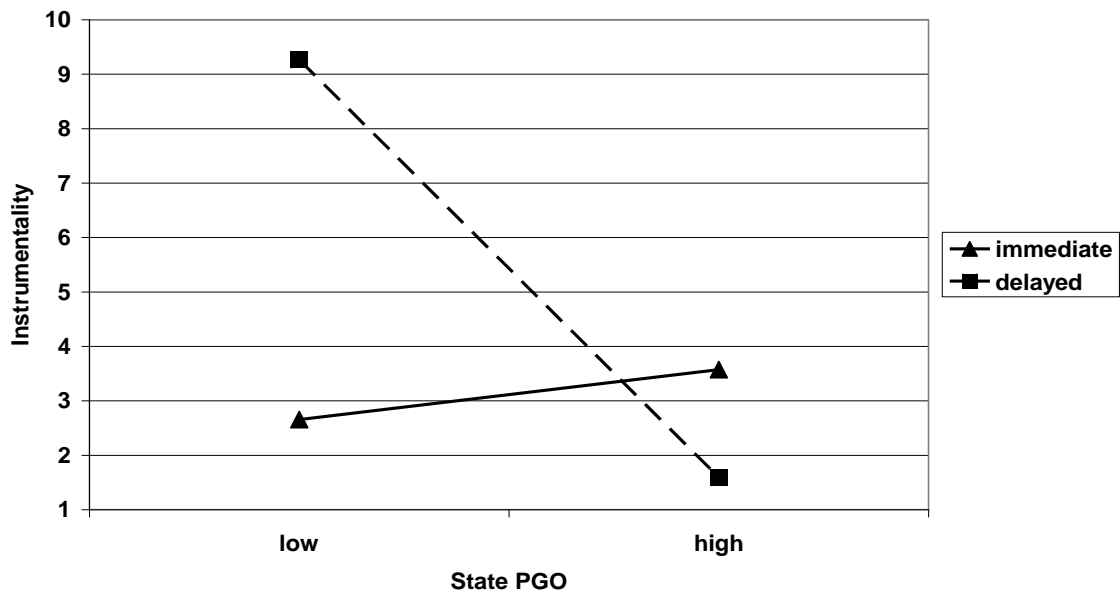


Figure 11: Moderating Effect of State PGO on Feedback and Instrumentality of Feedback

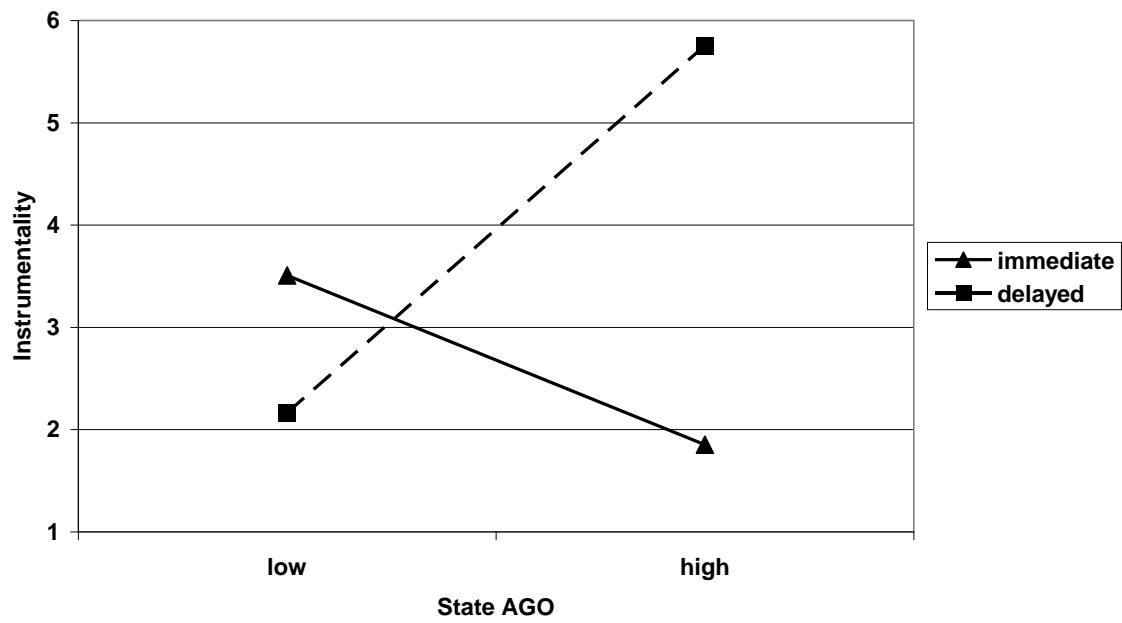


Figure 12: Moderating Effect of State AGO on Feedback and Instrumentality of Feedback

Table 9: Regression Results Predicting Positive Affect, Negative Affect, and Instrumentality of Feedback

Positive Affect				Negative Affect				Instrumentality of Feedback			
Predictors	<i>B</i>	<i>SE B</i>	$\beta$	Predictors	<i>B</i>	<i>SE B</i>	$\beta$	Predictors	<i>B</i>	<i>SE B</i>	$\beta$
Feedback (FB)	.19	1.02	.14	Feedback (FB)	-.11	.44	-.22	Feedback (FB)	-2.44	1.54	-1.33
State LGO	..26	.35	.31	State LGO	-.18	.15	-.54	State LGO	-.66	.52	-.57
State PGO	.24	.37	.34	State PGO	.22	.16	.78	State PGO	.93	.56	-.95
State AGO	.04	.38	.04	State AGO	-.13	.16	-.37	State AGO	-1.38**	.57	-1.09**
FB X State LGO	.01	.22	.04	FB X State LGO	.05	.09	.50	FB X State LGO	.56*	.33	1.57*
FB X State PGO	-.03	.22	-.10	FB X State PGO	-.12	.09	-1.04	FB X State PGO	-.74*	.33	-1.91*
FB X State AGO	-.02	.26	-.06	FB X State AGO	.12	.11	.73	FB X State AGO	1.05**	.40	1.85**

Note. Feedback is a dummy code where 1 = *immediate feedback*, 2 = *delayed feedback*. Sex is a dummy code where 1 = *male*, 2 = *female*. Instrumentality of Feedback is reverse coded. Beta is the standardized regression coefficient, and significance levels are based on directional, one-tailed *t* tests. Positive Affect  $R^2 = .27$  ( $p < .01$ ). Negative Affect  $R^2 = .12$ . Instrumentality of Feedback  $R^2 = .12$ .  $R^2$  significance levels are based on *F* tests.

\* $p \leq .05$  \*\* $p \leq .01$

Table 10: Regression Results Predicting Acquisition and Retention Scenario Performance with Instrumentality of Feedback as a Predictor

Acquisition Test Performance				Retention Test Performance			
Predictors	<i>B</i>	<i>SE B</i>	$\beta$	Predictors	<i>B</i>	<i>SE B</i>	$\beta$
Feedback (FB)	.39	.33	1.09	Feedback (FB)	-.23	.27	-.59
State LGO	.15	.11	.69	State LGO	-.10	.09	-.40
State PGO	-.03	.12	-.15	State PGO	.08	.10	.39
State AGO	.04	.12	.18	State AGO	-.02	.10	-.084
M Sex	-.02	.16	-.05	M Sex	.23*	.13	.57*
A Sex	-.01	.15	-.04	A Sex	.30*	.12	.75**
Team Fam	.00	.00	-.43	Team Fam	.00	.00	-.71
FB X State	-.09	.07	-1.25	FB X State	.08	.06	1.01
LGO				LGO			
FB X State	.02	.07	.20	FB X State	-.03	.06	-.35
PGO				PGO			
FB X State	-.03	.09	-.30	FB X State	.00	.07	.00
AGO				AGO			
M Sex X A	.00	.09	-.05	M Sex X A	-.21**	.08	-1.25**
Sex				Sex			
FB X Team	.00	.00	.48	FB X Team	.00**	.00	1.15**
Fam				Fam			
Instrumentality	.04	.03	.20	Instrumentality	.04*	.02	.18*
of FB				of FB			

Note. M Sex = Mortar Sex. A Sex = Artillery Sex. Team Fam = Teammate Familiarity. Feedback is a dummy code where 1 = *immediate feedback*, 2 = *delayed feedback*. Sex is a dummy code where 1 = *male*, 2 = *female*. Instrumentality of Feedback is reverse coded. Beta is the standardized regression coefficient, and significance levels are based on directional, one-tailed *t* tests. Acquisition Test  $R^2 = .11$ . Retention Test  $R^2 = .53$  ( $p < .01$ ).  $R^2$  significance levels are based on *F* tests.

\* $p \leq .05$  \*\* $p \leq .01$

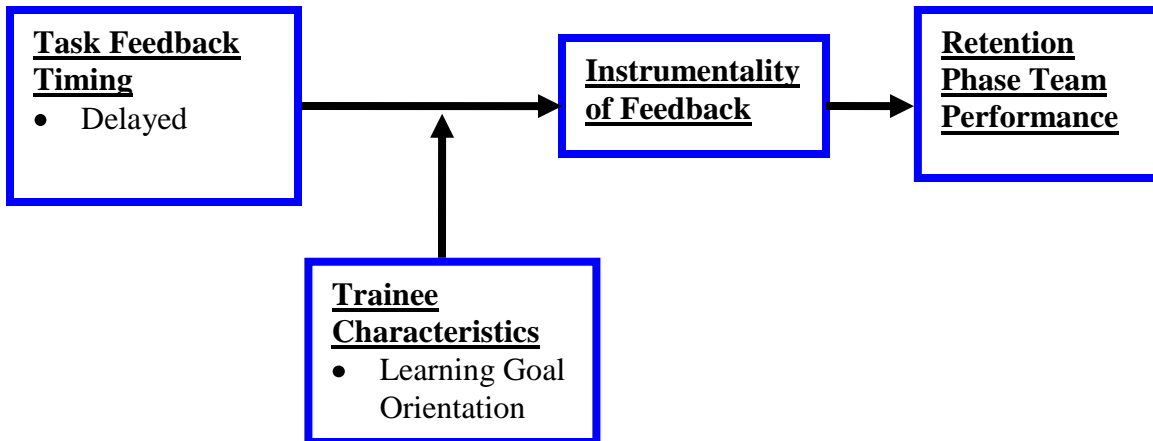


Figure 13: Final Model Supported By Results

## CHAPTER FIVE: DISCUSSION

The results of this study indicate that while there were no differences between teams that received immediate or delayed feedback during training on the acquisition scenario test, teams that received delayed feedback outperformed teams that received immediate feedback during training on the retention scenario test. Neither of the three goal orientation variables or their interactions with feedback timing significantly predicted acquisition scenario test performance. Furthermore, the three goal orientation variables failed to significantly predict retention performance. This study also found that males outperformed females when playing either FO position during the retention scenario.

Additionally, this study found that positive impact of delayed feedback on retention performance was greatest for teams higher in state LGO. However, retention performance was not predicted by the interaction of feedback condition with either state AGO or state PGO. It was found that during the retention scenario test the positive impact of delayed feedback was greatest for teams that were more familiar with each other. This study also found that teams in which the mortar position was played by a male and the artillery position by a female performed the best during the retention scenario test, where as teams with females in the mortar and artillery positions performed the worst during the retention scenario test. Lastly, the results of this study suggest that instrumentality of feedback mediates the relationship between the interaction of feedback timing with goal orientation and retention team performance.

## Theoretical Implications

The present experiment sought to extend prior research in a number of ways. While a number of studies have investigated the effects of delayed versus immediate feedback during acquisition and retention performance at the individual level, this was the first to investigate the effects of feedback timing on acquisition and retention performance during simulation based team training. On the one hand, the temporal contiguity perspective suggested that feedback should be presented at the time an action is made a team's decisions or actions should be linked with cues in the environment at the time the action is made (Corbett, Koedinger, & Anderson, 1997; Guthrie, 1935). This perspective suggested that providing feedback during an action would help strengthen the link between the context in the environment and the decision that was made. On the other hand, the task interruption theory suggests that immediate feedback serves as a task interruption and may actually hinder learning (Schmidt, 1991; Schmidt & Bjork, 1992). This theory suggests delayed feedback is best for the maintenance of requisite KSAs and cognitive processes necessary for effective performance during simulation based team training.

This study found that there were no performance differences on an acquisition scenario test between teams that received immediate or delayed feedback. However, consistent with expectations, teams that received delayed feedback made more accurate target prioritizations on a retention scenario test than teams receiving immediate feedback. These findings failed to support the temporal contiguity perspective and strengthened support for the task interruption perspective. Specifically, the results of this study and the task interruption perspective suggests that providing immediate feedback



actually interferes with learning (Schmidt, 1991; Schmidt & Bjork, 1992) and in order for feedback to be most effective, especially during complex or novel tasks, feedback should be delayed. What's more, the results of this study showed that those teams which received delayed feedback made more accurate target prioritizations from test 1 to test 2. In other words, one week after initial training those teams that received delayed feedback had an increase in performance during the retention phase of training. These results are consistent with findings using other types of training interventions (e.g., behavioral role-modeling). It seems that the beneficial effects of delayed feedback not only helps maintain performance but can also help increase performance over time.

Another way this study contributed to the literature is by investigating the moderating effects of team level goal orientation on the relationship between feedback timing and performance during simulation based team training. In prior research, goal orientation has been shown to influence the manner in which individuals respond to features of the training environment (Brown, 2001; Smith-Jentsch, Milanovich, & Merket, 2001; Towler & Dipboye, 2001). However, little research had been performed regarding team level goal orientation and its influence on various training features (e.g., feedback timing). This study found that team level state LGO indeed moderated the relationship between feedback condition (immediate or delayed) and retention performance. On the one hand, high LGO teams that received delayed feedback made more accurate target prioritizations on a retention scenario test than high LGO teams that received immediate feedback. This finding supports the notion that high LGO teams are better equipped to benefit from the delayed feedback they received prior to the retention test. Recall that high LGO teams seek and prefer challenges. Similar to the argument

made by Towler and Dipboye (2001), it could be the case that high LGO teams perceive training using immediate feedback as unchallenging and, as a result, detrimental to their performance. However, because delayed feedback forces trainees to work harder cognitively during training, high LGO teams are likely to prefer delayed feedback during training.

On the other hand, this study found that low LGO teams benefited more from immediate feedback than delayed feedback. It seems that low LGO teams may perceive training using delayed feedback as too challenging and therefore detrimental to their performance. Low LGO teams, unlike high LGO teams, most likely prefer immediate feedback because it provides immediate knowledge of results and guidance without team self-regulation. In summary, preference for a challenge and engagement in greater self-regulatory processes allow delayed feedback to be more advantageous, compared to immediate feedback, for high LGO teams during the retention phase of training. However, preference for immediate knowledge of results and performance guidance without having to self-regulate allows immediate feedback to be more advantageous, compared to delayed feedback, for low LGO teams during the retention phase of training. Therefore, future theoretical research on feedback timing should consider the impact of LGO.

While a number of studies have investigated the effects of learning and performance goal orientations, few have investigated the subcomponents of “prove” and “avoid” within performance goal orientation. Recent evidence has shown support for a three factor model of goal orientation. However, few studies have investigated prove and avoid performance goal orientation within a team performance context. The current study

provided further support for the 3 factor model of goal orientation. This study found LGO, PGO, and AGO exhibited low to moderate intercorrelations. Specifically, the findings revealed that high LGO teams were also likely to be high in PGO and high PGO teams were likely to be high AGO teams. Additionally, there was a negative relationship between LGO and AGO. This pattern held for both trait and state goal orientation. These results are consistent with Payne et al.'s (2007) meta-analysis and continue to support the notion that that researchers should not always assume that LGO and PGO will associate differently to various outcomes.

Corresponding trait and state goal orientation dimensions demonstrated a positive relationship with one another. However, results from this study did show a more dynamic set of results with the state goal orientation operationalization compared to the trait goal orientation operationalization. Consistent with prior research, this study provides support for the use of state goal orientation measures versus trait goal orientation measures (Chen, & Mathieu, 2008; Steele-Johnson, Heintz, & Miller, 2008; Van Duyne, 2002). Theoretically state goal orientation, compared to trait goal orientation, is considered more proximal to learning outcomes and thus should have stronger relations with acquisition and retention scenario test performance. As expected, this study found stronger and more robust relations using state, versus trait, operationalizations of goal orientation

In addition, this study provides support for the theory of transfer appropriate processing. The theory of transfer appropriate processing suggests that the closer the training environment is to the operational environment the greater the transfer of the requisite competencies to the operational environment (Morris, Bransford, & Franks, 1977). The paradox of the theory of transfer appropriate processing is that the same

training features that foster initial learning during the acquisition of requisite competencies during training may not foster long term retention of those same competencies. Furthermore, the retention of necessary competencies during training is a prerequisite for the transfer of those competencies in the operational environment. This study found that although delayed feedback did not improve performance during the acquisition phase of training, over and above immediate feedback, it did improve performance during the retention phase of training.

Lastly, the results from this study showed a small positive correlation between acquisition and retention performance. Initially this result would seem problematic. However, this result is consistent with training theory that distinguishes initial training performance from maintenance or transfer performance (Keith & Frese, 2008; Schmidt & Bjork, 1992; Taylor et al., 2005). There are a number of changes in trainees' KSAs that can occur at the conclusion of initial training as a function of time elapsed or training design features (Ford & Weisbein, 1997). Each of these changes can influence the relationship between initial training and the maintenance and/or retention of requisite KSAs. Therefore, it is not uncommon to find a small relationship between acquisition and retention performance. As mentioned previously, the paradox of the theory of transfer appropriate processing is that the same training features that foster initial learning during training may not foster long term retention or transfer of those same competencies.

### Practical Implications

This study provides trainers and instructional systems designers with a number of practical implications regarding how to design training features within scenario/simulation based team training. Although technology has made it possible to

deliver on-line feedback during scenario based team training, trainers and instructional system designers must not focus solely on what they *can do*, but focus more on what they *should do* in order to create the most effective instructional environment. One practical implication from this study is that when trainers or instructional system designers are deciding “when” to deliver feedback within a scenario based team training environment, in order to enhance training retention, it may be best to do so at the completion of the scenario. In fact, this advice is consistent with the traditional SBT approach (Salas, Burke, & Cannon-Bowers, 2000). That is, when implementing feedback within an SBT environment it is best to provide the feedback during the post-scenario debrief/AAR and the feedback should be based on the learning objectives of the scenario.

The second practical implication from this study is that it may be beneficial for trainers or instructional system designers to measure trainee characteristics prior to training and use this information to tailor training. This study found that team state LGO, on the day of initial training, interacted with the timing of feedback to predict retention performance. This finding suggests that if a practitioner discovers that a team is low in LGO then he or she can create a training environment which reinforces the underlying LGO mechanisms that would be beneficial to trainee’s long term retention of skills. In other words, trainers and instructional system designers could manipulate situational cues (e.g., task information) or rewards to induce a higher state LGO in low LGO teams in order to reap the potential benefits of high LGO in a delayed feedback training context. Trainers and instructional system designers can create a high LGO environment by repeatedly telling trainees that they can improve their task performance by developing techniques and strategies for learning and by providing rewards on the basis of self

improvements (Steele-Johnson et al., 2008). This recommendation is consistent with recent research that has looked at the potential benefits of situationally induced state goal orientations in various learning contexts (Chen, & Mathieu, 2008; Steele-Johnson, Heintz, & Miller, 2008). Another option, based on the findings of this study, is to provide those teams with a lower degree of LGO with immediate feedback during acquisition training in order to improve retention performance. Lastly, the results of this study suggests that if a practitioner discovers that the team has a high degree of LGO, then it is best to provide delayed feedback in order to maintain retention of skills.

Although not the primary goal, this study found that team's perceived instrumentality of the feedback mediated the relationship between the interaction of feedback timing with goal orientation and retention team performance. In other words, the beneficial effects of the interaction between feedback timing and state LGO were realized only if the team perceived the feedback as useful. This finding suggest that trainers, managers, and instructional system designers must consider trainees perceptions of not only the training itself, but also the perceived usefulness or instrumentality of various training design features (e.g., feedback). In addition, this study implies that it is still important to collect trainee reactions to training programs. Consistent with Goldstein's (1991) views this study suggest that, although not very useful by themselves, reaction measures, together with Kirkpatrick's (1959) other training evaluation criteria, can provide very useful information to trainers and instructional systems designers.

This study also suggests that practitioners must continue to be vigilant about the composition of their trainees and how they are influenced by various training features. This study found that team performance during the retention phase of training was

influenced by the composition of the team's sex and the interaction between teammate familiarity and feedback timing. Specifically, teams in which the mortar position was played by a male and the artillery position by a female performed the best during the retention scenario test. While teams with females in the mortar and artillery positions performed the worst during the retention scenario test. In addition, the positive impact of delayed feedback during the retention phase of training was greatest for teams that were more familiar with each other. This finding seems to be supported by research on transactive memory. Research on transactive memory suggests that the more familiar team members are with each other the more they have an awareness of not only their own knowledge but the knowledge of their teammates (Austin, 2003). Consistent with the results of this study, this awareness would seem to be most useful in situations in which teams must self-regulate without immediate knowledge of results (i.e., when provide with delayed feedback). Therefore, it seems that the composition of the forward observer team, with respect to teammate sex and the interaction between teammate familiarity and feedback timing, influences performance during the retention phase of training in this study.

#### Study Limitations and Directions for Future Research

A few limitations of this study should be noted. First, I failed to find support for my hypotheses related to immediate feedback during acquisition performance. However, this may be due to the nature of the FOPCSim task which is very complex and fast paced. It could be the case that participants were particularly sensitive to task interruptions during initial FOPCSim training causing a detriment in the expected performance for those who received immediate feedback. In addition, the overall training time was only

30 minutes. Although some SBT events are this brief some can last for hours. Perhaps if the initial training phase was longer the hypothesized effects for acquisition performance would have been statistically significant. Therefore, future research should investigate these effects utilizing different types of tasks and by increasing the duration of the acquisition training scenarios.

I also failed to find support for my hypotheses related to AGO and PGO. However, the form of the relationships regarding the interaction between state AGO and state PGO with feedback timing and instrumentality of feedback were similar in form to the hypothesized relationships between AGO's and PGO's interaction with feedback timing and retention. It could have been the case that the "external" referent (i.e., the researcher) or laboratory setting was not powerful enough to elicit participants AGO or PGO state goal preferences during actual scenario performance. Therefore, future research should investigate these effects in a setting that may be of more importance to trainees (e.g., an employment training session).

Delayed feedback was provided immediately at the completion of each training scenario. However, the timing of delayed feedback is on a continuum. How would the results found in this study compare to those where delayed feedback was provided at different intervals at the end of a training scenario (e.g., providing delayed feedback at the end of two training scenarios instead of one)? Future empirical research should further examine the relationships in this study by manipulating *when* delayed feedback is provided during training. In addition, the current study used college student participants and was conducted in a laboratory setting. Although this enhances the internal validity of the study, it is important for future empirical research to examine these relationships in a



variety of settings to determine their external validity. Another limitation of this study is that the voice recordings of team member's interactions were not available. Although, I collected information regarding the affective and cognitive components of attitudes, the behavioral component (i.e., the voice recordings) would have allowed me to better understand *how* team members interacted with each other, especially with regard to different team member's levels of goal orientation. Future team level goal orientation research should record team communications in order to better understand the goal orientation process in team settings.

It is also important to note that the feedback provided throughout the various training scenarios was outcome based text feedback. However, prior research has shown that other aspects of feedback have a significant impact on training performance. For example, research has shown that process feedback has a positive influence on performance during simulation based training (Astwood, Van Buskirk, Cornejo, & Dalton, 2008; Buff & Campbell, 2002). Future empirical research should investigate the effects of feedback timing during SBT by manipulating the other dimensions of feedback (e.g., content or modality of feedback). Additionally, the current study used a compensatory task requiring only a two person team. It could be possible that training design features and trainee characteristics influence teams differently depending on the interdependence of the team tasks and the size of the team. Future research should investigate the observed effects during a task that requires different levels of interdependence (e.g., a disjunctive or conjunctive task) and in an environment that requires a greater number of teammates.

## Conclusion

In summary, the results of this study demonstrate the usefulness of delayed feedback and state LGO during scenario based team training within a simulated environment. Consistent with expectations, the current study found that teams that received delayed feedback made more accurate target prioritizations on a retention scenario test than teams receiving immediate feedback. The results of this study also provides evidence that team composition (i.e., team level state LGO) moderates the relationship between feedback timing (immediate or delayed) to predict retention scenario performance. Specifically, because delayed feedback allows for the development of self-regulatory processes and provides a challenge to high LGO teams; it is more advantageous for high LGO teams, than immediate feedback, during the retention phase of training. Moreover, results of this study suggest that the above relationship is mediated by the team's perceived instrumentality of the feedback. In other words, the interactive effect of feedback timing and state LGO was realized only if the team perceived the feedback as useful.

The current study also has implications for theory and practitioners. This study extends the current literature by investigating the effects of immediate and delayed feedback, the moderating effects of team level goal orientation, and the prove and avoid dimensions of goal orientation on performance within a team simulation based training context. Implications for practitioners include recommendations for training design. Lastly, the findings of the current study provide promising opportunities for future research to explore.

APPENDIX A:  
MEASURES

Team # \_\_\_\_\_ FO \_\_\_\_\_

### DEMOGRAPHIC DATA FORM

Sex: M F

Age: \_\_\_\_\_

Major: \_\_\_\_\_

Class Standing: Freshman      Sophomore      Junior      Senior  
Other

GPA: \_\_\_\_\_

How often do you work with personal computers?

- \_\_\_\_\_ I've never worked with a personal computer
- \_\_\_\_\_ Only a couple of times ever in my life
- \_\_\_\_\_ Several times a year
- \_\_\_\_\_ Several times a month
- \_\_\_\_\_ Several times a week
- \_\_\_\_\_ At least once a day, everyday
- \_\_\_\_\_ For several hours everyday (over 4 hours a day)

Rate your experience with personal computers:

- \_\_\_\_\_ Little or none
- \_\_\_\_\_ Know a little; know Internet access, know some word processing and other software (e.g., Microsoft Word and Microsoft PowerPoint).
- \_\_\_\_\_ Know quite a bit; know Internet access, know word processing well, used other software packages (e.g., Microsoft Access, FTP, WinZip), and have done some programming (e.g., HTML).
- \_\_\_\_\_ Expert; know Internet access, word processing, other software, and have much experience with different programming languages (e.g., Flash, VB, C, and Java).

Do you own your own personal computer? YES NO

Do you currently or have you previously served in the military? YES NO

If yes, what is your current status? ACTIVE RESERVIST DISCHARGED

And what are/were your duties in the military?

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Please list any experience you have with first person shooters or strategic tactical war computer/video games (examples include Doom, Quake, Halo or other strategic/tactical first person shooters)?

---

---

Please indicate the # of hours per week that you currently play these types of games.

\_\_\_\_\_ hours/week

If you no longer play, how many hours per week did you play these games in the past?

\_\_\_\_\_ hours/week

Do you belong to any gaming social clubs or clans? YES NO

Have you had any experience(s) which have made you familiar with military missions, equipment, and/or terminology (for example, are you involved in ROTC, have friends or relatives in the military/armed forces, etc.)? Please explain:

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Do you know your teammate? YES NO

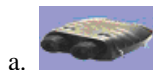
If yes, for how long? \_\_\_\_\_ Years \_\_\_\_\_ Months

Team # \_\_\_\_\_ FO \_\_\_\_\_

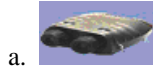
### FOPCSim Quiz

Please select the correct answer.

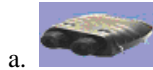
1. Which of the following is **not** one of the overarching rules of this simulation?
  - a. Follow the prioritization rules.
  - b. Correctly identify targets.
  - c. Select effective ammunition types.
  - d. Neutralize targets that move past your position.
  
2. Which of the following correctly describes how to change from tool to tool?
  - a. Use the scroll wheel on the mouse
  - b. Use the bracket buttons
  - c. Right click the mouse
  - d. Left click the mouse
  - e. Both A and B
  
3. Which tool is used to determine the distance of a target?
  - a. compass
  - b. CFF sheet
  - c. laser range finder
  
4. Which tool is used to determine the direction of a target?
  - a. compass
  - b. CFF sheet
  - c. laser range finder
  
5. Which tool is selected to input the information for a CFF?
  - a. compass
  - b. CFF sheet
  - c. laser range finder
  
6. After all information has been entered into the CFF sheet, what button do you press to send the transmission?
  - a. Continue
  - b. K
  - c. Enter
  
7. When you receive a Say Again, what does that indicate?
  - a. incorrect/incomplete text entry
  - b. select Continue
  - c. k wasn't pressed
  
8. After the shots make impact, how do you clear the information in the CFF sheet?
  - a. Mouse scroll bar
  - b. Select Continue
  - c. Hit escape
  
9. Which of the following pictures denotes the compass?



10. Which of the following pictures denotes the laser range finder?



11. Which of the following pictures denotes the CFF sheet?



12. Which of the following correctly describes how to get a target's range using the laser range finder?

- a. Scroll to the laser range finder, right click to zoom it, left click to get distance, right click or escape to get out
- b. Scroll to the laser range finder and right click
- c. Scroll to the laser range finder, left click to zoom it, right click to get distance, left click or escape to get out

13. How will you know if a moving target has been neutralized?

- a. Black smoke
- b. It stops moving
- c. Both of the above

14. Should you fire on a target once it's been neutralized?

- a. yes
- b. no

15. How many meters per second does a tank travel?

- a. 200
- b. 25
- c. 4
- d. 8

16. How many seconds does it take for a round to land once the CFF has been completed?

- a. 200
- b. 25
- c. 10
- d. 8

17. When engaging a T-72 what type of ammunition is 100% effective?

- a. H E Quick
- b. ICM
- c. VT

Team # \_\_\_\_\_ FO \_\_\_\_\_

### Feedback Reactions Questionnaire

<b>Please think about the feedback you received and circle the number on the scale (from 1-6) that matches your level of agreement or disagreement with the following statements.</b>		<b>Strongly Disagree</b>					<b>Strongly Agree</b>
<b>1.</b>	<b>The feedback I received was easy to understand.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>2.</b>	<b>The feedback I received could have been more useful.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>3.</b>	<b>It seemed like I received the same feedback over and over.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>4.</b>	<b>I ignored and made no attempt to use the feedback I received.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>

5. I have the following additional comments I would like to make concerning the feedback I was just provided with during this experiment.

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Team # \_\_\_\_\_ FO \_\_\_\_\_

### **Feedback Manipulation Check Questionnaire**

- 1. When playing the three training scenarios did you receive feedback during each training scenario or after each training scenarios (circle one)?**

**DURING EACH SCENARIO**

**AFTER EACH SCENARIOS**

Team # \_\_\_\_\_ FO \_\_\_\_\_

### “Trait” Goal Orientation Questionnaire

<b>Please circle the number on the scale (from 1-6) that matches your level of agreement or disagreement with the following statements.</b>		Strongly Disagree					Strongly Agree
<b>1.</b>	<b>I am willing to select a challenging work assignment that I can learn a lot from.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>2.</b>	<b>I often look for opportunities to develop new skills and knowledge.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>3.</b>	<b>I enjoy challenging and difficult tasks at work where I'll learn new skills.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>4.</b>	<b>For me, development of my work ability is important enough to take risks.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>5.</b>	<b>I prefer to work in situations that require a high level of ability and talent.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>6.</b>	<b>I'm concerned with showing that I can perform better than my coworkers.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>7.</b>	<b>I try to figure out what it takes to prove my ability to others at work.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>8.</b>	<b>I enjoy it when others at work are aware of how well I am doing.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>9.</b>	<b>I prefer to work on projects where I can prove my ability to others.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>10.</b>	<b>I would avoid taking on a new task if there was a chance that I would appear rather incompetent to others.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>11.</b>	<b>Avoiding a show of low ability is more important to me than learning a new skill.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>12.</b>	<b>I'm concerned about taking on a task at work if my performance would reveal that I had low ability.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>13.</b>	<b>I prefer to avoid situations at work where I might perform poorly.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>

**“State” Goal Orientation Questionnaire**

<b>Please circle the number on the scale (from 1-6) that matches your level of agreement or disagreement with the following statements.</b>		<b>Strongly Disagree</b>					<b>Strongly Agree</b>
<b>1.</b>	<b>I look forward to mastering the challenges of this task.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>2.</b>	<b>I want to really understand how to perform this task.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>3.</b>	<b>I enjoy challenging and difficult tasks during the scenario where I’ll learn new skills.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>4.</b>	<b>For me, development of my ability during this task is important enough to take risks.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>5.</b>	<b>I am eager to prove to others how good I am at this task.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>6.</b>	<b>I’m concerned with showing that I can perform better than my teammate on this task.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>7.</b>	<b>I try to figure out what it takes to prove my ability to my teammate at this task.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>8.</b>	<b>I would enjoy it if others were aware of how well I am doing at this task.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>9.</b>	<b>I would prefer to avoid taking on this task if there was a chance that I would appear rather incompetent to my teammate.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>10.</b>	<b>Avoiding a show of low ability during this task is more important to me than learning this skill.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>11.</b>	<b>I’m concerned about taking on this task if my performance would reveal that I had low ability.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>12.</b>	<b>I would prefer to avoid situations during this task where I might perform poorly.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>

Team # \_\_\_\_\_ FO \_\_\_\_\_ Session \_\_\_\_\_

PANAS-S

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel this way right now, that is, at the present moment. Use the following scale to record your answers.

1	2	3	4	5
Not at all	a little	moderately	quite a bit	extremely

\_\_\_\_\_ interested

\_\_\_\_\_ irritable

\_\_\_\_\_ distressed

\_\_\_\_\_ alert

\_\_\_\_\_ excited

\_\_\_\_\_ ashamed

\_\_\_\_\_ upset

\_\_\_\_\_ inspired

\_\_\_\_\_ strong

\_\_\_\_\_ nervous

\_\_\_\_\_ guilty

\_\_\_\_\_ determined

\_\_\_\_\_ scared

\_\_\_\_\_ attentive

\_\_\_\_\_ hostile

\_\_\_\_\_ jittery

\_\_\_\_\_ enthusiastic

\_\_\_\_\_ active

\_\_\_\_\_ proud

\_\_\_\_\_ afraid

**APPENDIX B:  
IRB HUMAN SUBJECTS APPROVAL LETTER**



University of Central Florida Institutional Review Board  
Office of Research & Commercialization  
12201 Research Parkway, Suite 501  
Orlando, Florida 32826-3246  
Telephone: 407-823-2901, 407-882-2901 or 407-882-2276  
[www.research.ucf.edu/compliance/irb.html](http://www.research.ucf.edu/compliance/irb.html)

### Notice of Expedited Initial Review and Approval

From : UCF Institutional Review Board  
FWA00000351, Exp. 5/07/10, IRB00001138

To : Randolph Astwood

Date : June 12, 2007

IRB Number: SBE-07-05044

Study Title: **Effective Timing of Feedback during Scenario Based Team Training within a Simulated Environment**

Dear Researcher:

Your research protocol noted above was approved by expedited review by the UCF IRB Chair on 6/12/2007. The expiration date is 6/11/2008. Your study was determined to be minimal risk for human subjects and expeditable per federal regulations, 45 CFR 46.110. The category for which this study qualifies as expeditable research is as follows:

4. Collection of data through noninvasive procedures (not involving general anesthesia or sedation) routinely employed in clinical practice, excluding procedures involving x-rays or microwaves. Where medical devices are employed they must be cleared/approved for marketing.

7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

The IRB has approved a consent procedure which requires participants to sign consent forms. Use of the approved, stamped consent document(s) is required. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Subjects or their representatives must receive a copy of the consent form(s).

All data, which includes signed consent form documents, must be retained in a locked file cabinet for a minimum of three years past the completion of this research. Any links to the identification of participants should be maintained on a password-protected computer if electronic information is used. Additional requirements may be imposed by your funding agency, your department, or other entities. Access to data is limited to authorized individuals listed as key study personnel.

To continue this research beyond the expiration date, a Continuing Review Form must be submitted 2 – 4 weeks prior to the expiration date. Advise the IRB if you receive a subpoena for the release of this information, or if a breach of confidentiality occurs. Also report any unanticipated problems or serious adverse events (within 5 working days). Do not make changes to the protocol methodology or consent form before obtaining IRB approval. Changes can be submitted for IRB review using the Addendum/Modification Request Form. An Addendum/Modification Request Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at <http://iris.research.ucf.edu>.

Failure to provide a continuing review report could lead to study suspension, a loss of funding and/or publication possibilities, or reporting of noncompliance to sponsors or funding agencies. The IRB maintains the authority under 45 CFR 46.110(e) to observe or have a third party observe the consent process and the research.

On behalf of Tracy Dietz, Ph.D., UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 06/12/2007 03:28:44 PM EDT

| Joanne Muratori |

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