THE EFFECTS OF VIDEO-COMPUTERIZED FEEDBACK ON
COMPETITIVE STATE ANXIETY, SELF-EFFICACY, EFFORT,
AND BASEBALL HITTING-TASK PERFORMANCE

THESIS

Presented to the Graduate Council of the
University of North Texas in Partial
Fulfillment of the Requirements

For the Degree of

MASTER OF SCIENCE

By

P. Jason Leslie, B.A.

Denton, Texas

December, 1998

This study examined the effects of frame-by-frame video-computerized feedback on competitive state anxiety, self-efficacy, effort, and baseball performance of high school players. Players were randomly assigned to one of three feedback conditions: (a) Hitting score, (b) Hitting score and frame-by-frame analysis of a mechanically correct swing, (c) Hitting score and frame-by-frame analysis of participant's swing and a mechanically correct swing. Once per week for six weeks, the players completed three questionnaires: (a) Hitting Self-Efficacy Scale, (b) Competitive State Anxiety Inventory-2C, and (c) Performance Effort Scale, and performed a hitting task. Results of the 3 (Group) x 6 (Trials) ANOVAs revealed no significant effects. This study does not support previous confidence-baseball hitting research.
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CHAPTER I

INTRODUCTION

Baseball is a common experience that millions of people enjoy and has been labeled America's favorite pastime. Attraction to the game of baseball begins early, when parents teach their children to play catch in the backyard. Children as young as five-years old are eligible for Little League Baseball participation (Sage, 1990). Other organizations (e.g., Pony League, Babe Ruth League, Connie Mack League, etc.) continue to sponsor youth baseball players until they reach early adulthood. After youth league organizations, successful players continue their participation at the collegiate and sometimes professional levels.

Several skills contribute to successful baseball performance. Successful baseball players are judged on five skills: (a) speed; (b) throwing ability; (c) defensive ability (fielding); (d) ability to hit for average; and (e) the ability to hit for power (A. Chase, personal conversation, January 23, 1998). A highly successful player usually excels in at least three of the five categories (B. Lord, personal conversation, January 27, 1998). Although each of these skills requires complex coordinated movements, hitting is considered the most difficult to perform (Polk, 1995). Polk (1995) stated that a player must have certain athletic skills before he can become a good hitter, since hitting is a very difficult skill to master. This is exemplified by the fact that an individual is considered a
superior hitter when a 30 percent success rate is achieved. Ted Williams, one of the
greatest hitters of all-time, said, “Baseball is the only endeavor where a man can succeed
three times out of ten and be considered a good performer” (Plaut, 1992; p. 67).

Because the nature of the sport requires a constant effort to improve it is
understandable why coaches and players aspire to learn as much as possible about hitting.
The biomechanics of a baseball swing are critical, but the mental approach at the plate
cannot be overlooked. The cognitive state of a hitter is likely to equate success or failure
during a given at-bat. The late Ty Cobb, Hall of Fame inductee, once said, “What’s
above the player’s shoulders is more important than what’s below” (in Dorfman & Kuel,
1995; p. ix).

Because hitting is a complex task, isolated hitting drills that allow players to focus
on one to two aspects of their swing (e.g., stride, hands, or contact point) are often
emphasized. The stationary batting tee affords such isolation to players. The stationary
batting tee helps develop the mechanics of a player’s swing using a stationary ball
(Stockton, 1984). The hitter practices his batting techniques by hitting a baseball off the
top of the rubber tubing of the stationary tee (Russo & Landolphi, 1998). Russo and
Landolphi (1998) indicated that there are many different stances and styles of hitting, but
all good hitters finish in the same position when they make contact with the ball. The
stationary batting tee allows the hitter to concentrate on every phase of the swing. A
swing that allows the hitter to drive the ball will result in the formula for successful
hitting (Russo & Landolphi, 1998).
Athletes of all ages want to perform at optimal levels. Optimal performance is highly dependent upon cognitive factors. Self-confidence is a cognitive factor that influences one’s athletic performance (George, 1994). Other researchers indicate that confidence is a critical part of athletic performance (Ravizza & Hanson, 1995). Self-confidence is the belief that one can successfully execute a specific activity or perform a desired behavior (Feltz, 1988). However, Feltz (1988) stated that self-confidence is not a global trait that accounts for overall performance optimism. For example, an individual may possess a high degree of self-confidence in one’s hitting ability in baseball, but have a low degree of self-confidence in bunting. If athletes are sufficiently motivated and have an understanding of the relationship between their thoughts, feelings, and behavior, then they can begin to develop self-confidence (Weinberg & Williams, 1998).

Over the past three decades, the construct of self-confidence has received an enormous amount of attention from sport science researchers (George, 1994). Self-confidence is one of the most frequently cited psychological factors thought to affect athletic performance (Feltz, 1988). One of the most consistent findings in sport psychology research is that as an individual’s level of confidence increases, so does performance (Weinberg & Gould, 1995). Furthermore, Ravizza and Hanson (1995) stated that professional and collegiate baseball players indicate that 80-100 percent of their performance is determined by their belief in their ability to successfully execute a given play and George (1994) indicated that self-confidence is related to athletic performance. Also, research findings indicate that successful elite athletes report a higher degree of self-confidence than do less successful elite athletes (Gould, Weiss, & Weinberg, 1981).
In reference to baseball players, Dorfman and Kuel (1995) indicated that confidence will influence success; lack of it will influence failure. In support of this, Polk (1995) identified confidence as one of the most important phases of hitting. One's lack of hitting success can be directly related to his mental attitude toward hitting (Stockton, 1984).

Self-confidence has been reflected in a number of ways, but perhaps the most extensively used conceptualization in sport performance research is Bandura's (1977) self-efficacy theory (Feltz, 1988). Bandura (1977) used the term self-efficacy to describe the conviction an individual has to successfully execute the required behavior to produce a certain outcome. Based on this theory, the construct of self-efficacy is more concentrated on one's judgement of performance potential given one's skills rather than with the sheer number of skills one possesses (George, 1994). Therefore, self-efficacy is a situation-specific form of self-confidence in which an individual believes he/she can accomplish whatever needs to be accomplished in a specific situation. Thus, self-efficacy is a behavioral pattern. Essentially, the term self-efficacy specifies the level of perceived competence and strength in that belief. Self-efficacy also influences one's choice of activities, achievement, persistence, and effort (Schunk, 1995).

Extensive research has been conducted on self-confidence and self-efficacy in a baseball setting. George (1994) found that higher performances predicted higher precepts of efficacy in high school and collegiate baseball players. Lower levels of somatic and cognitive anxiety were associated with stronger self-efficacy beliefs (George, 1994). Also, George (1994) indicated that stronger self-efficacy predicted greater effort and
higher hitting performance. Bram and Feltz (1995) found that contact average feedback given to youth baseball players yielded increased hitting efficacy, enjoyment, satisfaction, and persistence. Watkins, Garcia, and Turek (1994) studied 205 youth baseball players in a hitting task. Watkins and colleagues (1994) found that subsequent hitting trials were predicted by previous hitting performance and subsequent self-efficacy was predicted by previous self-efficacy. Schunk (1995) found that when individuals acquired information about how well they were performing a given task, their self-efficacy for continued learning and performance was positively influenced.

Athletes rely on intrinsic and extrinsic feedback about their performance. Intrinsic feedback is information received as a natural consequence of moving; it is provided by one's own sensory systems (Fischman & Oxendine, 1998). For example, a baseball player can feel the bat hit the ball, hear the bat hit the ball, and see the bat hit the ball. Extrinsic feedback differs from intrinsic feedback in that it is information received which is not a natural consequence of executing a response (Fischman & Oxendine, 1998) and it must be provided by external sources such as a coach, teammate, stopwatch, judge’s score, or videotape replay. Extrinsic feedback is supplied beyond intrinsic feedback and supplements the information naturally available (Fischman & Oxendine, 1998). Extrinsic feedback can provide information about the outcome of a performance or about the movement patterns that an athlete had previously completed.

Quite often, biomechanical analysis is provided by a coach to an athlete. A time consuming, yet effective means of extrinsic feedback, comes from videotaped performances. Visual information is a significant contributor to the performance of
motor skills (Seat & Wrisberg, 1996). Several explanations pertaining to the acquisition of a serial movement task have been indicated (Carroll & Bandura, 1987; Scully & Newell, 1985). However, there is minimal controversy over the fact that visual cues are indicative of an abundant source of pertinent information for performers.

Visual feedback, such as videotapes, allows individuals to analyze their performance. Modern video technology can provide athletes with extrinsic feedback. Video technology can be used to help athletes gain confidence and improve skills (Zinsser, Bunker, & Williams, 1998). Videotaped performances can provide an athlete with scenes of a successful performance or execution of a skill. Watching well-executed performances on video can positively influence the cognitive state of an athlete (Zinsser et al., 1998).

With new technology, such as digital video recorders, videotaped performances can be analyzed in a highly technical manner. Digital video recorders allow the user to play back an entire performance (i.e., baseball swing) or a single frame (i.e., photograph or still shot) of an isolated movement. Frame-by-frame replay is another benefit of the digital video recorder.

Frame-by-frame analysis feedback of a performance allows the athlete to see his/her movement in a progressive manner. Each movement, or frame, can be isolated and studied by the athlete and coach to pinpoint positive and detrimental aspects of the performance. The use of frame-by-frame analysis may allow athletes to deeply process the visual information.
Digital video recorders accompanied with analytical computer programs, such as the Visual Instructional System (VIS), ensure optimal visual feedback for coaches and athletes. VIS allows users to download a recorded performance for analysis. Once transferred to VIS, the performance can be manipulated in several ways. VIS was developed to provide a low-cost medium filter for the analysis of motion (Seat & Wrisberg, 1996). Seat and Wrisberg (1996) indicated that VIS would be beneficial for coaches, movement scientists, or individuals working in physical therapy settings.

Statement of the Problem

Self-efficacy and competitive state anxiety were measured in game situations (George, 1994) and self-efficacy has been measured in hitting from a pitching machine (Watkins et al., 1994). Both studies emphasized contact (minimal skill) rather than placement of a hit baseball. Participants in both studies received a score as the only feedback source. Previous research has not examined the influence of hitting accuracy and proper hitting mechanics on competitive state anxiety, self-efficacy, effort, and performance.

Statement of Purpose

The purpose of this study was to examine the effects of frame-by-frame video-computerized feedback on levels of competitive state anxiety, self-efficacy, effort, and hitting-task scores of high school baseball players.

Research Question

Based on previous research, a research question was developed and tested: What are the effects of video-computerized feedback on levels of competitive state anxiety,
self-efficacy, effort, and baseball hitting-task performance of high school baseball players?

Based on this question, it was hypothesized that use of video-computerized analysis would enhance levels of competitive state anxiety, self-efficacy, effort, and baseball hitting-task performance.

Definition of Terms

The following terms are used frequently in this study can be defined as follows:

**Self-Confidence** - The belief that one can successfully execute a specific activity or perform a desired behavior (Feltz, 1988).

**Self-Efficacy** - The conviction one has to execute successfully the behavior required to produce a certain outcome (Bandura, 1977). Self-efficacy can be considered as situationally specific self-confidence (Feltz, 1988).

**Hitting Self-Efficacy Scale (HSES)** - Scale used to assess the strength of baseball hitting efficacy by asking participants how certain they were of their ability to hit a baseball from a stationary batting tee into a designated target (see Appendix A). With permission, the scale was modified from George (1994) to make the instrument group and task specific.

**Competitive State Anxiety Inventory-2C (CSAI-2C) Form A** - A sixteen-item self-report measure, developed by Stadulis, Eidson, MacCracken, and Severance (1994), used to assess participants' somatic and cognitive anxiety associated with competition. The CSAI-2C (Form A) consisted of three categorical questions (i.e., Worry, Stress, and Confidence). Minor modifications were made to make the instrument group and task specific.
specific (see Appendix B).

**Performance Effort Scale (PES)**- A one-item self-report measure, developed by the researcher, used to assess the participants’ exerted effort in their hitting trial (see Appendix C). Participants rated their exerted effort as a percentage (0%-100%).

**Sony DCR VX-1000**- Digital recording device that offers users high quality pictures, unprecedented recording speeds, and unparalleled playback options when incorporated with the Visual Instructional System (VIS).

**Visual Instructional System (VIS)**- Relatively low-cost, user-friendly software package used to produce a functional, visual evaluation of a performance. Minimum and recommended computer requirements for VIS operation are provided in Table 1 (see Appendix I).

**Frame-by-Frame Video-Computerized Analysis**- A tiled movie sequence derived from VIS used for optimal performance evaluation (see Appendix D). The visual information depicted in this analysis may be used by coaches and athletes to direct attention to specific components of a movement (e.g., baseball swing) that require modification or refinement (Seat & Wrisberg, 1996).

**Scope**

Twenty-six members of a high school baseball team from the south-central region of the United States were participants in this study. Seven participants were eliminated from the study for failure to complete all trials. A repeated measures design was performed as each participant was measured on each of the four dependent variables.
Dependent and Independent Variables

There were four dependent measures for each participant for each trial. The dependent variables were scores on the (a) Hitting Self-Efficacy Scale; (b) Competitive State Anxiety Inventory-2C; (c) Hitting-Task score (i.e., total score from the designated target); and (d) Performance Effort Scale. The independent variable, feedback, had three levels: (a) feedback of the Hitting-Task score only (Group A); (b) feedback of Hitting-Task score and frame-by-frame video-computerized feedback of a mechanically correct baseball swing (Group B); and (c) feedback of Hitting-Task score and frame-by-frame video-computerized feedback of the participant’s baseball swing accompanied with a mechanically correct baseball swing (Group C).

Assumptions

The following assumptions were made:

1. This investigation presumed that the Hitting Self-Efficacy Scale, Competitive State Anxiety Inventory-2C, and Performance Effort Scale were statistically reliable and valid.

2. The questionnaires may not have allowed complete assessment of all relevant factors.

Delimitation

This investigation was delimited to high school baseball players. Furthermore, this study investigated one baseball team and there was a possibility of communication between the participants assigned to each of the experimental groups. Thus, members of each group may not have been completely naïve to the experimental manipulation.
Limitations

The following limitations were acknowledged:

1. Participants hit from a stationary batting tee rather than against live pitching.

2. External factors at the time of administration of the study (e.g., stress, motivation, emotion) may have influenced performance.

3. There was no control for the social desirability effect in the participants' responses to each questionnaire, nor to the extent to which participants correctly interpreted the items on each questionnaire.

4. The questionnaire format may not have allowed complete assessment of all relevant factors.

5. This investigation was conducted in a gymnasium rather than in the outdoor environment of traditional high school baseball practice.

Significance

The premise of this study was that the participants receiving video-computerized frame-by-frame analysis would show increased hitting-task performance, as well as improvement in competitive state anxiety, self-efficacy, and effort. The benefits of the analyses could benefit baseball players, as well as serve as an effective coaching aide. This information could be used by baseball players and coaches to better analyze baseball swings, thus increasing self-efficacy, effort, and performance.

The next chapter provides information on self-confidence, self-efficacy, effort and feedback, video-computerized analysis, and baseball hitting. Pertinent studies and information will be cited to support the need for the current study.
CHAPTER II

REVIEW OF LITERATURE

This chapter represents a review of literature related to the effects of frame-by-frame video-computerized feedback on levels of competitive state anxiety, self-efficacy, effort, and hitting-task scores of high school baseball players. That is, this chapter examines specific studies related to self-confidence, self-efficacy, effort, and feedback. The chapter begins by providing a brief background related to cognitive influences on performance. Thus, confidence and self-efficacy, as related to performance, are examined. Next, the influence of effort and feedback on the performance-self-efficacy relationship is presented. The chapter concludes by discussing video-computerized analysis (e.g., recording devices, computer software package) and baseball hitting.

Self-Confidence

Over the past three decades, many articles in the sport psychology literature focused on self-confidence (e.g., Feltz, 1988; George, 1994; Gill, 1986; Gould, Weiss, & Weinberg, 1981; Pickens, Rotella, & Gansneder, 1996; Vealey 1986; Weinberg & Gould, 1995; Weinberg, Gould, & Jackson, 1979). Self-confidence is one of the most frequently cited psychological factors thought to affect athletic performance (George, 1994) and has been called the most critical cognitive factor in sport (Feltz, 1988; Gill, 1986). Vealey (1986) defined sport-confidence as the belief or degree of certainty individuals possess
about their ability to be successful in sport.

Feltz (1988) conducted a comprehensive review of the self-confidence and sports performance relationship. She defined self-confidence as the belief that one can successfully execute a specific activity and indicated that a relationship exists between performance and confidence (Feltz, 1988). However, she stated that how the variables influenced one another is unclear. More empirical research is necessary to assess whether (a) self-confidence increases performance, (b) changes in performance affect self-confidence, and/or (c) the two variables consistently interact.

In general, support has been found for the notion that self-confidence is related to athletic performance. One of the most consistent findings in sport psychology research is that successful elite athletes report greater self-confidence than do less successful elite athletes (Weinberg & Gould, 1995). In addition, Weinberg and Gould (1995) indicated that increased performance is a product of increased self-confidence, as is the reciprocal. Researchers (e.g., Dorfman & Kuel, 1995; Feltz, 1988; Ravizza & Hanson, 1995) indicate that self-confidence can play a critical role in successful performances.

To investigate cognitive and performance variables of athletes, Gould et al. (1981) administered questionnaires to collegiate wrestlers (N= 49) competing in the 1980 Big Ten championship tournament. Volunteers completed the Psychological Preparation in Wrestling Questionnaire (PPWQ) to assess psychological factors used in training and competition. The PPWQ assessed items such as self-confidence, self-doubts, self-criticism, maximum wrestling potential, preparatory arousal, and attentional focus. The relationship between 22 cognitive variables and two performance variables (i.e.,
tourneytament seed and season win-loss record) were examined using t-tests and
discriminant function analysis. The most important variables separating the groups were
self-confidence, maximum potential, and the use of attentional skills. Compared to less
successful wrestlers, successful wrestlers were more self-confident, indicated that they
were closer to achieving their maximum wrestling potential, and focused their attention
only on wrestling-related thought prior to competition. Previous research (Weinberg et
al., 1979) was supported in that successful athletes differ (i.e., are more confident) than
less successful athletes. Gould and colleagues (1981) indicated that because self-
confidence was consistently found to be one of the most important variables related to
athletic success, it should be examined in more controlled field experiments. In addition,
they suggested that the effects of specific intervention techniques designed to increase
athletes' levels of self-confidence and performance could be examined in future research
(Gould et al., 1981).

Spink (1990) continued the cognitive-performance relationship research by
examining cognitive and behavioral strategies of 38 male gymnasts competing at
different competitive levels in an Australian gymnastic championship. The gymnasts
completed a standardized questionnaire prior to the first day of competition. The
questionnaire used in this study focused on cognitive factors that may have affected
training and competition. Spink's (1990) findings indicated that gymnasts competing at
different levels could be distinguished based on two cognitive factors: (a) psychological
recovery and (b) self-confidence. Gymnasts competing at higher elite levels were better
able to recover from their competitive mistakes and were more confident, as compared to
participants at lower elite levels (Spink, 1990). The notion that successful athletes are more confident than less-successful athletes was supported.

In another investigation of the confidence-performance relationship, Johnson (1994) attempted to establish whether reported self-confidence levels differed as a function of gender and ability level (i.e., three different ability levels based on handicap scores). Participants (N= 78) from private golf clubs in Calgary and Alberta responded to the self-confidence scale of the Psychological Skills Inventory for Sports before playing in organized club events. Results indicated no significant differences in mean self-confidence scores between males and females, nor between the middle and high ability groups. However, significant differences in self-confidence existed between the low ability participants, as compared to the middle and high ability participants. Again, low ability participants were less confident than their higher ability counterparts, thus supporting earlier work by Gould et al. (1981) and Spink (1990).

In a nonexperimental setting, Dorfman and Kuel (1995) suggested that athletes' confidence will most likely influence their success and a lack of confidence will likely influence their failures. Also, they postulated that the development of confidence requires risk-taking and occurs through gradual success. Furthermore, each success encourages individuals to persevere as they struggle with the next step (Dorfman & Kuel, 1995). Confident individuals approach difficult and challenging situations without the being concerned about failure. That is, athletes that have achieved success in the past are more likely to believe that they can achieve success in the future. Moreover, Dorfman and Kuel (1995) indicated that the specific goals an athlete focuses on each day are
critical. Thus, confidence is likely to grow with each identifiable success and overall performance should improve (Dorfman & Kuel, 1995).

Sport psychology researchers have investigated the relationship between confidence and performance during a competitive event by measuring self-report confidence an hour (or longer) before the competition (e.g., Gould et al., 1981; Spink, 1990). A major criticism of this approach is that if the time between confidence assessment and performance is too long, unassessed cognitions may occur and cause the original assessment to be less pertinent (George, 1994). Based on this criterion, Pickens and colleagues (1996) designed a study in which confidence was measured during a competitive performance. Fifty-four golfers participated in an 18-hole putting match against a competitor. Participants stated whether they were very, somewhat, or not confident in making a seven-foot putt prior to attempting the putt. Putting performance was defined as whether or not participants made the attempted putt. Participants indicated their level of confidence immediately before and after each putt by stating how confident (Very, Somewhat, or Not) they were during the attempted putt. Confidence measures taken before and during the first putt of each whole were correlated with putting performance for each hole. Pickens et al. (1996) found that confidence during the putt was more strongly related to performance than was confidence measured prior to putting. As would be expected, participants who reported being Very Confident made more putts, followed by those that were Somewhat Confident, with the Not Confident participants making the least number of putts. Also, Pickens and colleagues (1996) found that the relationship between putting confidence and outcome seemed to follow a continuum from
strong to weak (i.e., the relation was strongest for participants Not Confident and weakest for participants Very Confident). The authors indicated that no confidence equaled no chance of successful performance, whereas some confidence equaled a chance for success. They (1996) concluded that being confident during a performance may be more important than being confident before the performance. Based on their findings, the authors suggested that future research should examine different times to measure confidence in performance (e.g., before, during, or after) to determine the criterion variable used to affect the relationship between confidence and performance (Pickens et al., 1996).

In an applied setting athletes, coaches, and spectators regard self-confidence as a necessary quality for successful performances (McAuley & Gill, 1983). This was supported in baseball-specific research by Ravizza and Hanson (1995). Ravizza and Hanson (1995) indicated that professional and collegiate baseball players attribute 80-100% of their performance on a given day to be determined by their belief in their ability to succeed. The authors stated that confident athletes exude confidence by the way they carry themselves on the field or court (e.g., they look calm and in control). Although a highly confident baseball player may feel comfortable on the baseball field, he may display very low self-confidence if required to serve a tennis ball. Similarly, the same baseball player may be very confident in hitting the baseball, but not at all confident in bunting the baseball. Therefore, self-confidence is situationally specific (Ravizza & Hanson, 1995).
The following subsection begins with an overview of situationally specific confidence, or self-efficacy. The differences and similarities between confidence and efficacy are discussed. Also, research about self-efficacy and its influence on performance is reviewed.

Self-Efficacy

Bandura (1977) labeled situationally specific self-confidence as self-efficacy. In the physical activity domain, self-efficacy has particular importance. Although general findings of confidence are important in physical education and sport contexts, specific perceptions of confidence to perform the task at hand are crucial (Kavussanu & Roberts, 1996).

In a literature review on self-confidence and sport performance, Bandura’s (1977) self-efficacy theory stands out as the most tested and accepted theory conceptualized in sport performance (Feltz, 1988; Hamel, 1992). Although similar in meaning to self-confidence, self-efficacy is defined as the conviction one has to successfully execute the behavior that will produce a desired outcome (Bandura, 1977). According to Bandura (1977), self-efficacy is a specified level of conviction that an individual can successfully accomplish a task at a specific time, under certain conditions. Bandura (1977) distinguishes self-efficacy from self-confidence by indicating efficacy is the level of an individual’s expected performance attainment and the strength in the belief that he/she can attain certain levels of performance.

Feltz (1988) characterized self-confidence as the general belief that one can successfully execute a specific task (e.g., “I am very confident that I can hit a baseball”).
Self-confidence may differ for the same individual’s fielding ability (e.g., “I am not very confident that I can field a ground ball”). However, self-efficacy is more concerned with the judgement of what an individual can do with his or her given skill level. Self-efficacy can be measured by rating a performance, from a list of tasks deviating in difficulty levels, the highest level an athlete judges he/she can achieve at the present moment (i.e., right now). For example:

“How confident are you that you will score 0-5 points on the hitting task today?”

1  2  3  4
Not at all confident Very confident

“How confident are you that you will score 6-11 points on the hitting task today?”

1  2  3  4
Not at all confident Very confident

In the previous example, the different scoring ranges indicate the level of competence, and the strength of each is measured by the scale (i.e., Not at all confident to Very confident). Therefore, self-efficacy is specific and can change over time and possibly in a very short amount of time (George, 1994; Pickens et al., 1996). In competitive situations, the higher the level of self-efficacy, the higher the performance accomplishments are and the lower the emotional arousal (Bandura, 1977). Also, self-efficacy is considered an important mediating variable between instructional strategies and athletic performance (Gill, 1986).

According to Bandura (1977), efficacy levels change based on: (a) performance accomplishments (i.e., past performances), (b) observational (i.e., vicarious) experiences, (c) verbal persuasion, and (d) physiological and emotional arousal. Performance accomplishments provide the most effective source of efficacy feedback because they are
based on actual mastery experiences (Bandura, 1986). Successful performances raise expectations for future success whereas failure lowers expectations are lowered by failure (Bandura, 1986). For example, a baseball hitter may go to the plate thinking about (a) previous at-bats (i.e., performance accomplishments); (b) teammates’ previous at-bats against the opposing pitcher (i.e., observational experiences); (c) encouragement from coaches, teammates, and spectators (i.e., verbal persuasion); and (d) cognitive and physiological states (e.g., anxious, tense). These factors can change from at-bat to at-bat, game to game.

Bandura (1977) predicts that the level and strength of self-efficacy can be influenced by psychological interventions, which in turn, can influence performance. Efficacy levels are likely to dictate the amount of effort an individual puts forth and how long the individual will persist. That is, a person with high self-efficacy will most likely persist longer than an individual with low self-efficacy. Therefore, if an intervention such as frame-by-frame video-computerized analysis helps increase an athlete’s self-efficacy level and strength, it is likely that the athlete will continue to try to improve after experiencing some disappointments.

The level of persistence and effort also depends on the individual having the appropriate skill and adequate incentives (Bandura, 1977). This implies that an athlete may have adequate skill but no motivation to perform the skills. Therefore, self-efficacy will not predict performance. Thus, it cannot be said that only self-efficacy affects performance; other variables (e.g., motivation, effort) also play a role in performance.

There are three factors that can influence efficacy levels, thus influencing
performance: (a) magnitude (i.e., how hard or easy an individual perceives a task to be); (b) generality (i.e., how narrow or broad the level of efficacy; whether it is situationally specific or extends to many skills or situations); and (c) degree of belief in accomplishing a task (i.e., ranging from no confidence to high confidence). These factors are different for each athlete and can be thought of being represented by a continuum. For example, a baseball player who views the magnitude of the task as difficult (e.g., “I will never hit his fastball”), whose generality is broad and extends to all facets of the game (e.g., hitting and fielding), and whose belief in accomplishing a task is weak (e.g., “There is nothing I can do about it”) will be more inclined to give up than a player who perceives the situation differently. Conversely, a player with a smaller magnitude (e.g. “If I do my best and remain focused, I can do it”), a more narrow generality (e.g., “Although I misplayed the ground ball, that error will not affect my next at-bat. I will concentrate on one part of the game at a time”), and a stronger belief (e.g., “I will keep my eyes on the ball next time”) is more apt to succeed.

In summary, Bandura (1977) suggested that the efficacy expectation and performance relationship is reciprocal. An athlete’s expectations of performing well can influence performance and performance can be affected by one’s level of effort. Self-efficacy theory states that when necessary skills and appropriate incentives are present, self-efficacy can predict actual performance (George, 1994; McAuley & Gill, 1983). Bandura (1986) stated that an individual’s efficacy level is a predictor in choice of activities, effort, persistence, and achievement. Also, efficacy levels change based on past performances, observational experiences, verbal persuasion, and arousal. Individuals
with high self-efficacy for accomplishing a task participate more readily, work harder, persist longer when they encounter difficulties, and achieve at a higher level, as compared to individuals who doubt their capabilities (Schunk, 1995).

Bandura’s (1977) work is the cornerstone of self-efficacy research. Thus, several sport psychology researchers have investigated the efficacy-performance relationship by testing Bandura’s self-efficacy theory (e.g., Barling & Abel, 1983; Lee, 1982; Vongjaturapat, 1994; Weinberg, Gould, Yukelson, & Jackson, 1981; and Weinberg et al., 1979). Baseball-specific studies focusing on the efficacy-performance relationship (Watkins, Garica, & Turek, 1994; George, 1994) supported for Bandura’s (1977) self-efficacy theory. A review of the research follows.

In an early study, Weinberg and colleagues (1979) investigated the efficacy-performance relationship. They hypothesized that psychological procedures would alter the level and strength of efficacy, thus influencing performance. In their study, participants (30 males and 30 females) were asked to perform a leg lift task against another individual who was a confederate of the experimenter. Upon entering the lab, the participants were told that the confederate (a) was a member of a track team and who exhibited higher performance on a related task, or (b) had strained ligaments in a knee and who exhibited poorer performance on a related task. The task was manipulated so that the participant always lost. Results indicated that participants who competed under the first manipulation exhibited a decrease in persistence. However, individuals that competed against the confederate who had the knee injury exhibited high self-efficacy and had an increase in persistence on the task. Furthermore, after failing on the first trial,
high self-efficacy participants extended their legs for a longer period of time on the second trial, as compared to low self-efficacy participants. Thus, Bandura’s self-efficacy theory was supported.

In another early study, Lee (1982) examined self-efficacy as a predictor of performance for fourteen female (M = 9.7 years old) competitive gymnasts. Lee investigated the accuracy of athletes’ expectations, their coaches’ expectations, and their previous competition scores as predictors of competition performance. Lee found that the younger gymnasts predicted their competition performances “fairly accurately.” Experience and ability appeared to affect their accuracy. In contrast to Bandura’s self-efficacy theory, Lee found that previous performance was not a good predictor of performance. Instead, the coaches were found to be the best predictors of the athletes’ performance. The findings were not statistically significant and may be attributed to the small sample size. Because efficacy measures were collected later than previous performance scores, it is possible that the delay may have influenced the lesser accuracy. Efficacy was not measured within an effective time frame after performance, thus the self-reports may not have been accurate (George, 1994).

To further investigate the influence of self-efficacy on performance, Barling and Abel (1983) examined self-efficacy beliefs on tennis performance. Forty active tennis players responded to a self-rating scale that measured self-efficacy strength (“I can play most of my shots correctly”), response-outcome (“Improving my strokes will win me more points”), or valence expectancies (“Winning more points is important to me”). Also, ratings of tennis performance (i.e., knowledge, experience, footwork, power and
spin, accuracy, competition, concentration, anticipation, style, variation, consistency, and dependability) were completed by the researching team. Self-efficacy beliefs were found to be consistently related to different aspects of tennis performance. Only self-efficacy beliefs were consistently related to behavior, while response-outcome and valence expectancies were not, thus supporting Bandura’s self-efficacy theory.

Based on Bandura’s (1977) self-efficacy theory, Vongjaturapat (1994) designed a study to investigate (a) the effects of false information feedback on self-efficacy beliefs and subsequent weightlifting performance, and (b) whether self-efficacy or past performance is most related to subsequent weightlifting performance. Experienced weightlifters completed a one-repetition maximum on the bench press across six performance sessions. Male participants (N=36) were randomly assigned to one of three groups: (a) accurate performance information, (b) false information that they lifted more than their actual lift, or (c) false information that they lifted less than their actual lift. Participants indicated the amount of weight they were 100%, 75%, and 50% confident they could lift. Results indicated that false positive feedback (e.g., “You lifted 100 lbs.” but only 90 lbs. were actually lifted) increased future performance, and past weightlifting experience accounted for almost all of the variance in subsequent performance. That is, previous performance influenced subsequent performance, thus supporting Bandura’s self-efficacy theory.

In a further investigation of Bandura’s self-efficacy theory, Watkins et al. (1994) tested the relationship between self-efficacy and hitting in a baseball batting cage in a sample of 205 baseball players (nine- to seventeen-year-old males). Hitting performance
and self-efficacy were assessed during four opportunities in the batting cage two times per day, on two successive days at a baseball camp. Participants were permitted to swing at six pitches from a pitching machine. The speed of the pitched balls was controlled for each age group (i.e., 9-11 years = 45 mph; 12-14 years = 55 mph; and 15-17 years = 65 mph). A hit was scored when a batted ball went safely beyond the first rung (nine feet in front of home plate) of the batting cage.

As a self-efficacy measure in the Watkins et al. (1994) study, each participant was asked to rate his confidence that he could hit the ball 1-of-6, 2-of-6, 3-of-6, 4-of-6, 5-of-6, and 6-of-6 times. Efficacy estimates were scored zero to ten. Average self-efficacy scores were found to linearly increase with experience in the batting cage. Self-efficacy did not predict baseline hitting performance. In two cases (Trials 2 and 4) previous efficacy was moderately related to hitting performance.

Watkins and colleagues (1994) found that previous hitting predicted subsequent hitting, although in contrast to results obtained by Feltz (1982), the size of the correlations diminished across trials. This was attributed to the participants being relatively skilled at hitting a baseball and receiving ongoing instruction in additional hitting tactics (e.g., hitting drills emphasized by camp coaches).

Furthermore, Watkins and colleagues (1994) noted three issues raised by their findings. First, they found the capacity of performance to drive efficacy in young, experienced baseball players was similar to that observed in adult female diving participants (naive to the task) in a comparable design (e.g., Feltz, 1982). The causal role of performance to efficacy was similar across “naive” athletes or experienced athletes.
However, a distinct difference was that efficacy failed to predict performance. Belief in one’s ability is generally not as predictive of performance as is prior performance (Watkins et al., 1994).

Second, self-efficacy seemed to be somewhat consistent within the participant population (Watkins et al., 1994). The ability of a young population to understand the concept of efficacy has raised questions among researchers. Watkins and colleagues (1994) were confident that the participants understood efficacy and that it was accurately assessed. The baseball players adjusted efficacy (up or down) based on their previous hitting performances. Changes in efficacy occurred across trials, as participants’ evaluation of the task difficulty changed, although efficacies were consistent within individuals. These adjustments (i.e., between Trials 1 and 2, and Trials 3 and 4) should have strengthened the relationship between efficacy and hitting but did not. Even the final trial offered no relationship between efficacy and performance.

Third, other research assessment of efficacy immediately before a performance had relatively low power to predict performance at any time (Watkins et al., 1994). This result supported the concept that confidence and one’s ability to succeed at a familiar athletic activity is most likely an extension of actual performance.

The findings of Watkins and colleagues (1994) underscored the strength of previous performance in predicting efficacy and subsequent performance. They found that (a) subsequent hitting was predicted by previous hitting performance, (b) subsequent self-efficacy was predicted by previous self-efficacy, and (c) subsequent self-efficacy was predicted by previous hitting performance. Factors in this study that contributed directly
to performance were stable, changing very little from trial to trial. The authors concluded that prior performance will be the best predictor of subsequent performance in situations where other factors related to performance were also stable (e.g., pitching machine versus live pitchers).

In another baseball-specific study, George (1994) investigated confidence, efficacy, and baseball performance in a study similar to Watkins et al. (1994). Male (N=53) collegiate and high school baseball players completed self-report measures over a nine-game period during a summer baseball season. Perceptions of self-efficacy, competitive state anxiety, effort expenditure, and objective hitting performance were measured. Moderate support for Bandura's (1977) self-efficacy theory was found. Specifically, George (1994) found that (a) higher performances predicted stronger self-efficacy in six games, and lower levels of cognitive and somatic anxiety were associated with stronger self-efficacy in seven games and (b) stronger self-efficacy predicted greater effort in six games and higher hitting performance in five games.

On nine consecutive game days over a three-week period, participants completed the (a) Competitive State Anxiety Inventory-2 (CSAI-2), measuring participants' somatic and cognitive anxiety; (b) Hitting Self-Efficacy Scale (HSES), measuring participants confidence (i.e., 0-100% confidence) in putting the baseball into play one time in four at-bats to four times in four at-bats; and (c) Effort Scale (ES), which asked participants how much effort they put into hitting during the game. Contact average (i.e., the number of times a player hit the ball into fair territory divided by the number of at-bats) was also calculated for all participants. The CSAI-2 and the HSES were completed just prior to
each game. The ES was completed immediately after each game.

Overall, George (1994) found that cognitive anxiety was higher than somatic anxiety. The somatic anxiety reported by the collegiate players was significantly less, as compared to the high school players. Participants did not differ on cognitive anxiety. The strength of self-efficacy (i.e., putting the baseball into play) was high \((M=84.68\text{ out of } 100)\), with collegiate players reporting a higher level of self-efficacy. A relatively great amount of effort was exerted \((M=8.51\text{ out of } 10)\), with collegiate players exerting more effort. Research indicates that individuals with a strong sense of self-efficacy exert greater effort when obstacles were encountered, whereas those who have lower levels of self-efficacy exerted less effort (Weinberg et al., 1979).

George (1994) reported that contact averages were also high \((M=.825\text{ out of } 1.000)\), with the collegiate players having higher contact averages. This supported Bandura’s self-efficacy theory in that higher self-efficacy beliefs were associated with lower levels of anxiety, higher effort expenditure, and greater performance.

Furthermore, George’s (1994) results supported Bandura’s self-efficacy theory. Consistent with Watkins et al. (1994), past performance was a significant predictor of self-efficacy, which in turn, significantly predicted subsequent performance. Also, past performance exerted a stronger and more consistent influence on self-efficacy than self-efficacy exerted on performance (Feltz, 1982; 1988). Moreover, George’s (1994) findings indicated a support for Bandura’s (1977) model in that self-efficacy is a determinant of one’s effort expenditure. Significant results were reported in the efficacy-effort relationship; higher percepts of efficacy were associated with increased effort.
expenditure. This was an important finding because of Bandura’s declaration that self-efficacy influences effort, as well as choice of activities and persistence. George (1994) noted that these behaviors contribute to performance, but most research examines self-efficacy in relation to performance rather than in terms specified by the theory (Feltz, 1992).

As with the findings of Watkins and colleagues (1994), the direct effect of past performance on future performance was not observed in George’s (1994) study. This inconsistency may be attributed to methodological differences employed by the researchers, as compared to previous studies. Feltz (1982) stated that previous performance experiences may nullify the effects of self-efficacy beliefs on performance when performance trials are close together and minimally differ in terms of requirements. In George’s (1994) investigation, temporal intervals and task requirements such as facing different pitchers, playing at different fields, effects of defensive play, and other contextual variables may have influenced participants’ judgement on subsequent performance attempts. Other explanations of inconsistent findings in George’s (1994) study were that efficacy could likely change over the course of a game and that the efficacy measure was administered too long before game time.

To summarize, numerous sport psychology studies supported Bandura’s self-efficacy theory. Self-efficacy was found to (a) predict performance, (b) predict subsequent self-efficacy, and (c) influence effort. More importantly, high self-efficacy was found to yield better performances (e.g., Barling & Abel, 1983; George, 1994; Vongjaturapat, 1994; Weinberg et al. 1979). Based on this research, one might conclude
that an athlete’s belief that he or she is competent and can succeed in a task is related to his or her performance on that task (Schunk, 1995). However, this should not lead the reader to believe that this relationship is particularly strong. For example, previous performance is a stronger predictor of future performance than is self-efficacy (George, 1994; Watkins et al. 1994).

Schunk (1995) stated that when individuals engage in activities, they are impelled by personal situational factors (e.g., feedback), as well as personal influences (e.g., goal setting). People derive cues about their performance from these factors. When individuals perceive they are performing at a level of proficiency that is necessary or becoming more competent, self-efficacy is enhanced (Schunk, 1995). Lack of success or slow progress will not necessarily lower self-efficacy if persons believe they can perform better by adjusting their approach (e.g., expend more effort, use effective task strategies) (Schunk, 1995).

Self-efficacy goes beyond performance. Self-efficacy expectations influence one’s choice of activities, effort, persistence, and achievement (Bandura, 1977, 1986; Schunk, 1995). When required skills and appropriate incentives are present, self-efficacy is thought to predict performance (George, 1994; McAuley & Gill, 1983). Support for self-efficacy as a theory of behavioral change has been presented by several sport psychology researchers (e.g., Feltz, 1982; Fitzsimmons, Landers, Thomas, & van der Mars, 1991; Gayton, Matthews, & Burchstead, 1986; George & Feltz, 1995; Lee, 1982; Weinberg et al., 1981).
In many cases, the predictive power of self-efficacy can be enhanced when the performance is process-oriented rather than product-oriented (Treasure & Roberts, 1995). Persons with high self-efficacy work harder, persist in the task longer, and achieve at a higher level (Bandura, 1977).

When investigating an individual’s mental state (e.g., efficacy, confidence) and sport performance, Bandura’s self-efficacy theory stands out as the most tested and accepted concept. As previously stated, numerous sport psychology researchers have found support for Bandura’s self-efficacy theory. A relationship between efficacy and performance does exist (e.g., Barling & Abel, 1983; George, 1994; Weinberg et al. 1979). Because efficacy can be influenced by factors such as previous performance, external persuasion, and effort (Bandura, 1977), an expanded literature review was completed. Previous research indicates that self-efficacy can be influenced by effort and feedback (e.g., Bandura, 1977; George, 1994; Kavussanu & Roberts, 1996; Schunk, 1995; Weinberg et al. 1979). The following section discusses effort and feedback, and the influence of each on the self-efficacy-performance relationship.

Effort and Feedback

The research presented in the previous section demonstrated that individuals with a strong sense of efficacy exerted greater effort in the face of obstacles, whereas less effort is exerted by less efficacious individuals (George, 1994; Weinberg et al. 1979). In this section, sport psychology studies related to effort and feedback are presented. Also, the importance of feedback as related to performance is examined. Furthermore, the influence of feedback on performance and different types of feedback are discussed.
As previously stated, efficacy levels are likely to dictate the amount of effort an individual puts forth in a given task (Bandura, 1977). The level of effort depends on the individual having the appropriate skills and adequate incentives. Effort can be influenced by (a) task difficulty (e.g., a task that is too difficult or too easy may elicit minimal effort) and (b) performance expectations (e.g., if the individual expects to perform well, it is likely that he or she will). That is, performance is affected by an individual’s level of effort.

In a study that investigated the role of effort in a sport setting, Kavussanu and Roberts (1996) examined the relationship between perceived motivational climate and intrinsic motivation, and self-efficacy. Beginning tennis players (N= 285) at a university completed a battery of questionnaires assessing perceived motivational climate, goal orientation, intrinsic motivation, self-efficacy, and perceived ability. Perceptions of mastery climate were positively associated with effort, enjoyment, perceived competence, and self-efficacy. The results suggested that performance was influenced by effort and self-efficacy, thus supporting Bandura’s self-efficacy theory.

Another variable that is likely to influence the efficacy-performance relationship is feedback. Athletes use intrinsic and extrinsic feedback as a learning tool (Fischman & Oxendine, 1998) to gain insight to their performance. That is, feedback can allow the athlete to recognize correct and incorrect movement patterns of a performance.

Feedback can be an influential source of self-efficacy information. Performance feedback that indicates that an individual is performing well should increase self-efficacy (Schunk, 1995). The credibility of feedback is crucial if it is to influence outcomes
(Schunk, 1995). Schunk (1995) also indicated that when individuals have to work to succeed, effort feedback is viable.

Feedback, in a physical education and sport setting, is the information provided to a performer as a result of a given movement (Schmidt, 1991). Research indicated that physical practice is most important for motor skill learning. Fischman and Oxendine (1998) indicated that feedback is the second most critical aspect in learning a motor skill. Learning is practically nonexistent without feedback. If an individual does not know how he or she is performing, there is no reason to change the performance. Moreover, if a change is made impulsively, there is no assurance that the alteration will enhance performance.

Feedback can be divided into two distinct categories: (a) intrinsic feedback, and (b) extrinsic feedback. Athletes rely on intrinsic and extrinsic feedback about their performance so that they can improve their performance. Intrinsic feedback is information received as a natural consequence of moving; it is provided by one’s own sensory systems (Fischman & Oxendine, 1998). For example, a baseball player can feel the bat hit the ball, hear the bat hit the ball, and see the bat hit the ball.

Extrinsic feedback differs in that it is information received which is not a natural consequence of executing a response (Fischman & Oxendine, 1998) and it must be provided by an external source such as a coach, teammate, stopwatch, judge’s score, or videotape replay. Extrinsic feedback is supplied beyond intrinsic feedback and supplements the information naturally available (Fischman & Oxendine, 1998). Extrinsic feedback can provide information about the outcome of a performance or about the
movement patterns that an athlete had previously completed. Most important, extrinsic feedback is often controlled by a coach or instructor. Therefore, it can be provided or not, provided at different times, and provided in different forms to influence learning.

In summary, effort and feedback can be influential in an individual's athletic performance. Furthermore, effort and feedback can influence the efficacy-performance relationship. As one may see, feedback is very important in athletic performances. Without some type of feedback, an athlete would have great difficulty in correcting or fine tuning a performance.

A review of video-computerized analysis is discussed in the following subsection. Video-computerized analysis is a type of extrinsic feedback that may be the future trend for performance enhancement consultants, coaches, and athletes.

Video-Computerized Analysis

Quite often, biomechanical analysis is provided by a coach to an athlete. A time consuming, yet effective means of extrinsic feedback stems from videotaped performances. Visual information is a significant contributor to the performance of motor skills (Seat & Wrisberg, 1996). Several explanations pertaining to the acquisition of a serial movement task have been indicated (Carroll & Bandura, 1987; Scully & Newell, 1985). However, Seat and Wrisberg (1996) stated that there is minimal controversy over the idea that visual cues are indicative of an abundant source of pertinent information for performers.

Visual feedback, such as a videotaped performance, allows individuals to analyze performance. Modern video technology can provide athletes with this type of extrinsic
feedback. Video technology can be used to help athletes gain confidence and improve skills (Zinsser, Bunker, & Williams, 1998). Videotaped performances can provide an athlete with scenes of a successful performance or execution of a skill. Watching well-executed performances on video can positively influence the cognitive state of an athlete (Zinsser et al., 1998). In fact, video analysis is regularly used with the members of the United States Olympic teams and serves as a vital component of the U.S. Olympic Training Center’s tools for performance enhancement (Bryant, 1998). Bryant (1998) continued by indicating that virtually every aspect of sport is open to research using video analysis.

The quality of video analysis increases as technology progresses. With new technology, such as digital video recorders (i.e., Sony Digital DCR VX-1000) and computer software (i.e., Visual Instructional System [VIS]) videotaped performances can be analyzed in a highly technical manner. Digital video recorders allow the user to play back an entire performance (i.e., baseball swing) or a single frame (i.e., photograph or still shot) of an isolated movement. Frame-by-frame replay is another benefit of the digital video recorder.

Frame-by-frame analysis feedback of a performance allows the athlete to see his or her movement in a progressive manner. Each movement, or frame, can be isolated and studied by the athlete and coach to pinpoint positive and detrimental aspects of the performance. The use of frame-by-frame analysis may allow athletes to process and apply the visual information.
Digital video recorders accompanied with analytical computer programs, such as VIS, ensure optimal visual feedback for coaches and athletes. VIS allows users to download a recorded performance for analysis. Once transferred to VIS, the performance can be manipulated in several ways. VIS was developed to provide a low-cost medium filter for the analysis of motion (Seat & Wrisberg, 1996). Seat and Wrisberg (1996) indicated that VIS would be beneficial for coaches, movement scientists, or individuals working in physical therapy settings.

In conclusion, one might see the benefits of using technological advances in a sport setting. More specifically, the future of performance analysis seems to be headed in the computerized domain. As technology advances and prices decrease, such systems and equipment may be readily available for the general public.

The final subsection examines baseball hitting. Individual hitting drills are discussed, as are the fine points of hitting. Former and current baseball players and coaches are cited for their expertise in the sport and knowledge in baseball hitting.

Baseball Hitting

Since hitting is a complex task, isolated hitting drills are emphasized by coaches at all levels. Isolated hitting drills allow players to focus on one to two aspects of their swing (e.g., stride, hands, hips, contact point, or follow through). The stationary batting tee allows the hitter to concentrate on every phase of the swing. The stationary batting tee can help develop the mechanics of players’ swing using a stationary ball (Stockton, 1984) and hitters can practice their batting technique by hitting from stationary tees (Russo & Landolphi, 1998). Russo and Landolphi (1998) indicated that there are many
different stances and styles of hitting, but all good hitters wind up in the same position when they make contact with the ball. Good head position, along with a swing that allows the hitter to drive the ball, will result in the formula for successful hitting (Russo & Landolphi, 1998).

With a verbal description of an ideal baseball swing, one might realize the complexity of the task. Several variables, internal and external, must be in proper sequential order for successful hitting to occur. A slight mishap in timing or a minute physical flaw (e.g., dropping the hands) can lead to unsuccessful results.

To conclude the chapter, athletic performance is influenced by several factors. Factors such as self-confidence, self-efficacy, effort, and feedback are influential in one’s athletic performance (e.g., Bandura, 1977; Feltz, 1988; Fischman & Oxendine, 1998; George, 1994; Gould et al., 1981; Kavussanu & Roberts, 1996; Pickens et al. 1996; Ravizza & Hanson, 1995; Schunk, 1995; Spink, 1990; Watkins et al. 1994; Weinberg & Gould, 1995; Weinberg et al. 1979). However, which variables influence which remains unclear. Bandura’s self-efficacy theory appears to be the time-tested approach to studying confidence and efficacy, and performance. The trend in performance analysis may be headed toward highly technical video-computerized analysis. Such analysis can provide athletes with high quality visual feedback, which may be beneficial to performance. With a sound literature review that researched cognitive and physical components of athletic performance, a foundation was established for the current study. The current study investigated the effects of frame-by-frame computerized feedback on levels of competitive state anxiety, self-efficacy, effort, and hitting-task scores of high school
baseball players.

The following chapter outlines the methodology employed in this study. The chapter begins with the Participants subsection, followed by separate subsections on the apparatus, self-report measures, procedures, and concludes with the statistical design.
CHAPTER III

METHODOLOGY

Participants

Twenty-six members from a high school baseball team from the south-central region of the United States volunteered to participate in the study. Seven participants were eliminated from the study for failure to complete all trials. The age range was fourteen to eighteen years (M = 15.85) (see Table 2, p. 88). All participants had prior baseball experience. A mean of 9.92 years of baseball experience (see Table 2, p. 88) was calculated for the participant population (Range = 1 to 13 years). The team practiced on hitting skills, such as hitting from a stationary batting tee, which was an intricate part of this study. This team frequently recorded practice and game hitting with a video recorder. Parental consent (see Appendix E) and participant consent (see Appendix F) were obtained before beginning the study.

Apparatus

Video

"You can teach hitting volume one: A systematic approach to hitting" (Baker, Mercer, and Bittinger, 1996) was viewed at the beginning of the study and demonstrated the fundamental basis of a mechanically correct baseball swing. The video emphasizes (a) bat selection, (b) depth and distance in the batter's box, (c) stance and balance, (d)
grip on the baseball bat, (e) angle of the bat, (f) the critical inward turn of the baseball swing, (g) stride, and (h) the complete swing. The video features three individuals: Dusty Baker, Jeff Mercer, and Marv Bittinger. Dusty Baker is a former Major League player and current manager for the San Francisco Giants. Baker was also a hitting coach at the Major League level. Jeff Mercer is a highly regarded professional hitting instructor, Major League scout, and former baseball coach. Marv Bittinger contributed analytical skills.

**Stationary Batting Tee**

A standard tee by Athletic Training Equipment Company (ATEC) was used in this study. A rubber tube was attached perpendicular to the base of the tee and can be adjustable to any height in the strike zone. The stationary batting tee was placed five feet from the designated target and adjusted to accommodate the height of each participant. The rubber tube (i.e., where the baseball is held) was adjusted to three inches above each participant’s knee.

**Incrediballs**

Five Incrediballs were used in study. An Incrediball is a cloth baseball of exact size (nine-inch diameter) and weight (five ounces) of a regulation baseball. Incrediballs are designed for indoor use.

**Baseball Bats**

Five baseball bats were used over the course of the study. Participants chose one of the five bats to use for the duration of the investigation. Participants chose the bat they used during practices and games. The bat sizes were (a) 34-inch 30-ounce, (b) 33-inch
29-ounce, (c) 33-inch 28-ounce, (d) 32-inch 28-ounce, and (e) 32-inch 27-ounce.

**Target**

The target was painted on a turf mat (see Appendix G). The target was 3' x 3' and consisted of three horizontal 1' x 3' sections. The lines designating each section were one inch in width. The middle section was divided into thirds (i.e., three 1' x 1' sections). The target was green and the lines designating each section were yellow.

The hitter received three points for a batted ball that hit the center square of the middle section. Contact with any other area of the middle section resulted in two points. One point was awarded for a batted baseball that hit the top or bottom section. Any baseball that did not hit the target resulted in a score of zero. A batted baseball that hit between two sections received the higher point value (e.g., a batted baseball that hit in between a one-point and two-point section yielded a score of two points). Each batted baseball was scored by the researcher and his assistant. The research team practiced scoring during a pilot study that consisted of approximately 200 swings and were in agreement (i.e., same score) in 94% of the swings.

The target was adjusted to accommodate the height of each participant (i.e., coinciding with the height adjustment of the tee). For example, if the stationary batting tee was raised three inches, the target was raised three inches. This procedure controlled for the extraneous variable of height differences between participants.

**Recording and Analyses Equipment**

A Sony digital video camera (model DCR VX-1000) was used to record the participants' hitting performance. The frame-by-frame video-computerized analyses of
the participants’ swing was produced with the use of the Visual Instruction System (VIS). To use VIS, a movement (e.g., a baseball swing) is videotaped and then recorded into a personal computer via a video-capture card, which enables the user to capture the video image to the computer. Using the VIS software, frames of interest (e.g., in the baseball swing, from the contact point to the follow through) can be isolated for manipulation. These frames can then be viewed from the computer monitor or printed out for future reference (see Appendix D). The visual information derived from the pictures may be used to direct the participant’s attention to specific components of the movement that require modification or refinement (e.g., keeping a high follow through at the end of the swing). During the study, the researcher provided frame-by-frame video-computerized analysis printouts to the respective participants at the beginning of each trial (Trial 1 was the exception).

Self-Report Measures

**Hitting Self-Efficacy Scale (HSES)**

Strength of baseball hitting efficacy was assessed by asking participants how certain they were of their ability to hit a baseball from a stationary batting tee into a designated target. With permission, George’s (1994) Hitting Self-Efficacy Scale was modified to make the instrument group and task specific. The HSES is a six-item self-report measure. Each participant took ten swings per trial, excluding three warm-up swings away from the stationary batting tee. Each swing allowed a participant to score a maximum of three points and a minimum of zero points. Therefore, a maximum score would equal thirty and a minimum score would equal zero. Participants indicated on the
HSES their confidence in scoring within a designated point range of five (i.e., 0-5, 6-10, 11-15, 16-20, 21-25, 26-30) while maintaining proper hitting mechanics. For example, “How confident are you that you will score 0-5 points on the hitting task today?” Participants responded to each question using a Likert-type scale, ranging from 1 (not at all confident) to 4 (very confident).

Competitive State Anxiety Inventory

Participants’ somatic and cognitive anxiety associated with competition was measured using the CSAI-2C. The CSAI-2C is a sixteen-item self-report measure developed by Stadulis, Eidson, MacCracken, and Severance (1994). Minor modifications were made to make instrument group and task specific. For example, the statement, “I am concerned about this competition,” was modified to “I am concerned about my hitting in this competition.” The CSAI-2C had three sub scales: (a) cognitive state anxiety (Worry), (e.g., “I’m concerned that I will hit poorly from the tee today”); (b) somatic state anxiety (Stress), (e.g., “My body feels tense”); and (c) Confidence (e.g., “I feel self-confident”). Participants responded to each item using a Likert-type scale, ranging from 1 (not at all) to 4 (very much so), on five Worry (W), five Stress (S), and six Confidence (C) questions (each scored separately). Worry and Stress scores range from five to twenty; Confidence scores range from six to thirty. Question C9, “I am confident that I will hit well from the tee today,” served as a pre-performance measure.

The CSAI-2C was a modification of the original CSAI-2 developed by Martens, Burton, Vealey, Smith, and Bump (1990). Stadulis and colleagues (1994) used evaluative input from child and language arts teachers to develop the children’s version.
Items assessing the three dimensions of cognitive anxiety, somatic anxiety, and confidence on the revised instrument (i.e., CSAI-2C) were modified to accommodate the reading level and vocabulary of a young population.

The CSAI-2C reported a Cronbach alpha internal reliability coefficient of 0.75 on cognitive anxiety; 0.78 on somatic anxiety; and 0.73 on confidence (Stadulis et al., 1994). Principal factor analysis for the entire sample (N=632) supported the withholding of three factors accounting for 81% of the variance. Principal component analysis yielded similar results, thereby supporting the construct validity of the CSAI-2C.

Performance Effort Scale

Participants were asked to indicate how much effort they exerted during their hitting performance by rating the following statement: “How much effort did you put into the hitting task today?” Determination of participants’ effort was measured through a comparison of pre-treatment (i.e., C9 from the CSAI-2C) and post-treatment questions. The pre-treatment question was obtained with the CSAI-2C, number C9, which stated, “I am confident that I will hit well from the tee today.” Participants responded to the question by reporting their exerted effort as a percentage (0%-100%).

Baseball Hitting

For purposes of video-computerized feedback, a mechanically correct baseball swing was digitized from the “You can teach hitting volume one: A systematic approach to hitting” (Baker et al., 1996). Based on this video and a description of a mechanically correct baseball swing (i.e., Feldman, 1997), participants in Group C had their swings analyzed. Feldman (1997) used San Diego Padre Tony Gwynn as a model hitter to
describe a mechanically correct baseball swing. Feldman (1997) analyzed Gywnn’s swing:

1. Start with your feet shoulder width apart and equidistant from home plate. When your arms are extended, the barrel of the bat should cover the middle of home plate.
2. Place your hands together with the middle knuckles of each hand aligned. Grip the bat comfortably, but not too tightly.
3. Lift your front foot as the pitcher releases the baseball. This is the stride. The stride should be short, straight, and the same with every swing. At the same moment you lift your foot, shift your hands back (away from the pitcher). This is called loading.
4. Swing the bat and shift your weight onto your front leg, into the pitch.
5. As the ball hits the bat, snap your hips toward the pitcher. This is called “turning on the ball” and is essential for hitting power.
6. At the point of impact, lock your front knee to make your leg rigid. This provides a fulcrum, which allows you to put all of your back and leg strength into the swing, rather than solely your arms.
7. Swing through the baseball, not to the ball. Your arms should finish high (about eye level).
8. Throughout the swing, keep your eyes down. Track the baseball from the pitcher’s hand through impact.
Feldman (1997) concluded the article by stating that once the mechanics are mastered, hitting is in the head. Gywnn's recommendation was to be relaxed and confident.

Procedure

A verbal explanation of the study was presented to all participants and informed consent was obtained from each participants' parent/guardian and the baseball players. Also, biographical data was collected from each participant. An identification number was assigned to each participant to ensure confidentiality.

The baseball coaching staff agreed to designate the top nine hitters based on previous performance and perceived ability. Once the top nine hitters were randomly assigned to one of the three groups, the remaining players were randomly assigned to one of three groups. The process of randomly assigning the top nine hitters separately ensured an even distribution of participants per group, based on participants' previous performance and perceived ability. Participants were unaware of this process.

Participants were randomly assigned to one of three groups: (a) feedback of Hitting-Task score (Group A); (b) feedback of Hitting-Task score and frame-by-frame video-computerized analysis of a mechanically correct baseball swing (Group B); and (c) feedback of Hitting-Task score and frame-by-frame video-computerized analysis of each participant's baseball swing accompanied with frame-by-frame video-computerized analysis of a mechanically correct baseball swing (Group C). Group A and Group B consisted of seven participants; Group C consisted of five participants. Each group included three highly skilled hitters, as rated by the head baseball coach.
To coordinate the fundamental hitting skills for the coach, athlete, and researcher, the video “You can teach hitting volume one: A systematic approach to hitting” (Baker et al., 1996) was viewed at the beginning of the research project. The instructional video was selected for its systematic approach to hitting which clearly illustrates the eight steps to improve hitting. Volume one illustrates (a) bat selection, (b) depth and distance in the batter’s box, (c) stance and balance, (d) grip on the baseball bat, (e) angle of the bat, (f) the critical inward turn of the baseball swing, (g) stride, and (h) the complete swing.

**Location and Setup**

This study was conducted in a gymnasium (see Appendix H), thus Incrediballs were used per the request of the head baseball coach. The participants hit from an ATEC stationary batting tee that was placed six feet away from a padded backstop (6' x 4'). The target, centered on the padded backstop, was adjusted to accommodate the height of each participant (i.e., coinciding with the height adjustment of the tee). The base of the target was at least twenty-four inches from the floor. Each participant chose a bat of his preference to use for the duration of the study.

Each trial consisted of two to three participants from the same group (i.e., Group A, Group B, or Group C) meeting in the gymnasium. At the completion of the trial, the participants returned to baseball practice. After the first group completed the trial, participants from one of the other two groups were instructed to go to the gymnasium. At no time were members from different groups (i.e., Group A, Group B, or Group C) in the gymnasium simultaneously.
Before each trial, the participants completed the Hitting Self-Efficacy Scale, followed by the CSAI-2C. The researcher collected each scale to ensure confidentiality. Participants then hit ten Incrediballs from a stationary batting tee into the designated target while being videotaped. Participants were videotaped from a side angle (i.e., facing hitter’s mid-section) using a Sony Digital Camera (model DCR VX-1000). The camera was placed on a tripod located seventeen feet from the batting tee. The recording speed of each trial was set at 1/1000. After the tenth swing, the hitting performance score was recorded and given to the participant. Next, the participant completed the PES and returned to baseball practice. All equipment was disassembled and removed from the gymnasium at the completion of the final hitting trial for each session.

Participants in the control group (Group A) hit from the stationary batting tee and received feedback limited to their Hitting-Task score for the trial. Participants in Group B hit from the stationary tee after receiving frame-by-frame video-computerized analysis of a mechanically correct baseball swing. Seven frames were used: (a) ready position, (b) inward tuck, (c) stride, (d) hips and hands, (e) contact point, (f) extension, and (g) follow through. The mechanically correct swing of the elite hitter was transcribed from the aforementioned videotape. Group B received their Hitting-Task score at the completion of the hitting trial.

Participants in Group C hit from the stationary batting tee and received feedback about their total score for the trial. In addition, the videotaped performance was computer-analyzed using VIS. A frame-by-frame video-computerized analysis of each participants’ performance (i.e., seven frames) and the VIS analysis of a mechanically
correct baseball swing (i.e., seven frames) was printed out and given to the respective participants during the following session. The two analyses were printed vertically side by side for each trial (i.e., the participant’s swing was synchronized with the mechanically correct swing). This allowed the participants to assess where their body/bat position was in relation to where it should have been. The VIS analysis was provided approximately five minutes before the participant performed the hitting trial.

The frame-by-frame video-computer analysis of the mechanically correct baseball swing was consistent (i.e., unaltered) for Group B and Group C. Participants in Group B and Group C received their analyzed printout approximately five minutes before their hitting trial began. This gave each time to examine the printout. The printout was collected by the researcher when the participant began the hitting task.

Swing Analysis

The researcher designated the best (i.e., mechanically sound) swing for each participant in Group C. This swing was transcribed from the Sony digital video-recorder to the VIS software. Once each movie sequence was transcribed, VIS was used to tile each swing into frame-by-frame analyses. The researcher then designated the seven frames to be analyzed (i.e., ready position, tuck, stride, hips and hands, contact point, extension, and follow through). The tiled sequence (i.e., seven frames) was then synchronized with the seven frames of the mechanically correct swing. Once the tiled movies were synchronized, the file was saved on a Zip disk. Next, the file was copied for printing (see Appendix D).
Design

There were four dependent measures for each participant for each trial. The dependent variables were scores on the (a) HSES, (b) CSAI-2C, (c) Hitting Task, and (d) PES. The four dependent variables were used to determine if efficacy, worry, stress, confidence, or effort in a hitting task were influenced by the use of video-computerized frame-by-frame analysis. The independent variable, feedback, had three levels (a) feedback of Hitting-Task score (Group A); (b) feedback of Hitting-Task score and frame-by-frame video-computerized analysis of a mechanically correct baseball swing (Group B); and (c) feedback of Hitting-Task score and frame-by-frame video-computerized analysis of participants’ personal baseball swing accompanied with frame-by-frame video-computerized analysis of a mechanically correct baseball swing (Group C).

Using the Statistical Package for the Social Sciences (SPSS), a series of 3 (Group Assignment) x 6 (Trials) repeated measures analyses of variance (ANOVAs) were calculated to determine the relationship between competitive state anxiety, efficacy, effort, and hitting-task performance. Also, Pearson product moment correlations were calculated to determine the relationship between the psychological measures and hitting-task performance. To complete the statistical analyses, descriptive statistics were calculated for demographic variables and each dependent variable.
CHAPTER IV

RESULTS

The overall purpose of this study was to determine the effects of frame-by-frame video-computerized feedback on levels of competitive state anxiety, efficacy, effort, and hitting-task scores of high school baseball players. To collect data, two questionnaires (i.e., Hitting Self-Efficacy Scale [HSES] and Competitive-State Anxiety Inventory-2C [CSAI-2C]) were administered to the participants before each hitting trial. After completion of the HSES and CSAI-2C, each participant performed ten swings from a stationary batting tee and attempted to hit the designated target while being videotaped. A digital video-recorder and external observation were used to collect data during the hitting trial. That is, the digital video-recorder recorded the participants' hitting trials while two raters scored each batted ball. At the conclusion of the hitting trial, each participant received his Hitting-Task score (i.e., 0-30 points) and completed the Performance Effort Scale (PES). After returning the PES to the principal investigator, the trial was complete. The original participant population for this study was comprised of 26 high school baseball players. Of the 26 players, 19 (73%) completed all six trials. Therefore, seven participants were excluded due to not completing all six trials for reasons beyond the researcher’s control (e.g., absenteeism, dropping out).
The independent variable manipulated in this study, feedback, had three levels: (a) feedback of Hitting-Task score only (Group A); (b) feedback of Hitting-Task score and frame-by-frame video-computerized analysis of a mechanically correct baseball swing (Group B); and (c) feedback of Hitting-Task score and frame-by-frame video-computerized analysis of each participant's personal performance accompanied with frame-by-frame video-computerized analysis of a mechanically correct baseball swing (Group C). The dependent variables were values on the (a) Hitting Self-Efficacy Scale (HSES); (b) Competitive State Anxiety Inventory-2C (CSAI-2C); (c) Hitting Task; and (d) Performance Effort Scale (PES). It was assumed that all questionnaire responses were reported as honestly as possible by the participants.

Analysis of Data

Descriptive statistics were calculated for each dependent variable across trials (i.e., scores on the HSES, CSAI-2C, PES, and Hitting-Task) and demographics (i.e., participants' age and years of baseball experience). To determine if Group Assignment (i.e., types of feedback) had any influence on the dependent measures (i.e., scores on the HSES, CSAI-2C, Hitting Task, and PES), a series of 3 (Group Assignment) x 6 (Trials) repeated measures analyses of variance (ANOVAs) were calculated. The alpha level was set at $p < .05$. To determine the relationship between the psychological measures and hitting-task performance, Pearson product moment correlations were calculated. All calculations were performed using the Statistical Package for Social Sciences (SPSS).
**Group Assignment and HSES**

Scores for hitting self-efficacy were reported by participants’ responses on the Hitting Self-Efficacy Scale. Participants responded to six questions, each indicating a degree of efficacy (i.e., *not at all confident* to *very confident*) for a designated Hitting-Task score range. Total efficacy was calculated by adding the score for each of the six questions. The possible scoring range was six and the maximum score was twenty-four.

A 3 (Group Assignment) x 6 (Trials) repeated measures ANOVA was used to determine whether or not Group Assignment had any influence on the Hitting Self-Efficacy Scale (HSES) across trials. There were no group, trial, or group assignment by trial interaction effects for self-efficacy: $F(2, 16)=1.54, p=.24; F(5, 80)=1.41, p=.23; F(10, 80)=3.40, p=.74$, respectively. This finding indicated that efficacy was not affected by frame-by-frame video-computerized feedback. Means and standard deviations are provided in Table 3 (see Appendix I, p. 89).

**Group Assignment and CSAI-2C**

To measure cognitive anxiety, somatic anxiety, and confidence, the CSAI-2C was completed immediately after completion of the HSES. Questions related to each subscale were asked in alternating fashion. Scores for each subscale were tallied separately and reported as a total.

A 3 (Group Assignment) x 6 (Trials) repeated measures ANOVA was used to determine whether or not Group Assignment had any influence on the three measurements (i.e., worry, stress, and confidence) on the CSAI-2C across trials.
Worry. The Worry category is comprised of five questions on the CSAI-2C. The participants’ responses to the Worry questions were tallied for a total Worry score. The possible scoring range was five to twenty. Lower scores indicated less cognitive anxiety immediately prior to the hitting trial. There were no group, trial, or group assignment by trial interaction effects for worry, as measured on the CSAI-2C: $F(2, 16)=.02, p=.97; F(5, 80)=1.25, p=.29; F(10, 80)=.87, p=.56$, respectively. This finding indicated that worry was not affected by the use of frame-by-frame video-computerized analysis. Means and standard deviations are reported in Table 4 (see Appendix I, p. 90).

Stress. The Stress category is comprised of five questions on the CSAI-2C. The participants’ responses to the Stress questions were tallied for a total Stress score. The possible scoring range was five to twenty. Lower scores indicated less somatic anxiety immediately preceding the hitting trial. There was no group or group assignment by trial interaction effect for stress, as measured on the CSAI-2C: $F(2, 16)=.02, p=.98; F(10, 80)=.49, p=.89$, respectively. This finding indicated that video-computerized feedback had no influence on players’ stress levels. However, there was a trial main effect for stress, $F(5, 80)=3.41, p=.008$. Means and standard deviations are provided in Table 5 (see Appendix I, p. 91). Somatic anxiety decreased for all groups across trials (see Figure 1, p. 100).

Confidence. The Confidence category is comprised of six questions on the CSAI-2C. The participants’ responses to the Confidence questions were tallied for a total Confidence score. The possible scoring range was six to twenty-four. Higher scores indicated high confidence immediately prior to the hitting trial. There were no group,
trial, or group assignment by trial interaction effects for confidence, as measured on the CSAI-2C: $F(2, 16)=.49, p=.62; F(5, 80)=.96, p=.45; F(10, 80)=1.76, p=.08$, respectively. This finding indicated that confidence was not affected by the use of frame-by-frame video-computerized analysis. Means and standard deviations are provided in Table 6 (see Appendix I, p. 92).

**Group Assignment and Hitting-Task Score**

Two raters scored each hitting trial based the result of the batted balls. Zero was the minimum score possible and 30 was the maximum score possible. Higher scores indicated better hitting-task performance. A 3 (Group Assignment) x 6 (Trials) repeated measures ANOVA revealed no group, trial, or group assignment by trial interaction effects for hitting-task performance: $F(2, 16)=.12, p=.89; F(5, 80)=1.18, p=.33; F(10, 80)=.67, p=.75$, respectively. This finding indicated that hitting-task performance was not affected by frame-by-frame feedback. Means and standard deviations are provided in Table 7 (see Appendix I, p. 93).

**Group Assignment and PES**

Effort was measured by the participants' responses on the PES. The amount of effort put forth on the hitting task was indicated on the questionnaire by circling a level of effort (i.e., 0%-100%) in increments of ten. For statistical purposes, the percentages were transformed to whole numbers (e.g., 100% was transformed to 10). Higher scores indicated a high level of effort expended on the hitting task. A 3 (Group Assignment) x 6 (Trials) repeated measures ANOVA was used to determine whether or not Group Assignment had any influence on the Performance Effort.
Scale (PES) across trials. There were no group, trial, or group assignment by trial interaction effects for effort: $F(2, 16) = .04, p = .96$; $F(5, 80) = .68, p = .64$; $F(10, 80) = .83, p = .60$, respectively. This finding indicated that performance effort was not affected by frame-by-frame video-computerized feedback. Means and standard deviations are provided in Table 8 (see Appendix I, p. 94).

**Pearson Product Moment Correlations**

To determine the relationship between the psychological measures and hitting-task performance, Pearson product moment correlations were calculated for Group A, Group B, Group C, and all Groups together.

No significant correlations were revealed for Group A, $p > .05$ (see Appendix I, p. 95). The range of correlations for Group A was (a) Confidence, $r = -.23$ to $r = .47$; (b) Hitting Self-Efficacy, $r = -.06$ to $r = .31$; (c) Effort, $r = -.64$ to $r = .27$; (d) Stress, $r = -.75$ to $r = .29$; and (e) Worry, $r = -.47$ to $r = .29$.

Correlations for Group B were calculated (see Appendix I, p. 96) and significant relationships were found for effort-performance in Trial 2 ($r = .76$) and stress-performance in Trial 3 ($r = .77), p < .05$. It was noted that hitting-task scores had decreased from the previous trial (i.e., Trial 3 > Trial 2 > Trial 1), which may have influenced these relationships. The significant effort-performance correlation for Trial 2 showed that as effort increased, so did performance. For Trial 3, the stress-performance relationship indicated that higher stress scores were related to higher hitting-task performance scores. This finding indicated that increased physical arousal led to better performance. The range of correlations for Group B was (a) Confidence, $r = -.48$ to $r = .35$; (b) Hitting Self-
Efficacy, \( r = .00 \) to \( r = .36 \); (c) Effort, \( r = -.42 \) to \( r = .76 \) (significant, \( p < .05 \)); (d) Stress, \( r = -.20 \) to \( r = .77 \) (significant, \( p < .05 \)); and (e) Worry, \( r = .06 \) to \( r = .61 \).

Correlations for Group C were calculated (see Appendix I, p. 97) and a significant relationship was found for hitting self-efficacy-performance in Trial 5 (\( r = -.86 \), \( p < .05 \)). Hitting-task scores were lower in Trial 5 as compared to Trial 4. The negative correlation indicated that higher self-efficacy reports resulted in lower performance. The range of correlations for Group C was (a) Confidence, \( r = -.69 \) to \( r = .16 \); (b) Hitting Self-Efficacy, \( r = -.86 \) (significant, \( p < .05 \)) to \( r = .87 \); (c) Effort, \( r = .05 \) to \( r = .75 \); (d) Stress, \( r = -.55 \) to \( r = .61 \); and (e) Worry, \( r = -.37 \) to \( r = .42 \).

Correlations for all Groups were not significant at the \( p > .05 \) level (see Appendix I, p. 98). The range of correlations for all Groups was (a) Confidence, \( r = -.05 \) to \( r = .27 \); (b) Hitting Self-Efficacy, \( r = .002 \) to \( r = .29 \); (c) Effort, \( r = -.26 \) to \( r = .29 \); (d) Stress, \( r = -.23 \) to \( r = .25 \); and (e) Worry, \( r = -.08 \) to \( r = .35 \).

Summary

Descriptive statistics were calculated for each dependent variable and for demographic questions. Competitive state anxiety, efficacy, hitting-task performance, and effort were analyzed using a series of 3 (Group Assignment) x 6 (Trials) repeated measures ANOVAs. Also, Pearson product moment correlations were calculated to determine the strength of the relationship between the psychological measures and performance.

Results showed that there was not a significant effect of video-computerized feedback on competitive state anxiety, efficacy, effort, or baseball hitting-task
performance of high school baseball players. Certain trends existed, however none were significant. Therefore, the research hypothesis, the use of video-computerized analysis would enhance levels of competitive state anxiety, efficacy, effort, and baseball hitting-task performance, was rejected.
CHAPTER V

DISCUSSION

The primary purpose of this study was to examine the effects of video-computerized feedback on levels of competitive state anxiety, self-efficacy, effort, and baseball hitting-task performance. Information on confidence, self-efficacy, effort and feedback, video-computerized analysis, and baseball hitting was used to determine the presence of any significant influence on baseball hitting-task performance. To achieve this purpose, three questionnaires (i.e., Hitting Self-Efficacy Scale, Competitive State-Anxiety Inventory-2C, and Performance Effort Scale), digital-video recording, and external observation were the sources of data collection.

To gather data, baseball players from a high school located in the south-central region of the United States were selected. Originally, the group consisted of twenty-six participants. However, seven participants were excluded for failure to complete all six trials. The participant population was divided into the following categories: (a) feedback of Hitting-Task score only (Group A); (b) feedback of Hitting-Task score and frame-by-frame video-computerized analysis of a mechanically correct baseball swing (Group B); and (c) feedback of Hitting-Task score and frame-by-frame video-computerized analysis of each participant’s personal performance accompanied with frame-by-frame video-computerized analysis of a mechanically correct baseball swing (Group C). To
achieve the purpose of this study, descriptive statistics, a series of 3 (Group Assignment) x 6 (Trials) repeated measures analyses of variance (ANOVAs), and Pearson product moment correlations were performed using the Statistical Package for Social Sciences (SPSS).

The findings of this study are reported in separate sections which coincide with the research question and side headings for Chapter IV. The side headings for Chapter IV included (a) Group Assignment and HSES, (b) Group Assignment and CSAI-2C, (c) Group Assignment and Hitting-Task score, and (d) Group Assignment and PES. Below is a summary of the findings used in this study.

Video-computerized feedback had no significant effect on competitive state anxiety, self-efficacy, hitting-task performance, or effort. Based on results from Chapter IV, the use of video-computerized analysis did not influence the dependent measures used in this study. However, certain trends across trials did exist. Across trials, the trends were as follows:

1. Worry in Group C decreased.
2. Hitting-Task performance in Group C increased.
3. Effort expenditure in Group C increased.

Methodological Issues

The present study did not find significant relationships between competitive state anxiety, self-efficacy, effort, and baseball hitting performance. This is inconsistent with previous research that found such relationships existed (e.g., George, 1994). Methodological factors may have contributed to the lack of statistical significance. These
factors are listed and described in this subsection. Possible methodological issues were (a) limited number of participants, (b) time lapse between trials, (c) number of trials, (d) unmeasured changes in efficacy, (e) time of administration/intervention, and (f) participant experience level.

**Limited Number of Participants**

In the present study, only nineteen participants completed all six trials. It is likely that the statistically insignificant findings were a result of a small sample size. Generally, a sample size of 30 is desired to increase statistical power (Thomas & Nelson, 1996). That is, with a small number of participants in each group (i.e., Group A=7; Group B=7; and Group C=5), statistical significance was not achieved. With minimal participants, it is difficult to achieve statistical trends and account for group variance.

**Time Lapse between Trials**

A second possible reason that the use of video-computerized analysis did not significantly influence competitive state anxiety, efficacy, hitting-task performance, or effort was the time lapse between trials. Participants met with the researcher once per week, thus six days passed between each trial session. Martenik (1976) stated that if feedback is delayed too long, the individual’s attention may be distracted by other events or by performing other movements and activities. It is certain that within a week’s time the participants in the present study engaged in other baseball hitting drills, thus possibly nullifying the effects of the video-computerized analysis feedback.

Previous investigations have shown that knowledge of performance via visual feedback tends to enhance performance (Landin, 1998). However, the time frame over
which visual feedback remains advantageous is not clear (Kim & Kramer, 1997; Landin, 1998). The visual feedback presented in this study was provided approximately five minutes before the participants engaged in the hitting task. However, Group C received the visual feedback sheet of their actual baseball swing that was recorded in the previous week’s trial. Thus, participants in Group C were not presented with visual feedback of their actual baseball swing until the next trial. Group B received the visual feedback of the mechanically correct swing for each trial. For Group C, it is possible that visual feedback provided immediately after the hitting task may have been more beneficial, as opposed to receiving the personal baseball swing analysis from the previous week’s trial. For example, adjustments in a player’s swing may have been made during practice from trial to trial. Therefore, the visual feedback sheet for this player may not have been effective because his swing mechanics may have been adjusted from one hitting trial to the next.

**Number of Trials**

The present study consisted of one trial per week over a six-week period. It is possible that few trials across a relatively short time period was ineffective as a means of examining the effects of video-computerized feedback on competitive state anxiety, efficacy, hitting-task performance, and effort. Learning may not have occurred due to the time between trials, as mentioned above, and/or the number of trials. In essence, the experimental intervention was only employed six times over a six-week period. The limited exposure to the task was probably ineffective for learning the task and to change performance.
Unmeasured Changes in Efficacy

George (1994) indicated that efficacy measures administered too long before a performance may not be accurate. Thus, the performance measure in the present study was administered about five minutes before the hitting trial. However, it is possible that the participants' efficacy expectations changed from swing to swing during a given trial. For example, if a participant indicated that he was very confident in scoring 16-20 points on the hitting task but had only 8 points after eight swings, it would be impossible to score within the desired point range with two swings remaining. Thus, the desired scoring range could not be achieved and it is possible that efficacy changed (see George, 1994). A stronger efficacy-performance relationship may have been found if efficacy was measured before and during the hitting task. For example, efficacy could be measured two or three times during a performance to account for changes in efficacy. In doing so, fluctuations in self-efficacy during the performance could be assessed and compared to actual performance. Also, Watkins and colleagues (1994) found that efficacy assessment immediately before a performance had relatively low power to predict performance at any time. The results of the current study supported the idea that confidence and one's ability to succeed at a familiar athletic activity is most likely an extension of actual performance (Watkins et. al, 1994).

Time of Administration/Intervention

Another explanation that may have confounded the results of this study is the time of day the participants were tested. The participants were excused from their afternoon baseball practice to engage in the hitting task. Thus, the hitting task and intervention took
time out from their actual baseball practice. Plus, the hitting trials were sometimes conducted the day before a game, which was not an ideal situation for the athletes. Thus, it is possible that the players’ concentration was not at an optimal level. Also, because participants were sacrificing time away from baseball practice, their levels of effort and motivation may have been influenced. Bandura (1977) indicated that self-efficacy will not predict performance if the athlete has adequate skill but no motivation to use the physical skills.

**Participant Experience Level**

Previous research indicated that participants that are highly experienced with a task may have a stronger past performance-future performance relationship (see George, 1994). George (1994) stated that efficacy beliefs in research settings were probably derived from novice participants who had little or no experience with the task. Although the participants in the present study were experienced in hitting from a stationary batting tee, hitting into the designated target was a new task. None of the players had participated in a hitting task such as the one employed for this study. Thus, efficacy may have been influenced by the introduction of and limited time (i.e., six trials) with the hitting task.

Also, visual feedback may not be as advantageous once a skill is well-learned (Kim & Kramer, 1997). Participants potentially were not experienced enough to use the type of feedback provided during this study, as kinematic information may be most useful for experts. Although hitting into the designated target was a new task for these players, hitting from a stationary batting tee was not. All participants reported that hitting from a
stationary batting tee was part of their regular baseball practice routine. Moreover, the participants reported an average of 9.92 years of baseball experience (see Appendix I, p. 88). Although participants in the present study were not elite performers, they appeared to be adequately competent for the hitting task employed. The influence of feedback via frame-by-frame video-computerized analysis may have been nullified because hitting from a stationary batting tee was a well-learned, frequently practiced skill for these participants. Moreover, it is possible that the participants’ experience with advanced kinematic feedback, such as the type provided in this study, was limited.

This subsection explained possible methodological issues that may have confounded this study. The next subsection will provide readers with ideas for future research. The proposed ideas will most likely diffuse difficulties encountered in the present study.

**Future Research**

Statistical significance was not achieved in this study. Possible factors that may have influenced the results were (a) number of participants, (b) time lapse between trials, (c) number of trials, (d) unmeasured changes in efficacy, (e) time of administration/intervention, and (f) participant experience level. To control for these factors, future research investigating the influence of video-computerized analysis feedback on cognitive states and physical performance should:

1. Include a larger number of participants in each group. A minimum of ten participants in each experimental group (N=30) would be ideal.
2. Increase the number of trials per week. The benefit would be two-fold; the participants would engage in the trials more frequently and there would be less time between each trial. Thus, the participants would receive visual feedback more quickly and more frequently.

3. Increase the number of swings per trial. This would allow efficacy to be measured before and during the hitting performance, therefore accounting for efficacy changes during a performance.

4. Conduct a similar study using older, more experienced participants (i.e., collegiate players).

5. Conduct a similar study during the pre-season or off-season rather than employing an in-season intervention.

6. Increase the duration of the study. With more exposure to the task and the intervention, participants may further benefit from video-computerized feedback. Also, researchers could study the effects of long-term (e.g., six months) video-computerized analysis feedback intervention.
APPENDIX A

HITTING SELF-EFFICACY SCALE
Hit Self-Efficacy Scale
(Adapted from George, 1994)

Directions: Below are statements that ask you to rate your level of self-confidence, as referenced to the tee-hitting drill. Please read each statement, then circle the appropriate number below the statement to indicate your level of confidence for each point range (minimum score = 0; maximum score = 30). For question seven, write your predicted score in the blank. Your predicted score should be an exact number, not a point range. If you do not understand a statement, CIRCLE that statement, THEN ask the tester for an explanation. Answer as honestly as possible; your answers are confidential. Use the following scale to answer each statement:

1=Not at all confident; 2=Somewhat confident; 3= Confident; 4= Very confident

1. How confident are you that you will score 0-5 points on the hitting task today?
   1  2  3  4

2. How confident are you that you will score 6-10 points on the hitting task today?
   1  2  3  4

3. How confident are you that you will score 11-15 points on the hitting task today?
   1  2  3  4

4. How confident are you that you will score 16-20 points on the hitting task today?
   1  2  3  4

5. How confident are you that you will score 21-25 points on the hitting task today?
   1  2  3  4

6. How confident are you that you will score 26-30 points on the hitting task today?
   1  2  3  4

Hitting Task Score ___________ (0-30 points)

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(940) 365-2875 (Home)
(940) 565-2965 (Office)

Faculty Sponsor: Dr. Scott Martin
UNT Department of KHPR
P.O. Box 311337 Denton, TX
76203-1337
(940) 565-3418

This project has been reviewed by the University of North Texas Committee for the Protection of Human Subjects (Phone: 940-565-3940).
APPENDIX B

COMPETITIVE STATE ANXIETY INVENTORY-2C

(FORM A)
Competitive State Anxiety Inventory - 2
Form A (CSAI - 2C)
High School Baseball Players

Directions: Below are some statements about how high school baseball players feel when they participate in physical activities, like hitting from a batting tee. Please read each statement, then circle the appropriate number below the statement to indicate how you feel right now- at this moment- about hitting from the batting tee. There are no right or wrong answers. Do not spend too much time on any one statement, but choose the answer which describes your feelings right now. If you do not understand any statement or word, CIRCLE that statement or word, THEN ask the tester for an explanation. Use the following scale to answer each statement:

1= Not at all; 2= Somewhat; 3= Moderately so; 4= Very much so

W1 I am concerned that I may not hit from the tee as well as I can today.
1 2 3 4

S2 My body feels tense.
1 2 3 4

C3 I feel self-confident.
1 2 3 4

S4 I feel tense in my stomach.
1 2 3 4

C5 I feel secure.
1 2 3 4

C6 I am confident I can meet the challenge of hitting well from the tee today.
1 2 3 4

W7 I'm concerned that I will hit poorly from the tee today.
1 2 3 4

S8 My heart is racing.
1 2 3 4
Use the following scale to answer each statement:
1= Not at all; 2= Somewhat; 3= Moderately so; 4= Very much so

C9 I am confident that I will hit well from the tee today.
   PES 1 2 3 4

W10 I am worried about reaching my tee-hitting goal today.
    1 2 3 4

S11 I feel my stomach sinking.
    1 2 3 4

C12 I feel mentally relaxed
    1 2 3 4

W13 I am concerned that others will be disappointed with my tee-hitting performance.
    1 2 3 4

C14 I am confident because, in my mind, I picture myself reaching my goal.
    1 2 3 4

W15 I am concerned about not being able to concentrate today.
    1 2 3 4

S16 My body feels tight.
    1 2 3 4

Stadulis, Eidson, MacCracken, and Severance, 1995

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(940) 565-3418

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APPENDIX C

PERFORMANCE EFFORT SCALE
Participant ID_______

Performance Effort Scale

**Directions:** Below is a statement that asks you to rate how much effort you exerted on the hitting task **TODAY**. Please read the statement carefully, then circle the appropriate percentage below the statement to indicate how much effort you put into the hitting task today. If you do not understand the statement, ask the tester for an explanation. Answer as honestly as possible; your answers are confidential. Use the following scale to answer the statement:

1. How much effort did you put into the hitting task today?

   0%  10%  20%  30%  40%  50%  60%  70%  80%  90%  100%
APPENDIX D

VIDEO-COMPUTERIZED ANALYSIS
Dear Parents:

My name is Jason Leslie. Currently, I am a graduate student working on my master’s thesis at the University of North Texas. As partial fulfillment of the requirements of the master’s degree in kinesiology (Sport Psychology), I will be conducting a research project designed to examine if the use of video-computerized frame-by-frame analysis influences levels of competitive state anxiety, self-efficacy, effort, and hitting-task performance of baseball players. I will be using members of the Aubrey High School baseball team as my participant population. Permission was granted from Coach Rick Lane to work with the high school baseball team. At Mr. Lane’s request, the study will be incorporated into the regular baseball practice routine. I request permission for your son to participate.

Players will meet with my research assistant and I in the Aubrey High School gymnasium during their regularly scheduled baseball practice time once a week for a six week period. The study consists of one twenty-minute session per week where players will hit from a batting tee. Players will be videotaped during their performance. Video-computerized frame-by-frame analysis will be provided for the players the following session. In addition to hitting from a batting tee, each player will complete three questionnaires during each session.

Videotapes will be stored in a locked file cabinet during the study. At the conclusion of the study, the videotapes will be destroyed (i.e., erased). Information will be saved to computer disks and may be shown to my fellow colleagues and presented at professional conferences. To preserve confidentiality, numbers will be used to identify the players. Your son’s responses will be confidential.

Baseball players generally want to improve their hitting skills, so I expect that the players will be excited about participating. With new technology such as the aforementioned video-computer analysis, it is my premise that players will experience higher levels of self-efficacy and effort, which can lead to an increased hitting performance. However, if a player expresses a desire not to participate, he can immediately return to baseball practice without prejudice or penalty.

Your decision whether or not to allow your son to participate will in no way affect his standing with the baseball coaches at Aubrey High School. At the conclusion of the study, a summary of group results will be available to all interested players and parents. Coach Rick Lane will receive a summary report. Should you have any questions or desire further information, please call me at 940-365-2875 (home) or 940-565-2965 (office). Thank you in advance for your cooperation and support.

Sincerely,

P. Jason Leslie
Please indicate whether or not you wish to have your son participate in this project by completing a statement below. Please return the signed permission slip to Coach Rick Lane as quickly as possible.

Check and complete ONE of the following statements:

_____ I do grant permission for my child, __________________________, to participate in this project.

_____ I do not grant permission for my child, __________________________, to participate in this project.

__________________________
Parent/Guardian’s Signature

Faculty Sponsor: Dr. Scott Martin
UNT Department of KHPR
P.O. Box 311337 Denton, TX 76203-1337
(940) 565-3418

This project has been reviewed by the University of North Texas Committee for the Protection of Human Subjects (Phone: 940-565-3940).
Use of Human Participants
Informed Consent

Name of Participant: ____________________________

1. I hereby give consent to P. Jason Leslie to perform the following investigational procedure:

Distribute and analyze three questionnaires, videotape players' hitting performance from a batting tee drill, and provide computerized frame-by-frame analysis for the players. Procedure will take place one time each week for six consecutive weeks.

I have heard a clear explanation and understand the nature and procedure of this study. I understand the benefits to be expected and the risks that may be involved. I understand that I may stop participation or withdraw my consent at any time without prejudice or penalty. With my understanding of this, having received this information and satisfactory answers I have asked, I voluntarily consent to the procedure designated in Paragraph One above.

Date: ____________________________

Signed: ____________________________ Signed: ____________________________

Witness Participant

Signed: ____________________________ Signed: ____________________________

Witness Person Responsible

Contact Person: Jason Leslie
(940) 365-2875 (Home)
(940) 565-2965 (Office)

Faculty Sponsor: Dr. Scott Martin
UNT Department of KHP
P.O. Box 311337 Denton, TX
76203-1337
(940) 565-3418

This project has been reviewed by the University of North Texas Committee for the Protection of Human Subjects (Phone: 940-565-3940).
Procedures and Risks

1. Complete three questionnaires:
   a) Competitive State-Anxiety Inventory-2C (Form A)
   b) Hitting Self-Efficacy scale
   c) Performance Effort Scale

2. Hit ten baseballs from a batting tee.

3. Performance will be videotaped:
   a) Frame-by-frame video-computerized analysis of performance will be conducted for Group C.
   b) Participants in Group B will receive frame-by-frame video-computerized analysis of an elite baseball player's swing.

4. Possibility of injury and/or discomfort:
   a) Minimal physical risk; physical task (baseball swing) does not differ from stationary batting tee drill performed during regular practice.
   b) If a subject does not improve, there is a possibility that the individual may have lower levels of self-confidence and self-efficacy.

5. Benefits:
   a) It is proposed that participants will show increased levels of self-confidence and self-esteem (particularly participants in Group B and Group C). It is hypothesized that increased levels of self-confidence and self-efficacy will result in increased hitting performance. All participants will benefit from the extra batting practice from the stationary batting tee.

6. Confidentiality:
   a) Biographical data and responses to the provided questionnaires will be confidential. These data will be administered and collected by the principal investigator.
   b) Videotapes will be retained by the principal investigator. If videotapes are presented to colleagues, students, etc., participants will be referred to by an identification number.

7. Contact persons:
   a) P. Jason Leslie
      (940) 365-2875 (Home)
      (940) 565-2965 (Office)
   b) Dr. Scott Martin
      UNT Department of KHPR
      P.O. Box 311337
      Denton, TX 76203-1337
      (940) 565-3418
Biographical Information

Please provide the appropriate information on the answer sheet below. Answer the questions as honestly as possible. Your responses will be kept confidential.

Complete the following by writing the information in the blank.

Age:__________________

Weight:__________________

Height:__________________

Years of baseball experience:__________________

Please circle the correct information.

Classification: Freshman Sophomore Junior Senior

Throw: Right Left

Hit: Right Left Switch

What other organized sport(s) do you play? Circle all that apply.

Football Basketball Track/Cross-Country Other:__________________

Do you consider baseball your primary sport (the sport you are best at)? YES NO

Is hitting from a batting tee part of your regular baseball practice routine? YES NO

Do you think hitting from a batting tee improves your game hitting? YES NO

Contact Person: Jason Leslie
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(940) 565-2965 (Office)

Faculty Sponsor: Dr. Scott Martin
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(940) 565-3418

This project has been reviewed by the University of North Texas Committee for the Protection of Human Subjects (Phone: 940-565-1940).
Target measures 3' x 3' with three horizontal 1' x 3' sections. The middle section has three 1' x 1' sections. Scoring for each section is provided in the diagram.
APPENDIX H

LOCATION AND SET-UP
APPENDIX I

TABLES
Table 1  

**Minimum and Recommended Requirements for the Visual Instructional System**

<table>
<thead>
<tr>
<th>Item</th>
<th>Minimum</th>
<th>Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor</td>
<td>386-25</td>
<td>Pentium PI bus</td>
</tr>
<tr>
<td>Memory</td>
<td>4 MB</td>
<td>16 MB</td>
</tr>
<tr>
<td>Monitor size</td>
<td>Any</td>
<td>17 in. (Noninterlaced)</td>
</tr>
<tr>
<td>Monitor resolution</td>
<td>640 x 480 pixels</td>
<td>1,024 x 768 pixels</td>
</tr>
<tr>
<td>Video</td>
<td>VGA</td>
<td>SVGA, 2 MB</td>
</tr>
<tr>
<td>Hard drive</td>
<td>80 MB</td>
<td>500+ MB (SCSI or PCI interface)</td>
</tr>
<tr>
<td>Microsoft Windows</td>
<td>Version 3.1</td>
<td>Windows '95</td>
</tr>
<tr>
<td>Microsoft DOS</td>
<td>Version 5.0</td>
<td>Version 6.0</td>
</tr>
<tr>
<td>Pointing Device</td>
<td>Any</td>
<td>Mouse</td>
</tr>
<tr>
<td>Printer</td>
<td>None</td>
<td>Any high resolution</td>
</tr>
<tr>
<td>Video Capture</td>
<td>Microsoft video for Windows compatible</td>
<td></td>
</tr>
<tr>
<td>Video source</td>
<td>Any camcorder or VCR</td>
<td>S-VHS, Hi-8, or Digital with single frame control and VISCA computer interface</td>
</tr>
</tbody>
</table>

Wrisberg & Seat, 1996
Table 2

Participants' Age and Years of Baseball Experience

<table>
<thead>
<tr>
<th>Group</th>
<th>Age</th>
<th>Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>A</td>
<td>7.67</td>
<td>2.19</td>
</tr>
<tr>
<td>B</td>
<td>8.04</td>
<td>1.01</td>
</tr>
<tr>
<td>C</td>
<td>6.87</td>
<td>2.74</td>
</tr>
<tr>
<td>TOTAL</td>
<td>7.52</td>
<td>2.09</td>
</tr>
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</table>
Table 3

**Hitting Self-Efficacy Scale (HSES) Scores**

<table>
<thead>
<tr>
<th>Group</th>
<th>Trial 1</th>
<th></th>
<th>Trial 2</th>
<th></th>
<th>Trial 3</th>
<th></th>
<th>Trial 4</th>
<th></th>
<th>Trial 5</th>
<th></th>
<th>Trial 6</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>A</td>
<td>17.44</td>
<td>3.39</td>
<td>17.44</td>
<td>3.81</td>
<td>18.57</td>
<td>3.31</td>
<td>18.43</td>
<td>2.22</td>
<td>19.43</td>
<td>1.40</td>
<td>19.29</td>
<td>1.50</td>
</tr>
<tr>
<td>B</td>
<td>15.00</td>
<td>4.00</td>
<td>17.12</td>
<td>2.64</td>
<td>16.62</td>
<td>4.50</td>
<td>16.37</td>
<td>3.78</td>
<td>16.37</td>
<td>4.10</td>
<td>16.86</td>
<td>1.57</td>
</tr>
<tr>
<td>C</td>
<td>16.56</td>
<td>3.17</td>
<td>16.25</td>
<td>2.91</td>
<td>17.62</td>
<td>2.33</td>
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<td>19.67</td>
<td>2.66</td>
<td>18.40</td>
<td>2.07</td>
</tr>
<tr>
<td>TOTAL</td>
<td>16.38</td>
<td>3.52</td>
<td>16.96</td>
<td>3.10</td>
<td>17.56</td>
<td>3.44</td>
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<td>2.81</td>
<td>18.33</td>
<td>3.28</td>
<td>18.16</td>
<td>1.92</td>
</tr>
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</table>

**Note.** Possible scoring range was 0 (not at all confident) to 30 (very confident)
Table 4

CSAI-2C (Form A)- Worry

<table>
<thead>
<tr>
<th>Group</th>
<th>Trial 1 M</th>
<th>Trial 1 SD</th>
<th>Trial 2 M</th>
<th>Trial 2 SD</th>
<th>Trial 3 M</th>
<th>Trial 3 SD</th>
<th>Trial 4 M</th>
<th>Trial 4 SD</th>
<th>Trial 5 M</th>
<th>Trial 5 SD</th>
<th>Trial 6 M</th>
<th>Trial 6 SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>8.78</td>
<td>2.99</td>
<td>8.78</td>
<td>4.68</td>
<td>7.43</td>
<td>3.26</td>
<td>7.86</td>
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<td>6.86</td>
<td>2.41</td>
<td>7.00</td>
<td>3.46</td>
</tr>
<tr>
<td>B</td>
<td>8.00</td>
<td>2.39</td>
<td>6.75</td>
<td>1.67</td>
<td>6.62</td>
<td>1.92</td>
<td>8.37</td>
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<td>7.00</td>
<td>3.07</td>
<td>7.28</td>
<td>3.30</td>
</tr>
<tr>
<td>C</td>
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<td>2.22</td>
<td>7.62</td>
<td>2.77</td>
<td>7.87</td>
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<td>6.67</td>
<td>2.66</td>
<td>6.40</td>
<td>1.67</td>
</tr>
<tr>
<td>TOTAL</td>
<td>8.19</td>
<td>2.50</td>
<td>7.76</td>
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<td>6.86</td>
<td>2.61</td>
<td>6.95</td>
<td>2.90</td>
</tr>
</tbody>
</table>

Note: Possible scoring range was 5 (low cognitive anxiety) to 20 (high cognitive anxiety).
Table 5

CSAI-2C (Form A)- Stress

<table>
<thead>
<tr>
<th>Group</th>
<th>Trial 1</th>
<th></th>
<th>Trial 2</th>
<th></th>
<th>Trial 3</th>
<th></th>
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<tbody>
<tr>
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<td>M</td>
<td>SD</td>
<td></td>
<td>M</td>
<td>SD</td>
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<td></td>
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<td>SD</td>
<td></td>
<td></td>
<td>M</td>
</tr>
<tr>
<td>A</td>
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<td>3.70</td>
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<tr>
<td>B</td>
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<td>1.07</td>
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<td>C</td>
<td>6.78</td>
<td>1.79</td>
<td>5.37</td>
<td>0.74</td>
<td>6.12</td>
<td>1.15</td>
<td>5.87</td>
<td>1.36</td>
<td>5.83</td>
<td>1.60</td>
<td>6.40</td>
<td>2.19</td>
</tr>
<tr>
<td>TOTAL</td>
<td>6.92</td>
<td>2.74</td>
<td>5.92</td>
<td>1.91</td>
<td>5.87</td>
<td>1.40</td>
<td>6.22</td>
<td>1.78</td>
<td>6.14</td>
<td>2.03</td>
<td>5.95</td>
<td>1.87</td>
</tr>
</tbody>
</table>

Note: Possible scoring range was 5 (low somatic anxiety) to 20 (high somatic anxiety)
Table 6

CSAI-2C (Form A)- Confidence

<table>
<thead>
<tr>
<th>Group</th>
<th>Trial 1</th>
<th></th>
<th>Trial 2</th>
<th></th>
<th>Trial 3</th>
<th></th>
<th>Trial 4</th>
<th></th>
<th>Trial 5</th>
<th></th>
<th>Trial 6</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td></td>
<td>M</td>
<td></td>
<td>SD</td>
<td></td>
<td>M</td>
<td></td>
<td>SD</td>
<td></td>
<td>M</td>
</tr>
<tr>
<td>A</td>
<td>20.56</td>
<td>2.70</td>
<td>18.89</td>
<td>4.88</td>
<td>20.86</td>
<td>2.54</td>
<td>19.14</td>
<td>4.18</td>
<td>21.57</td>
<td>2.51</td>
<td>22.00</td>
<td>2.52</td>
</tr>
<tr>
<td>C</td>
<td>18.00</td>
<td>2.83</td>
<td>17.50</td>
<td>4.17</td>
<td>17.00</td>
<td>3.46</td>
<td>18.87</td>
<td>2.85</td>
<td>20.67</td>
<td>3.72</td>
<td>18.80</td>
<td>4.66</td>
</tr>
<tr>
<td>TOTAL</td>
<td>18.73</td>
<td>3.68</td>
<td>19.00</td>
<td>4.42</td>
<td>19.22</td>
<td>3.63</td>
<td>18.88</td>
<td>3.52</td>
<td>20.48</td>
<td>3.78</td>
<td>21.10</td>
<td>3.33</td>
</tr>
</tbody>
</table>

Note. Possible scoring range was 6 (not at all confident) to 24 (very confident)
### Table 7

**Hitting-Task Scores**

<table>
<thead>
<tr>
<th>Group</th>
<th>Baseline M</th>
<th>Baseline SD</th>
<th>Trial 1 M</th>
<th>Trial 1 SD</th>
<th>Trial 2 M</th>
<th>Trial 2 SD</th>
<th>Trial 3 M</th>
<th>Trial 3 SD</th>
<th>Trial 4 M</th>
<th>Trial 4 SD</th>
<th>Trial 5 M</th>
<th>Trial 5 SD</th>
<th>Trial 6 M</th>
<th>Trial 6 SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>12.00</td>
<td>3.91</td>
<td>11.44</td>
<td>6.13</td>
<td>9.89</td>
<td>6.67</td>
<td>10.86</td>
<td>5.93</td>
<td>10.86</td>
<td>7.06</td>
<td>13.00</td>
<td>4.28</td>
<td>9.00</td>
<td>4.62</td>
</tr>
<tr>
<td>B</td>
<td>13.12</td>
<td>5.14</td>
<td>11.87</td>
<td>5.08</td>
<td>9.50</td>
<td>4.17</td>
<td>8.75</td>
<td>3.99</td>
<td>11.62</td>
<td>6.05</td>
<td>11.12</td>
<td>5.11</td>
<td>11.00</td>
<td>4.69</td>
</tr>
<tr>
<td>C</td>
<td>11.50</td>
<td>3.70</td>
<td>9.78</td>
<td>2.44</td>
<td>9.63</td>
<td>2.77</td>
<td>12.87</td>
<td>3.98</td>
<td>13.12</td>
<td>4.64</td>
<td>12.33</td>
<td>5.54</td>
<td>12.20</td>
<td>2.17</td>
</tr>
<tr>
<td>TOTAL</td>
<td>12.21</td>
<td>4.25</td>
<td>11.00</td>
<td>4.69</td>
<td>9.68</td>
<td>4.71</td>
<td>10.83</td>
<td>4.77</td>
<td>11.91</td>
<td>5.74</td>
<td>12.09</td>
<td>4.79</td>
<td>10.58</td>
<td>4.15</td>
</tr>
</tbody>
</table>

*Note.* Possible scoring range was 0 (minimum) to 30 (maximum)
Table 8

**Performance Effort Scale (PES) Scores**

<table>
<thead>
<tr>
<th>Group</th>
<th>Trial 1</th>
<th></th>
<th>Trial 2</th>
<th></th>
<th>Trial 3</th>
<th></th>
<th>Trial 4</th>
<th></th>
<th>Trial 5</th>
<th></th>
<th>Trial 6</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>A</td>
<td>7.56</td>
<td>2.60</td>
<td>7.56</td>
<td>2.07</td>
<td>8.00</td>
<td>2.08</td>
<td>8.43</td>
<td>1.62</td>
<td>8.14</td>
<td>1.95</td>
<td>7.71</td>
<td>2.06</td>
</tr>
<tr>
<td>B</td>
<td>8.50</td>
<td>1.07</td>
<td>7.75</td>
<td>1.58</td>
<td>7.87</td>
<td>1.46</td>
<td>7.75</td>
<td>1.83</td>
<td>7.75</td>
<td>3.33</td>
<td>8.29</td>
<td>1.25</td>
</tr>
<tr>
<td>C</td>
<td>6.56</td>
<td>2.51</td>
<td>6.62</td>
<td>2.72</td>
<td>7.15</td>
<td>3.31</td>
<td>7.50</td>
<td>2.88</td>
<td>8.17</td>
<td>1.94</td>
<td>8.60</td>
<td>1.14</td>
</tr>
<tr>
<td>TOTAL</td>
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<td>2.27</td>
<td>7.32</td>
<td>2.13</td>
<td>7.65</td>
<td>2.35</td>
<td>7.87</td>
<td>2.13</td>
<td>8.00</td>
<td>2.45</td>
<td>8.16</td>
<td>1.54</td>
</tr>
</tbody>
</table>

*Note.* Possible scoring range was 0 (0% effort) to 10 (100% effort)
Table 9

**Correlations Between Psychological Measures and Hitting-Task Performance**

**Group A**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Trial 4</th>
<th>Trial 5</th>
<th>Trial 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confidence</td>
<td>.33</td>
<td>.45</td>
<td>.47</td>
<td>.13</td>
<td>.40</td>
<td>-.23</td>
</tr>
<tr>
<td>Hitting Self-Efficacy</td>
<td>.24</td>
<td>.24</td>
<td>.23</td>
<td>-.06</td>
<td>.31</td>
<td>-.05</td>
</tr>
<tr>
<td>Effort</td>
<td>.27</td>
<td>-.55</td>
<td>-.03</td>
<td>-.64</td>
<td>-.16</td>
<td>-.54</td>
</tr>
<tr>
<td>Stress</td>
<td>.23</td>
<td>.29</td>
<td>-.21</td>
<td>.31</td>
<td>-.75</td>
<td>.04</td>
</tr>
<tr>
<td>Worry</td>
<td>-.25</td>
<td>-.04</td>
<td>-.32</td>
<td>.13</td>
<td>-.47</td>
<td>.29</td>
</tr>
</tbody>
</table>

*Note, p < .05*
Table 10

Correlations Between Psychological Measures and Hitting-Task Performance

Group B

<table>
<thead>
<tr>
<th>Measure</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Trial 4</th>
<th>Trial 5</th>
<th>Trial 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confidence</td>
<td>.04</td>
<td>.35</td>
<td>.03</td>
<td>.14</td>
<td>.05</td>
<td>-.48</td>
</tr>
<tr>
<td>Hitting Self-Efficacy</td>
<td>.00</td>
<td>.30</td>
<td>-.12</td>
<td>.34</td>
<td>.36</td>
<td>.02</td>
</tr>
<tr>
<td>Effort</td>
<td>.25</td>
<td>.76*</td>
<td>.39</td>
<td>.23</td>
<td>.38</td>
<td>-.42</td>
</tr>
<tr>
<td>Stress</td>
<td>.17</td>
<td>.10</td>
<td>.77*</td>
<td>.03</td>
<td>-.20</td>
<td>.75</td>
</tr>
<tr>
<td>Worry</td>
<td>.13</td>
<td>.43</td>
<td>.38</td>
<td>.06</td>
<td>.55</td>
<td>.61</td>
</tr>
</tbody>
</table>

Note. *Correlation significant at the 0.05 level, p < .05
Table 11

Correlations Between Psychological Measures and Hitting-Task Performance
Group C

<table>
<thead>
<tr>
<th>Measure</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Trial 4</th>
<th>Trial 5</th>
<th>Trial 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confidence</td>
<td>.16</td>
<td>-.26</td>
<td>-.16</td>
<td>-.20</td>
<td>-.69</td>
<td>.005</td>
</tr>
<tr>
<td>Hitting Self-Efficacy</td>
<td>.29</td>
<td>-.51</td>
<td>.53</td>
<td>.15</td>
<td>-.86*</td>
<td>.87</td>
</tr>
<tr>
<td>Effort</td>
<td>.27</td>
<td>.05</td>
<td>.68</td>
<td>.58</td>
<td>.53</td>
<td>.75</td>
</tr>
<tr>
<td>Stress</td>
<td>.01</td>
<td>.61</td>
<td>-.05</td>
<td>-.36</td>
<td>.32</td>
<td>-.55</td>
</tr>
<tr>
<td>Worry</td>
<td>-.10</td>
<td>.17</td>
<td>-.13</td>
<td>-.15</td>
<td>.42</td>
<td>-.37</td>
</tr>
</tbody>
</table>

Note. *Correlation significant at the 0.05 level, $p < .05$
Table 12

Correlations Between Psychological Measures and Hitting-Task Performance

All Groups

<table>
<thead>
<tr>
<th>Measure</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Trial 4</th>
<th>Trial 5</th>
<th>Trial 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confidence</td>
<td>.15</td>
<td>.27</td>
<td>-.05</td>
<td>.06</td>
<td>-.06</td>
<td>-.30</td>
</tr>
<tr>
<td>Hitting Self-Efficacy</td>
<td>.12</td>
<td>.29</td>
<td>.17</td>
<td>.17</td>
<td>.08</td>
<td>.002</td>
</tr>
<tr>
<td>Effort</td>
<td>.28</td>
<td>-.09</td>
<td>.26</td>
<td>.08</td>
<td>.29</td>
<td>-.26</td>
</tr>
<tr>
<td>Stress</td>
<td>.18</td>
<td>.19</td>
<td>.12</td>
<td>.06</td>
<td>-.23</td>
<td>.25</td>
</tr>
<tr>
<td>Worry</td>
<td>-.08</td>
<td>.01</td>
<td>-.02</td>
<td>.02</td>
<td>.24</td>
<td>.35</td>
</tr>
</tbody>
</table>

Note, \( p < .05 \)
APPENDIX J

GRAPH
REFERENCES


