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SOCIAL COGNITIVE AND CONTROL THEORIES:
A TEST OF SELF-EFFICACY AND PERFORMANCE
IN STRENGTH AND CONDITIONING

presented by

Todd Anders Gilson

has been accepted towards fulfillment
of the requirements for the

Doctoral degree in Kinesiology

Deborah L. Feltz
Major Professor's Signature

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SOCIAL COGNITIVE AND CONTROL THEORIES: A TEST OF SELF-EFFICACY AND PERFORMANCE IN STRENGTH AND CONDITIONING

By

Todd Anders Gilson

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Kinesiology

2008

ABSTRACT

SOCIAL COGNITIVE AND CONTROL THEORIES: A TEST OF SELF-EFFICACY AND PERFORMANCE IN STRENGTH AND CONDITIONING

By

Todd Anders Gilson

Research, along with anecdotal evidence, has argued that self-efficacy is a key component when it comes to measuring performance in sport. Presently social-cognitive theory (Bandura, 1986, 2001) and perceptual control theory (Powers, 1978, 1991) differ in how each explains the manifestation of confidence of individuals who are repeatedly tested at a skill/task over a period of time. Specifically, Bandura and Locke (2003) found that self-efficacy has been consistently positive in contribution to motivation and performance over a series of nine meta-analyses. In contrast, Vancouver and colleagues (Vancouver & Kendall, 2006; Vancouver, Thompson, Tischner, & Putka, 2002; Vancouver, Thompson, & Williams, 2001) and Yeo and Neal (2006) revealed that self-efficacy was negatively related to performance at the within-person level over time, but was positively related to performance at the between-person level. In the present study 115 Division I collegiate football players from 5 different universities (*M* age = 20.55, *SD* = .97) completed a self-efficacy measure within 72 hours of a 1 repetition max test in the squat at three time points during off-season training. Utilizing a linear growth model in multi-level modeling, results revealed that self-efficacy was positively, but non-significantly related to squat performance ($p = .118$) at the within-person level and significantly related to squat performance between-persons ($p < .01$) when controlling for athletes' raw past performance. Furthermore, 17.7% of the Level 1 variance and 99.8% of the Level 2 variance surrounding current performance was explained with self-efficacy

and raw past performance included in the model. Although results did not fully support either theory at the within person level, they were in the opposite direction of what perceptual control theory predicts. This study helps further the understanding concerning the relationship between self-efficacy and performance when using a unique real-world task, which is less cognitively demanding, and allows for changes in performance over time.

DEDICATION

More important to me over the last four years at Michigan State University than anyone else has been my wife, Melissa. Her sacrifices included: marrying – at the time – an unemployed man, giving up her career in Los Angeles for Michigan, selling her car, and moving into a house sight-unseen. Though the phase, "I could not have done it without her" is repeated a lot in dedications, for what Melissa has endured, she deserves her name on this dissertation too… ahead of mine.

ACKNOWLEDGMENTS

To all: A thank you hardly explains how each of you shaped this work and my time at Michigan State University. The best I can offer is a reflection of what I leave with from each of you.

Dr. Feltz: Your vast knowledge of self-efficacy and willingness to take the time every week to discuss the progress of this dissertation allowed for its timely and competent completion.

Dr. Ewing: Since arriving at Michigan State University – in August of 2004 – your classes, guidance, and genuine empathy towards my pursuits and goals made the undertaking of a Ph.D. truly worthwhile.

Dr. Brophy: The perspectives of motivation that you challenged me with have not gone unforgotten. Your texts and class notes are kept close at hand and will continue to be utilized during my future academic pursuits.

Dean Ames: Your challenges and directions outlined for this dissertation – in its proposal defense – made all the difference in the world, as you removed the "training wheels" and forced me to grow as a researcher.

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CHAPTER ONE

Introduction

Overview

Research, along with anecdotal evidence, has argued that self-confidence (or self-efficacy, as it is referred to in social-cognitive theory) is a key component when it comes to measuring performance in sport. In the past, a number of models/theories have been put forth to better understand the relationship between self-efficacy and performance. Presently social-cognitive theory (SCT: Bandura, 1986, 2001) and perceptual control theory (PCT: Powers, 1978, 1991) differ in how each explains the manifestation of confidence of individuals who are repeatedly tested at a skill/task over a period of time.

From SCT, Bandura (1986, 2001) argues that self-efficacy, goals, and self-reactive influences play an important role on future efforts. Specifically, people with higher self-efficacy beliefs choose more challenging goals than those with lower levels of efficacy beliefs (Locke, Frederick, Lee, & Bobko, 1984). If high self-efficacy people match or exceed their goal in their first trial, they set even higher goals for the next performance, thus creating a discrepancy to be mastered. In the face of negative discrepancies between their goal and performance, those who have high self-efficacy beliefs will heighten their level of effort and persistence, according to Bandura, and those who have self-doubts will quickly give up – though the latter is very rare in high level sport. Thus, Bandura predicts a positive relationship between self-efficacy and performance over time.

This social-cognitive view of self-efficacy is contrasted with PCT (Powers, 1978, 1991). PCT is a cybernetic model that is based on a negative feedback loop wherein people are motivated to reduce the discrepancy between feedback received from their performance and their internal goals. If the discrepancy is reduced to zero, no further adjustment in performance is needed. Vancouver and his colleagues (Vancouver, Thompson, Tischner, & Putka, 2002; Vancouver, Thompson, & Williams, 2001) applied PCT to self-efficacy and hypothesized that when individuals have high self-efficacy they may be overly optimistic about the degree to which they are meeting their goals. This perception would reduce the discrepancy between a goal and perceived performance. In turn, individuals would apply fewer resources to meeting their goal(s), which would result in a lower subsequent performance. Thus, Vancouver et al. (2001, 2002) predict a negative relationship between self-efficacy and performance over time when measured within individuals.

Although Vancouver and colleagues (2001, 2002) provided research evidence for their hypothesis, Bandura and Locke (2003) criticized several elements of these studies, such as the artificial aspects of the task (Vancouver and colleagues used an analytical computer game), a lack of learning opportunity across trials, and solutions that were mostly based on guesswork. While there are many skills/tasks that could be employed to examine these two competing theories, using athletes performing in meaningful sports situations that allow for progression over time avoids these expressed criticisms.

Theoretical Background

In 1977, Bandura contended that the influence from thought patterns could actually exert a greater influence on future behavior when compared to feedback obtained from the task at hand. These thought patterns are conceptualized as self-efficacy, which is a specific type of expectancy that reflects one's beliefs in his/her ability to perform a behavior (or behaviors) required for a desired outcome. Bandura argued that the stronger these self-efficacy expectations were for individuals the better a performance would be, the more effort that would be displayed, and the longer individuals would persist at tasks in the face of challenges.

Bandura and Locke (2003), examining self-efficacy and performance through a series of nine meta-analyses in a variety of disciplines, revealed that self-efficacy has been consistent in its significant and positive relationship to motivation and performance. Specifically, in sport, self-efficacy has been shown to have a moderately positive relationship with performance. Moritz, Feltz, Fahrback, and Mack (2000) examined 45 studies from an array of sporting contests/skills/tasks and found an average correlation between self-efficacy and performance of .38. Even more striking is the fact that under challenging sport conditions, where one decision or skill can mean the difference between success or failure, self-efficacy was the sole determinant of performance success (Kane, Marks, Zaccaro, & Blair, 1996).

Self-efficacy is theorized to be the most important mechanism that exists in the broader framework of SCT (Bandura, 1986, 2001). In SCT, it is argued that individuals are responsible for their own self-reflection, self-regulation, and are active shapers of their own environment, rather than passive reactors to environmental stimuli (Maddux, 1995). Specifically, SCT asserts that behavior exhibited is purposeful, goal-directed, and not simply the product of hindsight relating to previous shortfalls. If enhancing motivation did hinge on the last of these points, individuals would simply set goals and attempt tasks in which they had already been successful to eliminate the contradiction between situational demands and their ability (Bandura & Locke, 2003). Furthermore, under SCT, people are capable of being self-reflective when it comes to their previous experiences and this analyzing and reflecting leads to self-regulation, where individuals control their body or alter the environment in a way that influences future behavior.

Social-cognitive theorists (Bandura, 1986, 2001; Bandura & Locke, 2003) do admit that reactive feedback from a task can influence future behavior, but only when adjustments in effort are necessary to achieve a desired outcome. Once this has occurred, individuals with high self-efficacy will set a more challenging goal for themselves and it is this discrepancy between one's current ability level and the new desired goal that will enhance motivation and persistence (Bandura & Cervone, 1986). In contrast, individuals who focus on eliminating differences between their abilities and situational demands – because of overwhelming self-doubts – suffer from deteriorating self-efficacy, self-set goals, self-satisfaction, performance, and eventually could withdraw from the activity (see Figure 1). Therefore, "…it is not the discrepancies people seek to eliminate but goals and valued outcomes that they seek to attain" (Bandura & Locke, 2003, p. 91).

In contrast to SCT (Bandura, 1986, 2001), PCT (Powers, 1978, 1991) offers a different explanation for confidence and the resulting human behavior in specific situations. PCT asserts that the input into a system, not the cognitions or output observed, is the critical component affecting behavior change. Thus, when the input is altered, the output will also be affected. In other words, behavior is controlled by the consequences one experiences, not from thought patterns and free-will as described earlier. Additionally, the notion of dynamic stability is central to control theory. This concept contends that after any disturbance is perceived, the system (i.e., human) and the environment will quickly return to a steady state of equilibrium (Powers, 1978). An

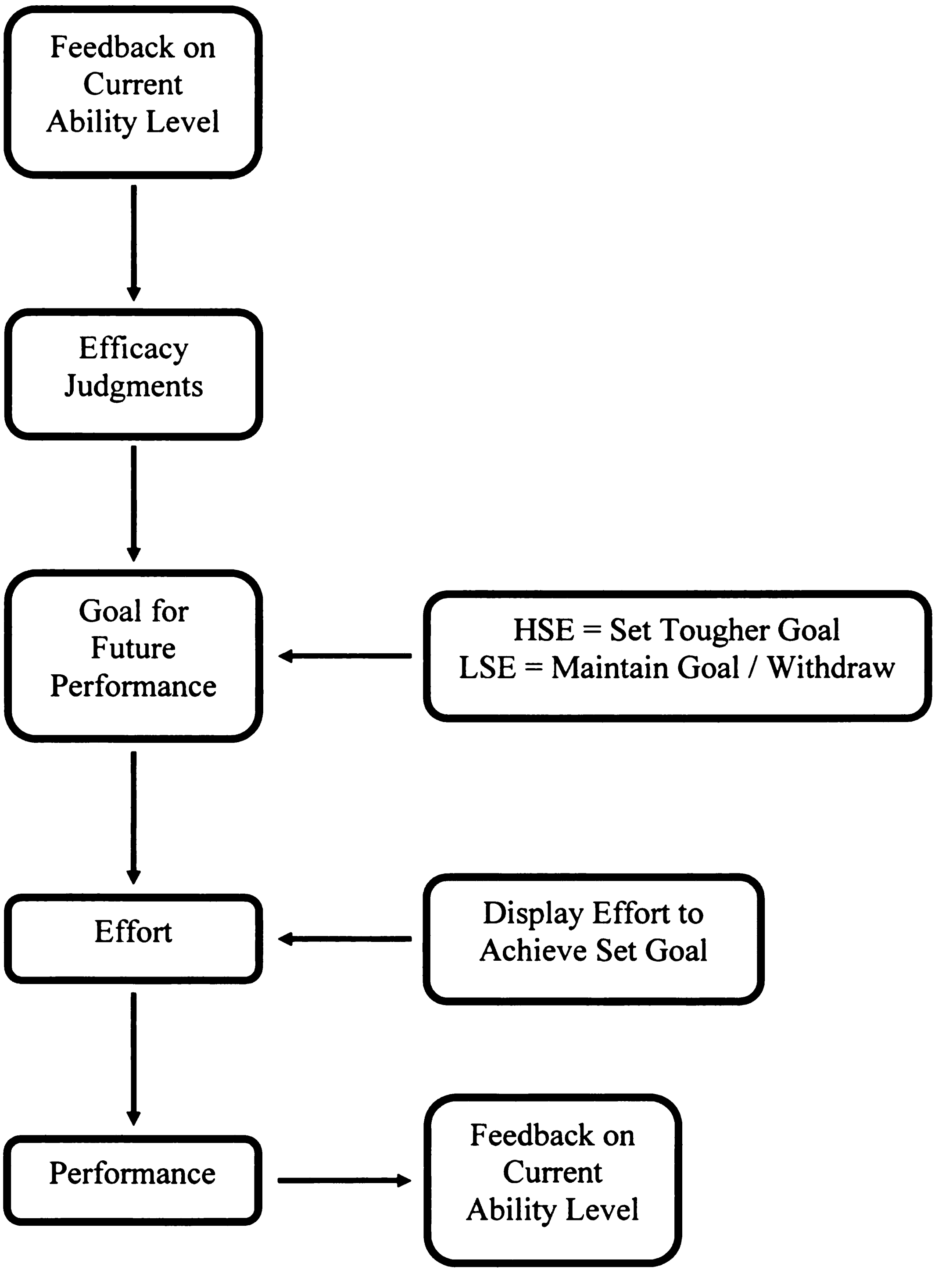

Figure 1. Conceptual Model of Social Cognitive Theory.
Note. HSE = High Self-efficacy; LSE = Low Self-efficacy

example of this phenomenon can be witnessed when an individual is playing tennis on a windy day. The added element of wind makes the game more difficult to play; thus, in response to this disturbance the individual will increase focus on the task at hand, alter the conditions by moving the game inside, etc. to negate the disruption currently experienced. Finally, it is important to note that behavior is not regulated and predictable according to PCT. Instead behavior varies in proportion to the disturbance at hand and can result in a multitude of actions, depending on the input provided (Powers, 1991). Therefore, because dynamic systems where people experience activities are always acting, control systems are always acting to maintain equilibrium.

When PCT (Powers, 1978, 1991) is utilized to help explain the relationship between self-efficacy and performance, striking differences are noticed. In a variety of studies employing computer analytical games and academic performance, Vancouver and colleagues found that self-efficacy was negatively related to performance at the within-person level over time, but was positively related to performance when examining data at the between-person level (Vancouver & Kendall, 2006; Vancouver et al., 2001, 2002). To help explain these findings, Vancouver and associates argue that the self-efficacy/performance relationship is actually a performance/self-efficacy relationship. For example, if individuals have a great performance, their resulting self-efficacy is likely to be enhanced, which could result in complacency and overconfidence during the next performance. Conversely, individuals who suffer from a sub-par performance will have a reduced self-efficacy, which may actually lead to more practice/studying to improve future performances. These contentions have been found in a professional sport context, examining playoff games in the National Basketball Association (NBA), where Mizruchi

(1991) stated that, "other things being equal, prior failure is likely to breed success" (p. 188). Therefore, Stone (1994) goes so far as to advocate for inducing mildly negative expectations to improve performance (see Figure 2).

Using athletes who perform meaningful sport-related tasks over a period of time allows for an optimal context to examine the competing explanations of SCT (Bandura, 1986, 2001), PCT (Powers, 1978, 1991), and performance. One such sport-related activity is strength training. In this arena, athletes are subjected to a daily variety of strength, speed, and agility exercises with the goal of improving on-field performance.

Strength Training Background

Modern strength training was founded by Boyd Epley in the early 1970's, when he began to train injured athletes at the University of Nebraska (Epley, 2004). Noticing the speed at which injured athletes were able to return to their sport, Epley successfully petitioned the athletics department to apply his strength training techniques to healthy athletes. As performance began to increase for all athletes, other universities soon copied the University of Nebraska, and strength training at the collegiate level was established. Today strength coaches work with athletes at a variety of competitive levels to increase strength, improve speed, increase neuromuscular coordination, and enhance resistance to injury (Epley). Additionally, with the inception of the National Strength and Conditioning Association (NSCA) in 1978, strength training has become commonplace in our society for athletes who want to achieve a greater performance during competition.

At the college level, where strength training is nearly mandatory for every sport, athletes are required to spend a great deal of time training for future competition. The NCAA (2007) allows Division I athletes to spend a maximum of 8 hours per week

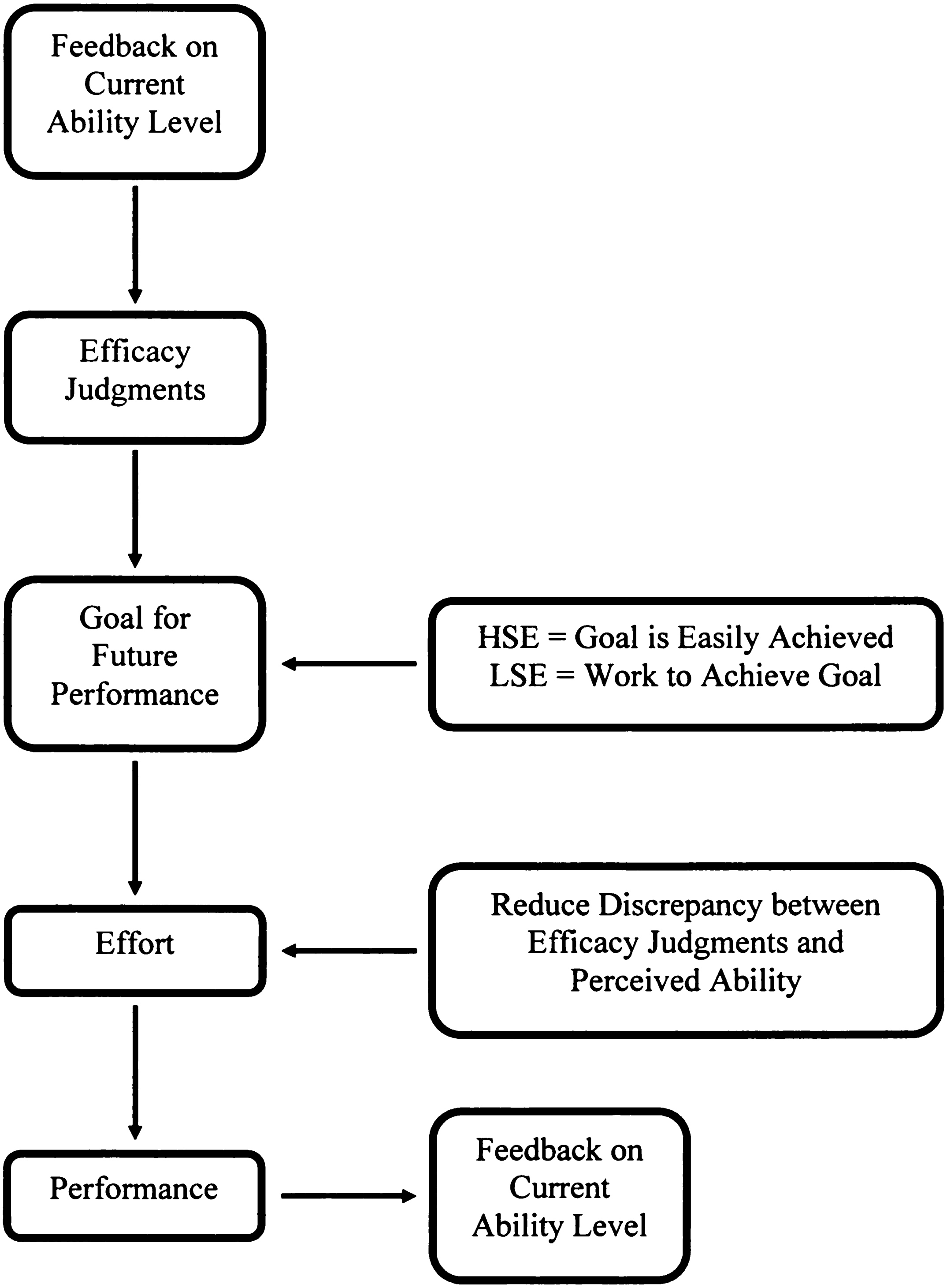

Figure 2. Conceptual Model of Perceptual Control Theory.
Note. HSE = High Self-efficacy; LSE = Low Self-efficacy

engaging in strength training with their specific strength coach. When this amount of time is calculated for one calendar year, strength coaches have the opportunity to interact with athletes more than sport coaches.

As with any sports team, athletes will vary in regard to effort and persistence over time, thus the amount of time athletes spend engaging in strength training sessions may not always be a positive experience. Strength training sessions may be perceived as monotonous because athletes engage in the same, core exercises every week (e.g., squat, power clean, bench, and standard agility running) and perceptions of ability in these exercises may exceed actual performance, which is tested infrequently. If strength training is perceived in this light, complacency, a focus on discrepancy reduction highlighted by PCT (Powers, 1978, 1991), and a negative relationship between self-efficacy and performance could result.

However, male athletes may also view their strength training as essential for increased sport performance, when compared to general weight lifting activities. In a sample of collegiate male athletes, Poiss, Sullivan, Paup, and Westerman (2004) supported this very contention as male athletes were found to engage in strength training for longer durations, more days of the week, and have a resulting higher self-confidence than their female counterparts. When these attributes are present for athletes during performance testing, athletes may exceed their expectations. This profound jump in ability may encourage athletes to work even harder during the next performance testing period to better their future ability level. If these notions are held by athletes, one should expect behaviors described by Bandura and Locke (2003) where discrepancy production results, athletes persist to improve over time, and a positive relationship between self-efficacy and performance is observed.

Nature of the Problem

Competing theories that explain self-efficacy and performance have been put forth. Both SCT (Bandura, 1986, 2001) and PCT (Powers, 1978, 1991) have convincing arguments, supporting data, and anecdotal evidence to show that their explanations of self-efficacy (or confidence) are correct (see Chapter 2 for a complete review). While these two theories have been tested against each other in other disciplines (e.g., Richard, Diefendorff, & Martin, 2006; Vancouver & Kendall, 2006; Yeo & Neal, 2006), knowledge gaps still exist. Specifically, Vancouver et al. (2001) have called for studies that use longer time periods in between trials. This contention is made because individual differences regarding capability beliefs (i.e., self-efficacy) may already be established and resistant to change when performance is tested and feedback is received over short durations. In contrast, when self-efficacy and performance are measured over greater lengths of time, "motivated application of resources toward perceived attainable goals may have had a greater effect" (Vancouver, et al., 2001, p. 617). Furthermore, Bandura and Locke (2003) argue that studies performed by Vancouver and colleagues were set up in a static environment that asked participants' how likely it was that they would be able to find a solution to the problem presented. According to Bandura and Locke these shortfalls hindered accurate measures of self-efficacy because the environment used prevented changes in participant's self-efficacy and questions were not formulated along self-efficacy guidelines (i.e., participants were not asked how confident they were; instead, participants were asked how likely it was that they would succeed).

In addition, researchers highlighted the discrepancies that existed on how to best control for past performance when measuring the self-efficacy/performance relationship. Studies that have found a negative relationship between self-efficacy and performance have statistically controlled for raw past performance (Vancouver et al., 2001; 2002; Yeo & Neal, 2006). This measure was taken because Bandura himself advocates for increasing mastery experiences (i.e., inducing a successful past performance for a participant) to bolster overall self-efficacy. Thus, by controlling these past mastery experiences research can show the true relationship between self-efficacy and performance (Vancouver et al., 2002). However, Bandura and Locke (2003) argue that controlling for raw past performance statistically overcorrects and biases the results in favor of the past performance. Specifically, Bandura and Locke argue that efficacy beliefs are autocorrelated and affect both past and future performance. Therefore, by using unadjusted raw past performance scores, researchers also partial out some of the efficacy beliefs affecting a future performance and suffer from a propensity to receive feedback showing a negative self-efficacy/performance relationship within individuals over time.

To adequately study the efficacy-performance relationship over a period of time, multi-level modeling (MLM) or hierarchical linear modeling (HLM) was necessary. MLM is advantageous because this statistical procedure recognizes that individuals and teams are not separate entities. Instead, each is part of a whole that is both affecting and being affected by the other. Furthermore, MLM allows for findings at one level of analysis (i.e., one individual over time multiple trials) to be applied to another level (i.e., mean scores across or between individuals) when testing hypotheses (Lindsley, Brass, &

Thomas, 1995). Research involving self-efficacy and performance has begun to adopt the use of MLM and has produced initial results that vary across levels of analysis and constructs tested, such as goal orientations, perceived motivational climates, and collective efficacy (Magyar, Feltz, & Simpson, 2004; Myers, Feltz, & Short, 2004; Myers, Payment, & Feltz, 2004; Vancouver & Kendall, 2006; Vancouver et al., 2001, 2002; Yeo & Neal, 2006).

Statement of Purpose

The purpose of this study was to examine the effects of self-efficacy and performance for a group of collegiate football players engaged in strength training during the off-season (January to August of the same year). Self-efficacy and performance measures (in the squat exercise) were taken at three time points during these months, when physical performance tests were completed by athletes. This purpose aligns with research that has called for an examination of self-efficacy and performance with a greater length of time in between performance trials and incorporation of more real world tasks (Bandura & Locke, 2003; Vancouver et al., 2001).

Hypotheses

The hypotheses for this study have been organized to test the two competing notions of how self-efficacy predicts performance and separated into the within-person and between-person level of analysis:

1. Because both SCT (Bandura, 1986, 2001) and PCT (Powers, 1978, 1991) agree that self-efficacy will positively affect performance at the between-person level, Hypothesis #1 predicted a positive relationship between these two variables over time when controlling for raw past performance.

2a. If SCT's (Bandura, 1986, 2001) conceptualizations of the association between self-efficacy and performance are correct; a positive relationship between these variables would be present at the within-person level over time when controlling for raw past performance.

2b. If PCT's (Powers, 1978, 1991) notions of the relationship between self-efficacy and performance are correct; a negative relationship between these variables would be present at the within-person level over time when controlling for raw past performance.

Assumptions

A few assumptions were implied within this study. First, as with any study utilizing self-report questionnaires, it was assumed that psychological constructs were accurately measured with the questionnaires employed and participants were honest in their responses. A few studies have noted the probability of humans to overestimate their abilities on self-report questionnaires (Ronis & Yates, 1987; Sniezek, Paese, & Switzer, 1990; Yates, Zhu, Ronis, Wang, Shinotsuka, & Toda, 1989). However, Bandura (1978) has long contended that when placed in situations where exaggerating or falsifying capabilities serves no purpose, self-report questionnaires would lend insight into current cognitions of individuals. Second, data on self-set performance goals by athletes were not collected in this study because of the difficultly of obtaining this information. Thus, it was assumed that the goal for all athletes was to best their previous performance in the squat exercise at the current time point (i.e., an athlete who squatted 330 lbs. at Time Point #1 had an implicit goal of squatting more than 330 lbs. at Time Point #2). Finally, this study also relied on strength coaches (who opted for paper packets, see Chapter 3) to distribute the questionnaires within 72 hours before a strength training testing date, so that measures of self-efficacy were accurately reflected in athletes' answers.

Delimitations

The generalizability of all findings are limited to competitive sport settings where late teens to adults engage in team sport. Furthermore, results are also limited to sport settings where specific strength training occurs for athletes who engage in these competitive sports.

Limitations

While a more complete discussion of limitations is found in Chapter 5, abbreviated versions of important limitations subsequently appear. First, in controlling for the past performance of athletes, raw past performance – instead of residualized past performance – was employed. Bandura and Locke (2003) argued strongly for residualizing past performance because raw past performance removes too much of the effect that self-efficacy has on current performance; however residualized past performance could not be calculated in this study because only three measures of self-efficacy were collected. Second, while the nesting of data was measured at both the within- and between-person level, overall team differences in self-efficacy and performance were not tested. This limitation could not be corrected because of the low number of Division I collegiate football teams in this study (n = 5), which made data analysis at the team level impossible. Finally, as outlined previously regarding the difficulty of obtaining such information, data on self-set performance goals for athletes were not gathered in this study.

Definitions

1RM: a one repetition maximum test used for strength training exercises where an athlete's best performance, over multiple trials conducted during one training session, is recorded.

Self-efficacy: the strength of an athlete's current belief in his ability to complete the squat strength training exercise successfully.

Squat performance: an athlete's performance in the squat, which is a strength lift, based on his 1RM.

CHAPTER TWO

Review of Literature

Overview

The review of literature in this chapter explains the competing theories of SCT (Bandura, 1986, 2001) and PCT (Powers, 1978, 1991) from a conceptual standpoint. The chapter is organized into five segments: development of SCT, development of PCT, criticisms of SCT, criticisms of PCT, and knowledge gaps.

The Development of Social-Cognitive Theory

In 1977, Bandura wrote about efficacy expectations in great depth and argued that these expectations help determine whether individuals use coping behaviors, how much effort will be expended, and for how long in the face of obstacles, all of which are important elements in performance. Through a study involving snake phobic individuals and questionnaires designed to measure their confidence in future interactions with snakes, Bandura found, "In all conditions, the stronger the efficacy expectations, the higher was the likelihood that a particular task could be completed" (p. 207). These results gave Bandura the ammunition to contend that performance consequences affect human behavior through the thoughts one has about what will happen in the future. Therefore, beliefs that individuals hold about a task can exert a greater influence on behavior than the reinforcement one receives from the task itself. A qualifying statement to the previous assertion is that succeeding at easy tasks provides no (or very limited) new information for one's self-efficacy; however, the mastery of challenging tasks conveys salient information resulting in increased confidence. Finally, Bandura laid out the four primary sources of efficacy expectations that individuals use when approaching a task: past performance accomplishments, vicarious experiences, verbal persuasion, and emotional states.

Performance accomplishments are based on one's own mastery experiences and affect self-efficacy through the cognitive processing of perceived successes and failures. Vicarious experiences carry efficacy information through the observation of and social comparison to others. Through this observation, individuals note the consequence(s) of the observed performer, and then use this information to form judgments about one's own performance (Maddux, 1995). Persuasive techniques include verbal persuasion, evaluative feedback, expectations by others, self-talk, positive imagery, and other cognitive strategies. The strength of the persuasive influence on self-efficacy has been hypothesized to depend on the prestige, credibility, expertise, and trustworthiness of the persuader (Bandura, 1997). Lastly, emotional states convey efficacy information through their association with past experiences of success and failure. Individuals who have associated their autonomic arousal with lacking the requisite skills to succeed will have low efficacy beliefs.

The results that Bandura found with snake phobic patients were consistent with a social learning approach of self-efficacy. Specifically, past accomplishments yielded better efficacy information that could be generalized to multiple situations when compared to vicarious experiences; while in turn, self-efficacy based on vicarious experiences yielded a stronger influence on performance than the self-efficacy of those in a control condition (Bandura, 1977). Important to note is that sources of self-efficacy can also have negative ramifications on participants (e.g., when self-efficacy is low) –

regardless of activity. These findings led Bandura to construct the broader theory of SCT (Bandura, 1986, 2001), which included self-efficacy.

From an expansive viewpoint, SCT (Bandura, 1986, 2001) is an agent-centered approach to understanding human action, thought, motivation, and emotion (Maddux, 1995). SCT also encompasses self-efficacy and its effects on motivation, effort, persistence, and performance. Specifically, according to Bandura (1986) several assumptions of human behavior are postulated in SCT:

1. People have the capability to symbolize experiences, courses of action they consider, the prediction of what will happen with each hypothesized decision, and the ability to relate these complex ideas to others.
2. Most behavior is purposeful, goal-directed, and a product of fore-thought, not hindsight. This point is dependent on people's ability to symbolize their experiences, as described in point #1.
3. People are self-reflective when it comes to analyzing and evaluating their thoughts and experiences. This ability allows for the self-control of thoughts and behavior.
4. People are capable of the self-regulation concerning their own behavior. This capability allows people to develop standards for their behavior and evaluate past behavior against these standards.
5. People can learn vicariously by watching other people's behavior and the resulting consequences. This assumption reduces the importance people place on a trial-and-error method of learning, especially with complex skills.

6. All of the previous capacities are a direct result of neuro-physiological structures that exist in the make-up of humans.
7. Through cognitive processes, people respond to their environment, but more importantly, use those same cognitive processes to control their own behavior. Furthermore, according to SCT (Bandura, 1986, 2001), everything does not influence everything else simultaneously and equally. Instead, the cognitive, behavioral, and environmental sources of influence are evaluated by the individual and then a behavior choice is made.

With the budding research exploring the self-efficacy/performance relationship, Maddux (1995) highlighted the importance of gathering information over multiple trials and time points to fully understand the relationship between self-efficacy and behavior (or performance, as in this study). This assertion is based on the fact that SCT (Bandura, 1986, 2001) assumes that relationships among cognitions, behavior, and the situational events will change over time. Or to phrase the relationship between self-efficacy and performance in another way, self-efficacy is not simply the judging of a future performance from a past behavior (Bandura, 1977). Therefore, as SCT relates to sport performance, multiple measurements of self-efficacy and performance are necessary to prevent the common mistake of simply judging the skills an athlete possesses at a given time point without considering the management of ever changing sport situations (Bandura, 1990).

Bandura (2001) also questioned the benefit of mapping the neuronal circuitry present during a great performance (in sport or otherwise), as some control theories were advocating. Specifically, even if researchers were to accomplish this task, the results would tell little about the inspirational nature of the performance and the motivation it would give others. Thus, the ability to set goals and achieve challenging tasks is best understood from a social-cognitive approach because, "Unless people believe they can produce desired results and forestall detrimental ones by their actions, they have little incentive to act or to persevere in the face of difficulties" (Bandura, 2001, p. 10). Bandura (2002) supported this statement by a review of many meta-analyses that showed self-efficacy beliefs significantly contribute to motivation, socio-cognitive functioning, and emotional well-being. Furthermore, as discussed first in his 1986 work, Bandura argued that self-efficacy beliefs are pivotal because they provide the foundation for other determinants in this agentic theoretical perspective (Bandura, 2006).

Self-efficacy affects one's family life, career path, education, health promotion, sex education, political participation, and sport performance (Bandura, 2006). Moving into the more specific realm of sport, the effects of having high self-efficacy not only yield better performances, but produce athletes who are not afraid to set challenging goals and persevere through setbacks (Feltz, Short, & Sullivan, 2008). While in their book, Feltz et al. acknowledged the fact that complacency can occur during upward spirals (see Lindsley et al., 1995), more important to success are the characteristics that people have incentive to act on their efficacy beliefs when they possess the required skills, that the nature of the task is clear, and the measure used for obtaining self-efficacy and performance data are unambiguous as possible. When these methodological concerns were addressed, self-efficacy was shown to have an average correlation with performance of .38, suggesting that self-efficacy has a moderately positive effect on ensuing sport performance (Moritz et al., 2000).

Recent work has focused on testing additional components of self-efficacy. For example, self-efficacy has been shown to be more influential in behavior than task-value (Locke & Sadler, 2007), that more confident athletes were related to more confident teammates and teams (Magyar et al., 2004), and that athlete self-talk (i.e., the verbal persuasion element of self-efficacy, see Bandura, 1977) was a strong predictor of performance for elite athletes (Vargas-Tonsing, Myers, & Feltz, 2004). Regardless of the components of self-efficacy that were measured, most research continued to show one overriding principle – that self-efficacy is the best predictor of performance (Feltz & Magyar, 2006).

The Development of Perceptual Control Theory

Most control theories are nested within cybernetic models (Vancouver, 2000). These cybernetic models are viewed as having many subsystems that interact with both themselves and the environment over time. The subsystems are dynamic and interactional, as they specifically explain how properties of the system and environment feedback and change over time. It is because of these assumptions that cybernetics contains the proper mechanisms to explain how mental causes become physical effects for both machines and animals (Wiener, 1948).

One of the first control systems developed provided explanation for the seemingly constant stability of systems that researchers were observing. In this model by Rosenblueth, Wiener, and Bigelow (1943), the system's environment can be maintained or even altered by acting on a variable when the perception of that variable is in disagreement with the system's goal. When this function takes place, the input to the system creates error, in which the goal and the perception are not aligned, and the system then produces an output to correct this imbalance. Furthermore, when applying this paradigm to explain how a system acts, it is assumed that the system in question does not need to know the nature of the disturbance, only that the current state of the variable differs from the goal and the system has the resources necessary to correct this disparity.

One might observe this behavior when an individual decides to lose weight. Assuming that the goal of the human was to return to the body weight that he/she was previously at 10 years ago and this individual's current body weight is more than the desired goal, an error in the system is detected. Additionally, despite the error perceived, the individual in this scenario is not required to produce an explanation as to why his/her body weight has increased over the last 10 years. If this person has enough motivation (along with other factors) to desire to be successful at the task at hand, the individual will work to return his/her body weight to a sense of stability in line with the present goal. It is the study of the communication process between the person in the above example and the environment that is referred to as cybernetics (Wiener, 1948).

It was soon realized that control theories could be included into parts of larger systems (Boulding, 1956). Specifically, control theories could help explain the larger communication process, now called cybernetics. Additionally, now that researchers had the ability to explain the stability they perceived in machines and animals and the ability to categorize these rationalizations as subsystems within cybernetics, beginning in the mid-20th century these systems were integrated to explain outcomes (Richardson, 1991). It was also at this point in time that control theories were recognized within psychological realms, which resulted in new theorizing influencing the cognitive revolution (see Miller, Galanter, & Pribram, 1960 and the test-operate-test-exit model).

Though control theories can apply to machines and living creatures, it is in engineering that more formal theorizing of control theories occurred (Vancouver, 2005). Specifically, in this field the term "control theory" became popular because the goal was to have a machine monitor itself and make corrections so human operators could be freed up for other tasks. Because of the past history of control theories seemingly embedded with engineering models, control theory has suffered from a machine analogy problem (Vancouver, 2005). This problem presented itself as psychological control theorists borrowed too much from engineering versions of these theories, thus giving credibility to criticisms that question the generalizability of control theories in explaining human behavior (Powers, 1978).

Powers (1978) first attempted to rectify these problems when he wrote about the shortfalls that hindered previous work in control theories. This article would later be viewed as the development of PCT (Powers, 1978, 1991). The thesis of this article was that unique behavior could manifest itself in a variety of settings. For example, two musicians may experience anxiety before a recital. While one musician executes his/her work masterfully, another may suffer from a catastrophic performance. Examining the inputs to a system (e.g., familiarity with the musical piece, practice time, and previous recital performance) is a more streamlined approached to understanding behavior; when compared to analyzing all of the various causes a system might have to exhibit behavior, while also looking for objective similarities within those causes. Therefore, by measuring the perceptions that an individual has concerning the input, all possible outcomes can be discovered (Powers, 1978).

Two important concepts in PCT (Powers, 1978, 1991) are dynamic stability and negative feedback loops. In PCT, disturbances are constantly perceived by individuals in comparison to a goal or standard they wish to achieve. Consider the following example: an individual playing a video game may experience vibrations in the joystick and overall increased pressure, because of the significance in the point of the game he/she has reached. Once this disturbance is perceived and compared to the past state of variables, in which the individual can no longer act, a new discrepancy will be perceived to be present (Vancouver & Putka, 2000). Assuming the individual wants to be successful at the video game, this person will increase focus and concentration to mitigate the pressure and joystick vibrations he/she is experiencing. Thus, the input perceived by the individual directly affected the amount of resources allocated to the task at hand. In this example the phenomenon of dynamic stability can be witnessed. Specifically, once this disturbance arose, the individual worked hard to steady the relationship with the environment to allow for future momentary disturbances to be less disruptive.

If the previous example is extended, a negative feedback loop can also be observed. Negative feedback loops (first discussed by Powers, 1973) help to explain complex behavior, which is exhibited by humans. Consider the scenario where the individual playing the video game was successful at controlling the vibrations in the joystick and the added pressure at a crucial point in the game. According to a negative feedback loop, the next time the individual in question encounters a similar situation his/her focus and concentration may not be as intense as before and resulting performance may suffer. These characteristics may be displayed by this – and other individuals – because according to negative feedback loops once successful, humans will fail to allocate enough future resources to meet a new challenging task. Vancouver et al. (2002) used the rationale of negative feedback loops to explain the decline in performance for participants who suffered from deteriorating performances while also displaying high levels of confidence.

In PCT (Powers, 1978, 1991), humans have the ability to compare their perception of external events against the inner specification for that perception, but again the input into a system (i.e., a person) is the determinant that regulates future behavior (Powers, 1991). Because the input in most settings is never inert, one can expect that behavior will be dynamic and only regulated when a disturbance is evident. Such is the case for an athlete whose performance fluctuates over time when competing against opponents of varying difficulties (Mizruchi, 1991). Using PCT, Powers (1991) explained that there are at least four ways in which effort can be increased for individuals: raising the reference signal (i.e., having higher level systems act through goal settings for lower level systems) – such as when a chess player controls a position of the board through decisions, hand movements, and finger movements, increasing the system's action sensitivity to a given amount of error, applying a disturbance that makes the perception deviate further from the reference setting, and adopting a pessimistic perception of achievement. The last suggestion is important in sport because there may actually be times when individuals can benefit from having mildly negative self-appraisals instilled to enhance a future performance and guard against over confidence (Stone, 1994).

At this point of the explanation about control theories, it is anticipated that readers will question the absence of decision-making processes from control theories (Bandura & Locke, 2003). Vancouver (2005) was aware of this perception and stated that decision-making constructs are "added on" to account for the unpredictable nature of human behavior. To help explain how these systems manifest themselves in humans, Vancouver (2005) used an example of how people learn to put on coats when it is cold outside. Individuals perform this behavior because they understand what causes heat loss; thus, the next time they venture into cold weather, a coat is worn before going outside. In this circumstance, the subsystem level of memory, coupled with a passive observation mode and an imagination mode, allows individuals to make projections about cold weather based on what has happened in the past.

Employing the notion of PCT (Powers, 1978, 1991) and the hypothesized over confidence that may exist among individuals, Vancouver and colleagues began to test self-efficacy and performance utilizing MLM, beginning in 2001. Specifically, for PCT work (that has continued to date), the hypothesis has always stated that within-individuals over time, self-efficacy will have a negative relationship with performance. As discussed earlier, PCT researchers believe this negative relationship exists because of the concepts of dynamic stability and negative feedback loops that control the input to a person. Thus, when individuals continually display competence in a task, overconfidence and resulting declines in performance may result (Mizruchi, 1991; Powers, 1991, Stone, 1994). Additionally, repeatedly demonstrating sub-par skills at a task will result in individuals practicing and studying more in between performance trials to increase future performances in order to restore the homeostasis between the perceived discrepancy in question and individuals' goals. Finally, at the between-person level, using PCT, Vancouver and colleagues have speculated that the self-efficacy/performance relationship is positive. This belief coincides with SCT (Bandura, 1986, 2001), in that individuals who are more confident will exhibit higher performances when compared against individuals with lower self-efficacy levels.

Vancouver et al. (2001) first found that with undergraduate students who participated in an analytical game, the within-person self-efficacy/performance relationship was negative when controlling for raw past performance. Specifically, participants were asked to rate how likely it was that they would be able to find a solution to the next puzzle. These findings were set in the framework of PCT (Powers, 1978, 1991) and a negative feedback loop that manifested itself for each participant. For example, if a participant was able to solve the puzzle in a few number of moves, his/her self-efficacy would likely rise for the next trial. However, as the participant's self-efficacy increased the probability of maintaining the high level of previous performance dropped. Thus, over 8-10 trials on the same analytical game (in this multi-study article), the relationship between self-efficacy and performance at the within-person level was negative and could be interpreted as a performance/self-efficacy relationship (Vancouver et al. 2001). To show that the latter contention has in fact been discussed before, Vancouver and associates highlighted the fact that Bandura (1986) noted the likely causal effect of past performance in determining one's current self-efficacy. Thus, Vancouver et al. (2001) stated, "Both [studies conducted by Vancouver et al. in 2001] found that performance does indeed positively influence self-efficacy but that self-efficacy does not positively influence subsequent performance" (p. 616).

In subsequent years, Vancouver and colleagues refined their methods and continued to examine the self-efficacy/performance relationship. When self-efficacy was positively manipulated, future within-person performance suffered for each individual (over 10 experimental trials), yet no change occurred in performance at the between-person level (Vancouver et al., 2002). Additionally, utilizing 5 actual exam scores for college undergraduates, instead of hypothetical computer game simulations, Vancouver and Kendall (2006) found that self-efficacy was negatively related to motivation and impending test performance at the within-person level during the semester. Therefore, one way to decrease self-efficacy – and potentially increase future performances – was to provide negative feedback to increase the motivation and effort exhibited by individuals (Vancouver & Tischner, 2004).

Although Vancouver and colleagues concluded that it might be beneficial to decrease self-efficacy to increase a future performance, Vancouver et al. (2002) stated that a high self-efficacy is not necessarily detrimental, because when measuring individuals at the between-person level higher self-efficacy participants always yielded better performances.

Also in response to early criticisms from non-control theorists, Yeo and Neal (2006) examined self-efficacy and performance effects with air traffic control laboratory simulations. This task was different than pervious performance tests employed by Vancouver et al. (2001, 2002) for two important reasons. First, the air traffic control task produced a dynamic environment – something the computer analytical games of Vancouver et al. (2001) could not. Second, the latter task allowed for the possible growth of self-efficacy and performance to occur over the 29 trials used for analysis, because solutions to scenarios were not primarily based on luck. Furthermore, Yeo and Neal took great care to develop a more accurate measure of self-efficacy that reduced the probability of measuring luck or chance by phrasing questions, "How confident are you of achieving a score of X in the upcoming trial?" (p. 1092). Using this different task and implementing the suggestions of previous researchers, results revealed conclusions that aligned with PCT (Powers, 1978, 1991), in that a negative relationship at the within-person level and a positive relationship at the between-person level regarding self-efficacy and performance were found.

The value of the studies conducted by Vancouver and colleagues (2001, 2002, 2006) and Yeo and Neal (2006) are inherent by implementing many of the suggestions of previous self-efficacy researchers. Specifically, each of these studies incorporated a range of at least 5 to 29 trials to measure the effects of self-efficacy on performance (Maddux, 1995) and controlled for raw past performance – an argument Vancouver et al. (2001) pointed out that some previous SCT (Bandura, 1986, 2001) research had failed to include (see Feltz & Lirgg, 1998).

Criticisms of Self-efficacy within Social-Cognitive Theory as it Relates to Repeated Performances

When considering the strength of efficacy beliefs as a predictor of performance at the between-person level of analysis, some researchers have found past performance to be the stronger predictor of future performance over time (e.g., Ackerman, Kanfer, & Goff, 1995; Feltz, 1982; Vancouver et al., 2001, 2002). For instance, Feltz (1982) found that as one gained experience on a back-diving task, past performance had a greater predictive association with self-efficacy than self-efficacy had with performance, and that after the first trial, performance on previous trials was the major predictor of performance on the next trials. However, as Feltz et al. (2008) noted, the performance conditions in the Feltz (1982) and previously cited studies were invariant, and that when conditions are more varied over time, efficacy beliefs are the stronger predictors of performance (e.g., George, 1994; Lee, 1986; Myers, Feltz, et al., 2004).

Furthermore, Bandura (1997) countered that comparing the predictive strength of self-efficacy and past performance on future performance is not useful to understanding the psychosocial determinants of performance. As he stated, "performance is not the cause of performance" (p. 395). However, if past performance is to be compared with self-efficacy beliefs, Bandura (Bandura, 1997; Bandura & Locke, 2003) argued that the psychosocial aspects that are embedded in a performance score should be statistically partialled out (i.e., residualize past performance). This argument is based on the notion that a performance score is a "conglomerate index" that, as Feltz et al. (2008) note, includes efficacy beliefs as well as other psychosocial factors (e.g., goal effects) operating at the time. In fact, when Feltz, Chow, and Hepler (in press) reanalyzed the Feltz (1982) data using residualized past performance scores, results showed that past performance was not as strong as self-efficacy in predicting performance over time.

Of course, Vancouver and his colleagues have criticized self-efficacy beliefs as having a negative effect on performance when measured on an intraindividual basis across time (Vancouver et al., 2001, 2002). Even Bandura has recognized the role of complacency when discussing self-efficacy and performance in longitudinal methodological designs (Bandura, 1977, 1997). In addition, Bandura himself found a negative relationship between the "superior condition" – a randomly assigned group of participants who received comparison feedback that aligned with their treatment condition – and performance when examining organizational decision-making at the within-person level over time. (Bandura & Jourden, 1991). Specifically, the "superior condition" group of simulated organization decision-makers suffered a decline in their performance over the progressive phases used in this study. Because of this finding, Bandura and Jourden stated, "Complacent self-assurance creates little incentive to expand the increased effort needed to attain high levels of performance" (p. 949); exactly what Powers (1991) argued and other researchers supported (Mizruchi, 1991; Stone, 1994; Trafimow & Sniezek, 1994).

Vancouver (2005) has also criticized SCT (Bandura, 1986, 2001) for placing too much emphasis on the cognitive processes that determine behavior. Vancouver (2005) contends that today's cognitive researchers entered the field of psychology when it was dominated by acognitve approaches; thus, it was natural for these researchers to counter the dominance that existed in the field. However, to a new generation of researchers, utilizing cognitive processes to explain behavior is over used (e.g., Bargh & Chartrand, 1999; Wegner & Wheatley, 1999). Specifically, PCT (Powers, 1978, 1991) researchers argue that non-conscious thought, which is not acognitive, plays a vital role in determining behavior for human systems. Vancouver (2005) notes that PCT can explain nonconscious processes (e.g., see the previous example of body temperature regulation), whereas in SCT and goal-setting theories explanation regarding how these processes operate is absent. "Thus, if we wish to be more complete in our analysis, it seems that both types of processes need to be given consideration" (Vancouver, 2005, p. 45).

Finally, though Vancouver and associates (2001, 2002) acknowledge that many meta-analyses show a positive relationship between self-efficacy and performance (Bandura & Locke, 2003; Moritz et al., 2000; Stajkovic & Luthans, 1998), these results have glaring flaws. According to PCT (Powers, 1978, 1991) theorists, these meta-analyses are suspect for two main reasons. First, PCT is viewed as a complementing, not contrasting, theory to SCT (Bandura, 1986, 2001) in that both theories agree self-efficacy positively affects performance when measured between-people over time. Thus, PCT researchers have no disagreement with the findings that show higher self-efficacy produces a better performance for individuals, when compared to participants with lower self-efficacy scores. Secondly, by employing methods that sometimes failed to control for raw past performance and did not employ the advantages of MLM (see Lindsley et al., 1995) to measure self-efficacy and performance, true causal relationships between these constructs are unknown. Heeding the advice from Maddux (1995), PCT contends that longitudinal (within-person) research – that controls for raw past performance – is necessary to understand the self-efficacy/performance relationship.

Criticisms of Perceptual Control Theory

In the past psychological control theorists have borrowed many concepts from engineering versions of control theories, thus creating the perception that while control theories could be well applied to machines, their explanatory powers were limited with humans (Powers, 1978). While Vancouver (2005) refuted this claim, no recent work conducted by Vancouver and colleagues (2001, 2002, 2006) or Yeo and Neal (2006) has been set in a sporting context. In fact, for every study, except Vancouver and Kendall (2006), participants completed highly analytical computer game simulations. Therefore, these tests provided no (or very limited) new information for self-efficacy in humans, because it was impossible to separate an individual's correct discernment of a solution from a total guess (Bandura & Locke, 2003).

SCT (Bandura, 1986, 2001) has hypothesized that higher levels of self-efficacy will result in a more desirable behavior and/or a greater performance. To optimize a situation in favor of this hypothesis, Feltz et al. (2008) recommend that people have incentive to act on their efficacy beliefs when they possess the required skills, that the nature of the task is clear, and the measures used for obtaining self-efficacy and performance data are unambiguous as possible. Furthermore, to accurately measure the self-efficacy/performance relationship, "Self-efficacy and performance should be assessed at significant junctures in the change process to clarify their reciprocal effects on each other" (Bandura, 1977, p. 194). Repeatedly testing individuals in a disconnected activity structure, such as previous PCT research has done, results in performance feedback that is not transferable or controllable from one task to the next (Bandura & Locke, 2003). Thus, self-efficacy measured in this manner could produce a negative relationship with performance.

The most crucial criticism of PCT (Powers, 1978, 1991) is that previous studies neglected important methodological considerations. For example, as noted previously, Bandura and Locke (2003) claim that incorporating raw past performance into a model overcontrols for past performance. Specifically, the authors argue that the self-efficacy effects of previous trials should be partialled out of prior performances (i.e., by residualizing past performance) when testing for the predictive strength of past performance and self-efficacy in subsequent trials. This method is ideal because simply including the raw past performance of an individual provides a measure that is a mix of psychosocial factors that are unmeasured at that time point.

In this same article, Bandura and Locke (2003) challenge the tasks selected by Vancouver et al. (2001, 2002) for participants to complete. First, they mention that meaningful tasks that permit progressive changes in perceived self-efficacy and performance must be employed, because in a series of disjointed activities there is nothing that can be learned as one progresses to the next task. Second, the environment must be dynamic. Specifically, when nothing changes in the environment – in which one is being tested – performance usually stabilizes. This consistency will then produce a "false" finding that past performance is the cause of current performance. Lastly, even when a negative relationship was found between self-efficacy and performance by Vancouver et al. (2001, 2002), what benefits did these studies offer to people in the realities of the world in which they cope? Bandura and Locke implore Vancouver and colleagues (and other future researchers) to test the self-efficacy/performance relationship in more meaningful real-life conditions, so that true relationships between these variables can be known. Finally, the results of Vancouver and associates may be internally flawed because the self-efficacy measure was not concordant with the performance test. In the work conducted by Vancouver et al. (2001, 2002), participants were asked "how likely" it was that they would be able to find a solution to the next task. The methodology of measuring "luck" and "guesses" did not accurately assess self-efficacy, according to a multitude of SCT researchers (Bandura & Locke, 2003; Feltz, et al., 2008; Moritz et al., 2000).

In addition to these criticisms, Vancouver and colleagues' (2001, 2002, 2006) work also suffers from findings that do not completely support a negative relationship between self-efficacy and performance. Specifically, in 2001, Vancouver et al. reported that self-efficacy and personal goals negatively related to performance, but, "These analyses were conducted within trial types (pre- and postmanipulation) and do not account for the significant differences in performance (or personal goals) associated with the manipulation" (p. 614). In their 2002 work, Vancouver and associates confirmed a negative relationship between self-efficacy and performance, but noted that for all participants, performance generally worsened over time. Finally, when not controlling for the goal level of participants, in a classroom exam environment, self-efficacy was only non-significantly related to performance in the negative direction (Vancouver & Kendall, 2006).

SCT (Bandura, 1986, 2001) scholars firmly believe that research supports the notion that having high self-efficacy not only yields better performances, but produces athletes who are not afraid to set challenging goals and persevere through setbacks (Feltz et al., 2008). This distinction is important because if it was truly the input into a system and a person's desire to reduce the discrepancy between their efficacy judgments and perceived ability that explained behavior (as in PCT, Powers, 1978, 1991) one would expect to see significant overconfidence for athletes with high self-efficacy and an eventual downturn in performance. Such is not the case for the most elite level athletes at the college and professional levels.

Remaining Knowledge Gaps

In one article, which was neither written in a SCT (Bandura, 1986, 2001) or a PCT (Powers, 1978, 1991) framework, a hypothesis was presented for performance over time and the researchers advocated for specific methodological designs. The thesis of this article by Lindsley et al. (1995) was that the self-efficacy/performance relationship was a positive, cyclic cycle that over time became a deviation-amplifying loop. For the latter, when a performance became sub-par a corresponding reduction in self-efficacy resulted, which in turn produced an even worse future performance. The authors argued that over time, self-efficacy and performance must follow either a positive spiral, a negative spiral, or a self-correcting spiral – where a decrease in performance and self-efficacy is followed by an increase in self-efficacy or performance. According to Lindsley et al., each spiral needs to contain at least three time points and these relationships can best be measured by employing MLM where individuals, groups, and even organizations can be analyzed simultaneously. Answering the question as to which spiral is the best, the authors caution that positive spirals (which SCT postulates) may not be beneficial because they will be positively related to overconfidence and result in an upcoming negative spiral. Furthermore, spirals can occur even if the tasks participants are engaging in are well learned, which is usually the case in sporting contexts. Therefore, to achieve maximum long-term learning, and resulting high performance, failures need to be encountered by participants and corresponding adjusts made.

Bandura (1977) has always argued that the relationships between self-efficacy and performance affect each other as, "Mastery expectations influence performance and are, in turn, altered by the cumulative effect of one's efforts" (p. 194). When applied to sport scenarios, this recursive relationship can help to explain winning and losing streaks, overconfidence, and even performance spirals (Lindsley et al., 1995; Mizurchi, 1991; Stone, 1994). Additionally, the work of Yeo and Neal (2006) was an important step beyond that of Vancouver and associates (2001, 2002, 2006), because the former authors attempted to include all requirements listed by Bandura and Locke (2003) into their study. However, even though a flight simulator game was used that offered the potential for progressive changes in self-efficacy and performance, the requirements of testing participants at a task in which people have incentive to act on their efficacy beliefs (Feltz et al., 2008) and allowing for a greater amount of time in between trials (Maddux, 1995) was abandoned in this and previous PCT (Powers, 1978, 1991) research. Because of the lack of research integrating the necessary components of SCT (Bandura, 1986, 2001), the arguments by Bandura and Locke (2003) that, "An organism that is focused solely on regulating perceptions would not survive for long" (p. 92) has yet to be challenged. Therefore, the current status of the self-efficacy/performance relationship for individuals over time remains in doubt. Numerous studies have found support for the positive relationship of self-efficacy and performance in individual and team sports using path analysis and structural equation modeling (e.g., Feltz, 1982, 1988; Feltz & Mugno, 1983; Feltz et al., 2008; George, 1994; McAuley, 1985; Moritz et al., 2000; Myers, Feltz, et al., 2004; Myers, Payment, et al., 2004). However, in the past 7 years, more studies than ever have questioned this assumed positive relationship and produced strikingly different findings (Vancouver & Kendall, 2006; Vancouver et al., 2001, 2002; Yeo & Neal, 2006). This dissertation has attempted to add to the knowledge base of this debate by taking methodological steps yet to be included in previous work.

CHAPTER THREE

Method

Participants

Participants for this study were 115 Division I collegiate-level football athletes at five different Division I, 4-year universities across the United States. Participants' ages ranged from 19 – 23 (M = 20.55, SD = .97) and the dominant ethnicity represented was Caucasian (61.7%), with African-American second (29.6%). The football position that each participant played was self-reported in one of two categories: bigs or skill. Bigs (n = 70) comprised offensive linemen, defensive linemen, linebackers, and tight ends. Skill players (n = 45) encompassed quarterbacks, running backs, wide receivers, defensive backs, place kickers, and punters. Though position played was not a focal point of this study, these two groups are commonly used by strength coaches around the country because each group has different demands in the sport of football. Furthermore, training and drills are devised to mimic the sport characteristics as closely as possible for each group (Epley, 2004).

Originally, data collection began on 411 athletes, at seven different Division I, 4-year universities for this study. However, because past performance for Time Point #1 (from August 2006) was controlled for in this study, participants who were freshmen in the fall of 2006 were excluded from the data because they had yet to enter college and lacked performance data at this time point. Additionally, during the course of this study one university missed a time point and another university changed testing procedures (e.g., removed the squat exercise from the battery of performance tests); thus, all participants from these schools were excluded. Finally, individual athletes were removed from this study's sample if they failed to complete either the self-efficacy measure and/or squat performance test at any time point due to illness, injury, etc. Therefore, of the final 115 athletes in this study with complete data, sophomores were the highest represented group (40.9%), juniors second (40.0%), and seniors third (19.1%). Participants also self-reported their scholarship status. Athletes who were on some form of athletic scholarship (e.g., full or partial athletic scholarship) comprised 72.2% of all participants, while athletes with no athletic scholarship represented 27.8% of the sample. Data were also gathered on participants' game playing status for the previous season. As with the other demographic measures, this variable was self-reported and revealed that 44.3% of the participating athletes started and/or played 15+ plays in each game, 31.3% of the athletes played 1 – 14 plays in each game, and 24.3% of the athletes received no playing time. Finally, the strength coach recorded the body weight (lbs.) of each participant at the outset of the study. Results showed that the mean body weight was 231.9 (SD = 42.3) for all participants, 255.6 (SD = 35.1) for bigs, and 195.0 (SD = 20.2) for skill players.

All participants in this study engaged in strength training for a minimum of 3 hours per week, under the supervision of their strength coach(es). In addition, only universities that performed a test in the squat a minimum of three separate times during the off-season training period were considered. Finally, participants' data were removed from this study if they suffered an injury in the previous season (or during the current off-season training period) that hampered physical performance at any testing time point.

Instrumentation

Demographics. All athletes completed a demographic questionnaire at Time Point #1 of this study (see Appendix A). This instrument was used to gather information about athletes' university attended, position, age, ethnicity, eligibility, scholarship status, last year's playing status, and any major injuries suffered in the previous season that may impede upcoming strength training tests. Additionally, (at Time Points #2 and #3) all participants completed a shortened demographic questionnaire that only contained items about their name, university, and position, so that athletes' answers could be tracked through the off-season.

Self-efficacy questionnaire for athletes (SEQ-A). To measure the task self-efficacy of athletes for the squat, the SEQ-A (see Appendix B) was developed according to the guidelines put forth by Bandura (2006). The SEQ-A consisted of three questions, in which athletes rated how confident they were in regard to a specific graded statement. Answers for all questions ranged on a 10-point Likert scale, with 0 = not at all confident and 9 = absolutely confident. Specifically, athletes rated their confidence to best their previous performance in the squat by any amount of weight, to best their previous performance by 10 lbs., and to best their previous performance by 20 lbs.

Performance. Performance in strength training was measured by 1RM testing for athletes in the squat. This particular exercise was chosen based upon input from four strength coaches (three current coaches and one former coach) as being the most important for the sport of football, the least technically difficult, and the most often used during the off-season.

Procedures

General procedures. Following approval from the Institutional Review Board, strength and conditioning departments and/or general athletic directors across the country were contacted about participation in this study ($N = 241$). If approval was granted from the strength and conditioning/athletic departments, three specific dates were set by the researcher and strength coach for surveys to take place ($n = 7$, though this number was later reduced to $n = 5$ because of the previously discussed reasons). These specific dates were fairly uniform across all participating universities: the first time point occurred in January 2007, the second in March of 2007, and the final time point in late July or early August of 2007. At the outset of the study, the strength coach decided if it was more convenient for paper packets to be distributed at each time point or if athletes should complete the designated questionnaires over the internet using www.surveymonkey.com, a survey design website. To participate in this study using the second option, the strength coach (or a football administrator) furnished the researcher with e-mail addresses of all potential participants to facilitate future contact. Two of the five universities in this study chose to have athletes report demographic and confidence information in this manner. Finally, for each time point, strength coaches were asked to send performance results of athletes to the researcher.

Time Point #1 – paper packets. One week before Time Point #1, the researcher sent out packets containing an informed consent (see Appendix C), demographic questionnaire, and SEQ-A to an assistant strength coach designated to administer the questionnaires. For each university that participated via paper packets, the assistant strength coach had to either have completed a master's degree or currently be in graduate school at the doctoral level so that they would be familiar with the informed consent process and could protect the confidentiality of the data. From this assistant (and the directions given by the researcher in each packet, see Appendix D), athletes learned about the nature and goals of the study and then had the option to participate. Athletes who agreed to participate in this study were then given a previously described packet to complete no more than 72 hours before their strength training performance tests began.

Upon completion of the packets by all willing participants, the assistant strength coach designated to administer the questionnaires returned all survey packets to the provided box without revealing athletes' answers to any other strength coaches. Head strength coaches at each university also submitted the past performance data from the summer of 2006 and current performance data for all athletes who participated in this study to the assistant strength coach. The provided box containing all data was then mailed back to the researcher through pre-paid address labels. Once returned, all hard copies of packets were entered into a statistical computer program, on a password protected computer and then stored by the researcher in a locked file cabinet to protect the confidentiality of all participants.

Time Point #2 and #3 – paper packets. One week before Time Points #2 and #3, survey packets were again mailed out; however, these packets contained a reduced demographic questionnaire (with only name, university, and position) and the SEQ-A to the same assistant strength coach designated to administer the questionnaires. Athletes who participated once again completed the provided packets no more than 72 hours before strength training performance tests were set to begin. The assistant strength coach designated to administer the questionnaires then returned all questionnaires to the provided box, once again maintaining the confidentiality of athletes' answers. Assistant strength coaches then mailed the provided box back to the researcher through pre-paid address labels. Once questionnaire data were received for each time point, data were entered into a statistical software package on a password protected computer. After data entry, all hard copies of questionnaire packets were stored in a locked file cabinet to protect the confidentiality of all participants. Finally, performance data were sent to the researcher (either by mail or by e-mail) at a later date when the head strength coach compiled the most recent strength training performance results.

Time Point #1 – online. Initially, all athletes' e-mail addresses were provided by the strength coach or a football administrator at the participating university. Potential participants then received e-mail notification, with a specific link they could click on to complete their personalized survey. In addition, the first round of e-mails contained information about the nature and goals of the study and instructions for all participants on how to remove their name from the e-mail listserv if they did not wish to participate in the future. Online surveys at this time point contained an informed consent, demographic questionnaire, and SEQ-A. Each survey remained "open" for athletes to click on and complete starting 72 hours before strength training testing was scheduled to begin. Reminder e-mails were sent to all participants approximately 24 hours before strength training performance tests were set to begin to give participants one final chance to complete the online questionnaire.

On the morning when physical strength tests were slated to begin, for each specific university, questionnaires were "closed" to prevent tampering. Upon completion of the testing time point head strength coaches at each university submitted the past performance data from the summer of 2006 and current performance data for all athletes who participated in this study (by mail or e-mail) so that performance could be measured. All data were then either downloaded, copied and pasted in, and/or manually entered into a password protected computer for future analysis. Finally, no hard copies of participants' data were printed out using this method; thus, all data were stored on a password protected computer and on www.surveymonkey.com, which was protected by a unique password.

Time Points #2 and #3 – online. Seventy-two hours before the beginning of strength training physical tests, e-mail links were again sent out to athletes who did not ask to have their contact information removed from the listserv. This e-mail briefly re-introduced the study and encouraged all potential participants to once again click on an included link to complete their personalized survey. Similar to the paper packet option at these respective time points, the surveys only contained a condensed demographic questionnaire (with name, university, and position) and the SEQ-A. Once again, reminder e-mails were sent to all participants 24 hours before the scheduled strength training testing date to give participants one final chance to complete the online questionnaire.

In the morning of the scheduled physical testing date, for each specific university, questionnaires were "closed" to prevent tampering. All data were then downloaded onto a password protected computer for future analysis. No hard copies of data were printed out using this method; thus, all data were stored on a password protected computer and on www.surveymonkey.com. Finally, the head strength coach mailed or e-mailed performance data to the researcher at a later date when performance results were compiled and these data were entered into a statistical software program for future analysis.

General follow-up procedures. Once all data from Time Points #1, #2, and #3 were collected and entered by the researcher, data analysis began. Upon discovery of all pertinent results, a website was developed by the researcher and a hyperlink was e-mailed to all head strength coaches at participating universities. This website displayed the results of the specific strength coach's team on all questionnaire measures and performance tests. This website also showcased comparisons between universities based on the data collected by the player positions of bigs and skill players. Care was taken with the development of the website as university names were changed and coded so that only the provider(s) of that data were able to identify their answers. Finally, the website also offered practical tips on how confidence affects performance of athletes (based on research) and what coaches can do to facilitate a healthy relationship between these two variables.

Data Analysis

Following data collection and entry at all time points, self-efficacy data from the SEQ-A were averaged for each participant, thus creating one composite self-efficacy score per athlete per time point. Data were then analyzed in a traditional software package (SPSS) for outliers, to obtain descriptive statistics, and conduct any necessary transformations. Findings revealed that no outliers were present among self-efficacy or performance scores at each time point. Furthermore, all data were normally distributed, as the average self-efficacy at Time Point #1 displayed the most severe skewness score (-1.13) and average self-efficacy at Time Point #3 exhibited the largest kurtosis score (.76). Once complete, data were exported to Hierarchical Linear and Nonlinear Modeling (HLM v6.04: Raudenbush, Bryk, & Congdon, 2007) for further analysis.

To best explore the relationships that existed between self-efficacy and squat performance among athletes, MLM was employed. MLM presents itself quite regularly in social science research questions when, specifically, psychologists are interested in how characteristics of individuals manifest themselves over time in relation to a dependent variable (Raudenbush & Bryk, 2002). In this type of study, the problem is two-fold as individuals were measured for growth (or change) over a period of time and differences between individuals – based on characteristics measured – were used to compare progress against others in the study (i.e., growth was measured at the first level by fitting slopes to individuals' squat performance over time and interindividual differences of both means and covariances relating to squat performance were analyzed at the second level, simultaneously, as a basis of comparison). Without utilizing MLM, a researcher is left with two choices: to disaggregate all variables to the lowest level of measurement (i.e., within-person measures over each period of time) or to aggregate all the within-person measures to the higher level and perform the analysis at this level (Park & Schutz, 2005). Both options have significant drawbacks; the first violates the interdependence assumption required for traditional statistical analysis, as different measures of the same person are obviously related. The second disregards any within-person information, which may make up a significant portion of the total explained variance and/or have the ability to answer the research question(s) of interest (Yeo & Neal, 2006).

Therefore, in this study where various time points were "nested" within one individual and research questions posed were also based on differences between individuals, MLM provided an advantage over traditional repeated measure tests (Pfeiffer, Dowda, Dishman, Sirard, & Pate, 2007). Specifically, the earlier question of whether the appropriate level of analysis was utilized for a study employing MLM becomes a moot point because, "Multilevel modeling techniques offer researchers the opportunity to not only analyze their data in a more technically appropriate manner than traditional singlelevel methods allow, but also to extend the range of research questions to add contextual richness and complexity" (Duncan, Duncan, Okut, Strycker, & Hix-Small, 2003, p. 248).

In addition to MLM, this study also used a linear growth model for both within- and between-person analysis. According to Singer and Willett (2003), three important features of a study can reveal if the data are suited for this type of analysis: (a) three or more waves of data; (b) an outcome whose values change systematically over time; and (c) a sensible metric for clocking time. Again, this study met these requirements; and thus, a linear growth model, utilizing MLM, was the statistic of choice.

One important component of devising equations in MLM (see Chapter 4 for equations used in this study) is the process of centering. In quantitative research, variables need to have meaning to the researcher and readers so that results can be better understood. In MLM, this is crucial because the intercepts and slopes of Level 1 predictors become the outcome variables at Level 2 (see Raudenbush & Bryk, 2002 for a more complete review). While centering is optional in MLM, doing so with meaningful interval data generally improves the interpretability of the intercept (Singer & Willett, 2003). In HLM v6.04 (Raudenbush et al., 2007) there are three choices when entering variables into an equation: leaving the data uncentered, group mean centering the data, or grand mean centering the data.

Uncentered data may be beneficial with specific types of data or variables. One example is the variable of *TIME* that presents itself in this study. By leaving *TIME* uncentered, the value of 0 is equal to each athlete's past performance from the summer of 2006, before self-efficacy measures were taken. Consequentially, values of 1, 2, and 3 for *TIME* reflect the time points when athletes were measured on self-efficacy and performance. Centering this variable offers no benefit because examining the raw differences over time points is a research question of interest.

For the other two types of centering, it is important to consider the effect that centering the intercept will have on the corresponding slope (Raudenbush & Bryk, 2002). Group mean centered data are when a constant (e.g., in this study the time point's mean for the variable in question) is subtracted from a predictor to alter its parameter's meaning. This option is only available at Level 1, because it is impossible to group mean center Level 2 outcome variables. Grand mean centered data are when a constant (e.g., the overall mean of the variable in question across all time points) is subtracted from a predictor to alter its parameter's meaning. Leaving the variables of self-efficacy and past performance in the squat uncentered in this study would lead to nonsensical results because data reported for these variables rarely (if ever) extended all the way down to a score of 0. Furthermore, had these variables been left uncentered, the fitted intercept would estimate a participant's performance for values such as a self-efficacy composite score of 0 at each time point and a past performance of 5 lbs. in the squat, both of which a collegiate football athlete could not report as a participant in this study (Singer & Willett, 2003).

As Singer and Willett (2003) stated, "Recentering works best when the centering constant is substantively meaningful – either because it has intuitive meaning for those familiar with the predictor or because it corresponds to the sample mean" (p. 114). Group mean centering (for the variables of self-efficacy and past-performance in squat) was the best option for this study at Level 1 because each time point was examined individually; thus, grand mean centering data at Level 1 would have clouded the results by subtracting the same constant from each participant's score at each time point. Grand mean centering was chosen for Level 2 predictors of self-efficacy and past-performance in the squat because of the improvement to better interpret the intercept. *TIME* was the only variable to be left uncentered in this study for the reasons previously discussed. Finally, as implied, raw past performance was controlled for by simultaneously entering this variable into the model along with self-efficacy and current performance data (see Chapter 4 for complete models).

CHAPTER FOUR

Results

Variable Correlations

Subsequently outlined are the descriptive statistics for variables measured in this study. Table 1 highlights Cronbach's Alphas and mean self-efficacy scores for the graded self-efficacy statements in the SEQ-A at each time point and when aggregated to Level 2. As shown, the Cronbach's Alphas for the SEQ-A varied little at Level 1, as it only ranged from $\alpha = .92$ at Time Points #1 and #3 to $\alpha = .93$ at Time Point #2. These results are more than sufficient for a study of linear change (Singer & Willett, 2003). To develop a self-efficacy composite score for each participant at each time point, a mean self-efficacy score from the SEQ-A at each time point was computed.

Table 2 shows the means, standard deviations, and intercorrelations for all 115 participants across trials and Table 3 highlights this same information, condensing all time points. Results from these analysis revealed that any correlation between self-efficacy and current performance was almost non-existent, a finding that is contradictory to most previous research conducted (George, 1994; Kane et al., 1996; Feltz & Lirgg, 1998; Vancouver et al., 2001; Yeo & Neal, 2006). In fact, only Vancouver et al. (2002) reported correlations similar to the results found in Tables 2 and 3. Noticing that current performance was highly correlated with past performance, it was possible that past performance was a suppressor variable, which "hid" the correlations between self-efficacy and current performance. In other words, the greater the relationship between past performance and current performance, the less self-efficacy and current performance would correlate. To rectify this problem, partial correlations were run controlling for past

Table 1

Cronbach's Alpha's for the SEQ-A

Level 1 *(N = 115)*

	α	*M* SE Composite	*SD*	*M* SE #1	*M* SE #2	*M* SE #3
Time Point #1	.92	6.80	2.24	7.42	6.89	6.09
Time Point #2	.93	6.62	2.41	7.30	6.70	5.87
Time Point #3	.92	6.83	1.87	7.63	7.03	5.82

Note. Self-efficacy is on a 10-point scale, *M* SE Composite = self-efficacy of all athletes for their performance in the squat, *M* SE #1 = self-efficacy of all athletes to best their previous performance in the squat by any amount of weight, *M* SE #2 = self-efficacy of all athletes to best their previous performance in the squat by at least 10 lbs., *M* SE #3 = self-efficacy of all athletes to best their previous performance in the squat by at least 20 lbs.

Level 2 *(N = 115)*

	M SE Overall	*SD*
SEQ-A Composition Model	6.75	1.62

Note. Self-efficacy is on a 10-point scale, *M* SE Overall = self-efficacy of all athletes for their performance in the squat across all time points.

Table 2

Descriptive Statistics for Self-efficacy and Squat Performance

Level 1 ($N = 115$)

	M	SD	1	2	3	4	5	6	7
1. Self-efficacy 1	6.80	2.24	—						
2. Self-efficacy 2	6.62	2.41	.48**	—					
3. Self-efficacy 3	6.83	1.87	.20*	.28**	—				
4. Performance 0	391.10	72.02	-.10	-.19*	-.04	—			
5. Performance 1	431.85	79.42	.04	-.16	-.04	.95**	—		
6. Performance 2	456.88	80.10	.03	.02	-.01	.87**	.91**	—	
7. Performance 3	459.17	81.88	-.09	.07	.02	.75**	.80**	.85**	—

Note. Self-efficacy is on a 10-point scale, performance is measured in US pounds (lbs.).

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

Table 3

Descriptive Statistics for Overall Self-efficacy, Past Performance, and Squat Performance

Level 2 *(N = 115)*

	M	*SD*	1	2	3
1. Overall Self-efficacy	6.75	1.62	___		
2. Overall Past Performance	426.61	74.85	-.03	___	
3. Overall Performance	449.30	76.40	-.08	.97**	___

Note. Self-efficacy is on a 10-point scale, past performance and performance are measured in US pounds (lbs.).

$^{**}p < .01$.

performance (and self-efficacy) at each time point (see Figure 3) and with overall variables (see Table 4). Findings showed that correlations between self-efficacy and performance greatly improved in the subsequent analyses. Therefore, there was a significant amount of shared variance between the three variables in question and leaving past performance uncontrolled for did not accurately depict the relationship between self-efficacy and performance (i.e., the self-efficacy/performance relationship for the squat exercise was dependent on past squat performance). Finally, as discussed further in Chapter 5, team level comparisons using HLM v6.04 (Raudenbush et al., 2007) were not possible because only five universities participated in this study, resulting in too low of a sample size for Level 3 analysis. However, descriptive statistics of important variables by university could be calculated and these results appear in Table 5.

Unconditional Means Model

Before model fitting could begin in HLM, an unconditional means model was first run to examine the variance of athletes' performance in squat (Singer & Willett, 2003). The unconditional means model entered and run in HLM v6.04 (Raudenbush et al., 2007) for this study appears below:

$$\text{PERF\_SQU} = \pi_{00} + e_{ij}$$

Based on the random effect, the average performance in the squat varied significantly across individuals, $\chi^2(114, N = 115) = 1691.31, p < .001$. Additionally, these results from the model also revealed that 93.3% of the variance that was present for athletes around the intercept was systematic and not error.

In addition to the variance around the intercept that the unconditional means model reported, this same model was also used to evaluate the within-person and

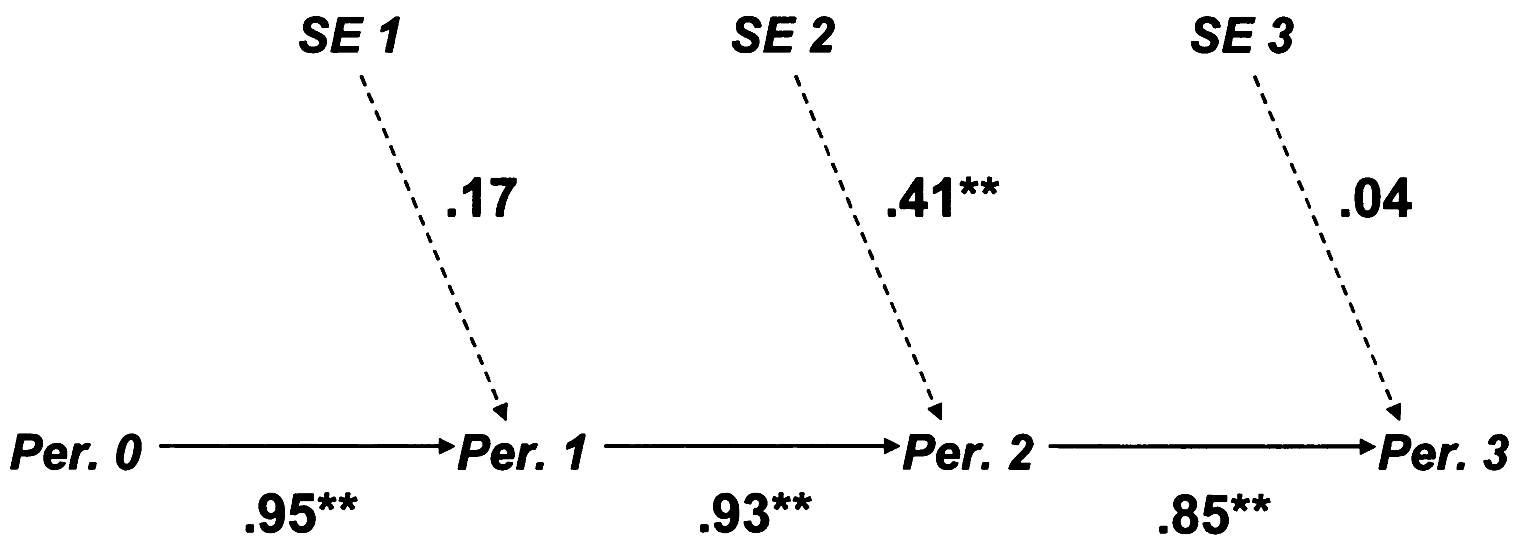

Figure 3. Partial Correlations for Self-efficacy and Performance across all Time Points. Note. SE = self-efficacy at a specific time point, Per. = performance at a specific time point.

*p < .05, **p < .01.

Table 4

Partial Correlations for Overall Self-efficacy and Squat Performance

Level 2 *(N = 115)*

	M	*SD*	1	2
1. Overall Self-efficacy	6.75	1.62	___	
3. Overall Performance	449.30	76.40	.20*	___

Note. Self-efficacy is on a 10-point scale, performance is measured in US pounds (lbs.), and overall past performance was a control variable.

$*p < .05$

Table 5

Means for Self-efficacy and Squat Performance by University

	University A* (n = 9)	University B (n = 20)	University C (n = 31)	University D* (n = 28)	University E (n = 27)
1. *M* Self-efficacy 1	5.78	6.22	6.57	7.65	6.94
2. *M* Self-efficacy 2	7.33	5.92	6.57	6.82	6.77
3. *M* Self-efficacy 3	6.41	5.63	7.09	7.19	7.19
4. *M* Performance 0	358.44	403.00	406.29	377.30	390.00
5. *M* Performance 1	390.33	445.00	455.32	411.96	429.63
6. *M* Performance 2	420.11	474.00	473.39	447.68	447.04
7. *M* Performance 3	428.33	483.00	496.77	419.07	450.19

Note. Self-efficacy is on a 10-point scale, performance is measured in US pounds (lbs.).

*Universities that play football in Division I-AA, which is a smaller subdivision of Division I collegiate football.

Table 6

Standard Deviations for Self-efficacy and Squat Performance by University

	University A* (n = 9)	University B (n = 20)	University C (n = 31)	University D* (n = 28)	University E (n = 27)
1. *SD* Self-efficacy 1	3.51	1.65	2.54	1.83	1.92
2. *SD* Self-efficacy 2	1.47	2.56	3.12	2.17	1.79
3. *SD* Self-efficacy 3	1.91	2.33	1.89	1.64	1.36
4. *SD* Performance 0	83.52	74.49	80.35	62.83	63.49
5. *SD* Performance 1	86.84	76.33	92.09	68.11	68.23
6. *SD* Performance 2	87.20	72.56	91.35	74.01	73.63
7. *SD* Performance 3	90.72	76.22	87.24	68.23	68.82

Note. Self-efficacy is on a 10-point scale, performance is measured in US pounds (lbs.).

*Universities that play football in Division I-AA, which is a smaller subdivision of Division I collegiate football.

between-person variance components, or intraclass correlation coefficient (ICC, ρ). Results of this test revealed that $\rho = 0.82$, which means that 82% of all the variance in squat performance scores was located at the between-person level, while 18% of the variability was at the within-person level. Because the goal of this study was to explain the relationship between self-efficacy and performance, the information presented showed that HLM was an appropriate statistic to run because variance was located at both the within-person and between-person levels.

Unconditional Growth Model

According to Singer and Willett (2003), if results from the unconditional means model show that HLM is an appropriate statistic to use when analyzing data, the next step is the addition of the variable, *TIME*, thus creating an unconditional growth model. Including *TIME*, and comparing the resulting sigma-squared (σ^2) with the unconditional means model's σ^2 illustrated whether the change in squat performance is linear over the course of all time points. In the unconditional growth model, $\sigma^2 = 998.01$, which was reduced from 1180.22 in the unconditional means model. This decrease in σ^2 revealed that 15.4% of the within-person variation in squat performance was associated with the *TIME* predictor. However, this simple linear increase in performance was not the best model, as important variation still remained undiscovered, $\chi^2(114, N = 115) = 2000.11$, $p < .001$.

Model Building and Hypothesis Testing

It was hypothesized that according to SCT (Bandura, 1986, 2001), the relationship between self-efficacy and squat performance would be positive at both the within-person and between-person levels. In contrast, Powers (1978, 1991), Vancouver and colleagues

(2001, 2002, 2006), and Yeo and Neal (2006) postulated, based on PCT, that self-efficacy and performance would have a negative relationship at the within-person level and a positive relationship at the between-person level. To initially test this hypothesis at the within-person level, the following Level 1 model was built:

$$\text{Level 1: } Y_{ij} = \pi_{0j} + \pi_{1j}(\text{TIME}) + \pi_{2j}(\text{SE\_SQUAT}_{ij} - \text{SE\_SQUAT}_{j}) + \pi_{3j}(\text{PP\_SQUAT}_{ij} - \text{PP\_SQUAT}_{j}) + e_{ij}$$

In this model, Y_{ij} is the squat performance at Time i for athlete j, π_{0j} is the Level 1 intercept, π_{1j} is the effect of *TIME* for each athlete, π_{2j} is the effect of self-efficacy for each athlete, π_{3j} is the effect of raw past performance for each athlete, and e_{ij} is the error associated at each time point for each athlete measured. Results revealed that raw past squat performance was a significant predictor for current performance, $t(341) = 2.18, p = .03$. Additionally, *TIME* and self-efficacy were positive factors of current performance and approached significance in this model, $t(341) = 1.62, p = .11$; $t(341) = 1.57, p = .12$, respectively. The final estimation of variance components for this model showed that even with Level 1 predictors, a significant amount of variance was left to be explained, $\chi^2(114, N = 115) = 2046.49, p < .001$; thus, the addition of Level 2 predictors was warranted. Complete results of this model are found in Table 6.

Upon discovery of the best Level 1 model (presented previously), Level 2 predictors of self-efficacy and past-performance were added to fully test the two competing theories. In this model, the Level 1 predictors remained the same and the following Level 2 equation was added:

Table 7

Level 1 Model for Squat Performance

Fixed Effect	Parameter	Coefficient	*SE*	*df*	*t*
Intercept	β_{00}	435.99	10.85	114	40.18***
Time	β_{10}	6.65	4.10	341	1.62
Self-efficacy	β_{20}	2.07	1.32	341	1.57
Past Performance	β_{30}	.21	.10	341	2.18*

Random Effect	Parameter	Variance Component	*SD*	*df*	χ^2
Mean Performance	r_{0j}	5511.49	74.24	114	2046.49***
Level 1 Effect	e_{ij}	975.39	31.23		

*$p < .05$, ***$p < .001$.

$$\text{Level 2: } \pi_{0j} = \beta_{00} + \beta_{01}(\text{M\_SE\_SQUAT}_j - \text{M\_SE\_SQUAT}) + \beta_{02}(\text{M\_PP\_SQUAT}_j - \text{M\_PP\_SQUAT}) + r_{0j}$$

$$\pi_{1j} = \beta_{10}$$

$$\pi_{2j} = \beta_{20}$$

$$\pi_{3j} = \beta_{30}$$

At Level 2, all Level 1 variables became outcome variables, thus β_{00} is the average intercept for all athletes, β_{01} is the effect of mean self-efficacy of all athletes, β_{02} is the effect of mean raw past squat performance of all athletes, r_{0j} is the Level 2 error associated with the intercept, β_{10} is the effect of linear practice or *TIME*, β_{20} is the effect of self-efficacy, and β_{30} is the effect of raw past squat performance. Because the advantage of HLM is that Level 1 and Level 2 predictors are simultaneously run during analysis, the complete model tested was:

$$\text{PERF\_SQU} = \beta_{00} + \beta_{01}(\text{M\_SE\_SQUAT}_j - \text{M\_SE\_SQUAT}) + \beta_{02}(\text{M\_PP\_SQUAT}_j - \text{M\_PP\_SQUAT}) + \beta_{10}(\text{TIME}) + \beta_{20}(\text{SE\_SQUAT}_{ij} - \text{SE\_SQUAT}_j) + \beta_{30}(\text{PP\_SQUAT}_{ij} - \text{PP\_SQUAT}_j) + r_{0j} + e_{ij}$$

The results from this model are presented in Table 7. Raw past performance was a highly significant predictor of current performance at the between-person level, $t(112) = 30.85$, $p < .001$. Furthermore, as both SCT and PCT expected, results showed that when controlling for raw past performance, self-efficacy was positively related to current performance at the between-person level, $t(112) = 2.71$, $p < .001$. Within-person results showed that when controlling for raw past performance the effect of self-efficacy on current squat performance remained non-significantly positive, $t(339) = 1.57$, $p = .12$.

Table 8

Multilevel Model for Squat Performance

Fixed Effect	Parameter	Coefficient	*SE*	*df*	*t*
Intercept	β_{00}	435.99	7.43	112	40.18***
Aggregated SE	β_{01}	2.27	.84	112	2.71***
Aggregated PP	β_{02}	.99	.03	112	30.85***
Time	β_{10}	6.65	4.10	339	1.62
Self-efficacy	β_{20}	2.07	1.32	339	1.57
Past Performance	β_{30}	.21	.10	339	2.18*

Random Effect	Parameter	Variance Component	*SD*	*df*	χ^2
Mean Performance	r_{0j}	10.48	3.24	112	114.62
Level 1 Effect	e_{ij}	971.37	31.17		

**p* < .05, ****p* < .001.

Furthermore, the effect of linear practice, or *TIME*, also remained constant, $t(341) = 1.62$, $p = .11$. Important to note is that with the addition of time, self-efficacy, and past performance the final estimation of variance components revealed that additional predictors were needed to explain remaining variance, $\chi^2(114, N = 115) = 114.62, p = .41$. However no further predictors collected for this study (demographic or otherwise) yielded significant values when included in the multilevel model.

Variance Explained

Based on the complete Level 1 and Level 2 model previously tested, the amount of variance explained at both within-person and between-person levels was calculated related to squat performance. As shown in Table 8, 85% of the total squat performance variance could be accounted for with the all predictors included. Level 1 predictors accounted for 17.4% of the within-person difference in squat performance (or 3.1% of the total variance after multiplying by the variability at the within-person level; 1 – ICC). The inclusion Level 2 predictors only yielded an additional 0.3% explanation of the within-person difference in squat performance scores (or 0.1% of the total variance after multiplying by within-person variability). Likewise, 99.8% of the variance between athletes' squat performance (or 81.8% of the total variance after multiplying by the ICC) was explained by aggregated self-efficacy and raw past performance scores, while no variance in squat performance scores between athletes was explained by only Level 1 predictors.

Alternative Analyses

In this chapter, only the final analysis previously discussed, and conducted with HLM v6.04 (Raudenbush et al., 2007), has been described in detail. In spite of the many

Table 9

Squat Performance Variance Explained

Predictors	Within-Person Level (σ^2)	Between-Person Level (τ_{00})
No predictors	1180.22	5443.22

Predictors	Within-Person Level (σ^2)	Between-Person Level (τ_{00})
Level 1 Only	975.39	5511.49
Percent of Level Variance	17.4%	___
Percent of Total Variance	3.1%	___

Predictors	Within-Person Level (σ^2)	Between-Person Level (τ_{00})
Levels 1 and 2	971.37	10.48
Percent of Level Variance	17.7%	99.8%
Percent of Total Variance	3.2%	81.8%

transformations, stratifications, and additional techniques explored, the results presented in this chapter offered the clearest picture of how self-efficacy affected performance in the squat exercise. For example, data were screened for evidence of quadratic relationship, but this analysis produced no support for this type of relationship across time points. Another analysis was conducted by residualizing past performance from Time Points #1 and #2 and comparing those results to current performance at Time Points #2 and #3, as Bandura and Locke (2003) and Wood and Bandura (1989) suggested. However, this process removed one wave of data, thus violating one of the principles for a linear growth model (Singer & Willett, 2003). Still a different model built in HLM v6.04 (Raudenbush et al.) examined how self-efficacy affected participants' change scores in squat performance from Time Point #0 to Time Point #1, Time Point #1 to Time Point #2, etc., using percentage of change, percentage of change ×100 (to increase variance), and raw change scores in lbs. In all cases, there was not enough variation in the dependent variable to run a stable model in HLM v6.04 (Raudenbush et al.) and because HLM v6.04 is a more stable statistical software platform than SAS or MLwiN, these analyses were abandoned. Even though normality of data was achieved (see Chapter 3), basic square-root and logarithmic transformations of self-efficacy were performed in an attempt to achieve significance in this predictor affecting squat performance. In each case, results fared worse than raw performance scores and these analyses were discarded. Finally, participants were stratified based on their self-efficacy scores (i.e., those athletes who scored a consistent +/- 1 standard deviation away from the self-efficacy mean – across all participants – at each time point were grouped into a high self-efficacy or low self-efficacy group). Results revealed that for each group, self-efficacy had a nonsignificant effect on squat performance at both the within- and between-person levels, though low *n*'s for each stratified group make any result, utilizing this analysis, questionable at best.

Therefore, a summary of the findings as they relate to the hypotheses as stated in Chapter 1 are as follows:

1. Self-efficacy will positively affect performance at the between-person level when controlling for raw past performance – supported.

2a. As SCT (Bandura, 1986, 2001) contends, self-efficacy will positively predict performance over time when controlling for raw past performance – not supported.

2b. As PCT (Powers, 1978, 1991) argued, self-efficacy will negatively predict performance over time when controlling for raw past performance – not supported.

CHAPTER FIVE

Discussion

Self-efficacy/Performance Relationship at the Between-Person Level

At the between-person level, results supported the predictions of SCT (Bandura, 1986, 2001), PCT (Powers, 1978, 1991), and Hypothesis #1 of this study, in that self-efficacy had a significant and positive relationship with current performance. In addition, this relationship remained strong even when controlling for raw past performance. This finding was not surprising as a multitude of recent studies and meta-analyses have confirmed the significance of self-efficacy to performance at this level of analysis, regardless of the arena in which tests were conducted (Bandura & Locke, 2003; Moritz et al., 2000; Stajkovic & Luthans, 1998; Vancouver & Kendall, 2006; Vancouver et al., 2001, 2002). However, in this study an even stronger predictor of performance at the between-person level was past performance.

As Bandura would note, through previous studies (Bandura & Locke, 2003; Wood & Bandura, 1989), the failure of this dissertation to residualize past performance is most likely the reason for past performance loading as a strong predictor of current performance. Specifically, as argued in Chapter 2, raw past performance provides too conservative of an estimate in regard to the function of self-efficacy on performance; and therefore, is nothing more than, "a conglomerate index encompassing the set of unmeasured sociocognitive factors operating at the time" (Bandura & Locke, 2003, p. 91). Because of the additional 5 months that would have been required to obtain a fourth measurement time point – complete with self-efficacy and performance data – this study chose to control for raw past performance instead of residualized past performance.

Finally, Bandura's notions of residualizing past performance have recently been shown to be accurate as Feltz, et al. (in press) reported that when past performance was residualized, self-efficacy was a stronger predictor of current performance than past performance.

Self-efficacy/Performance Relationship at the Within-Person Level

At the within-person level of analysis, results offered little support for either SCT (Bandura, 1986, 2001) or PCT (Powers, 1978, 1991), though results fared worse for PCT. Specifically, findings regarding the effect of self-efficacy on performance were in the opposite direction of what is proposed in PCT and what Vancouver and colleagues (2001, 2002, 2006) and Yeo and Neal (2006) found. However, similar to the findings of the latter, the inclusion of self-efficacy in the Level 1 model explained only an additional 0.8% of the variance around squat performance, when raw past performance was already present (i.e., 16.6% of the variance explained without self-efficacy and 17.4% of the variance explained with self-efficacy). This is not completely surprising, as Bandura (1997) noted that performance is rarely measured with complete accuracy; thus, other unmeasured factors were present in determining the variance in squat performance of individuals over time. Furthermore, the fact that strength training is a "semi-static" environment probably led to the result that past performance explained a large amount of variance at both the within- and between-person level (Bandura & Locke, 2003). Important to note is that composite self-efficacy scores did represent the mean for each participant at each time point; and thus, were subject to natural centering around the observed mean. However, even evaluated against the most recent studies to examine confidence and performance over time, self-efficacy scores were more homogeneous in this study when compared to Yeo and Neal (2006) and Vancouver and Kendall (2006); though these studies did employ an 11-point self-efficacy measure, which allowed for slightly more change than the 10-point scale used in this study. Therefore, although there was a positive relationship between self-efficacy and performance at the within-person level, it was not significant and explained little additional variance.

Because of the weak self-efficacy effect, within-person findings for this study also supported prior work showing the importance of previous performance in predicting current performance, in sport settings (Carnahan, Shea, & Davis, 1990; Fitzsimmons, Landers, Thomas, & van der Mars, 1991; Watkins, Garcia, & Turek, 1994). These works, coupled with the results of this study, highlight the need for more exploration of the direction of the self-efficacy/performance relationship, within-people over time and with the use of residualized past performance.

At the within-person level of analysis, findings also revealed a general trend of self-efficacy increasing over time. This trend was speculated to exist by Yeo and Neal (2006) if additional practice time was present for participants in between testing time points, though no study incorporating the suggestions of SCT (Bandura, 1986, 2001) and PCT (Powers, 1978, 1991) had methodologically been able to confirm this notion until now. Because of this general increase in self-efficacy and performance over three time points, a positive self-efficacy and performance spiral was found in this study (Lindsley et al., 1995). If true technique learning and skill development did take place for the athletes in this study over the 8 months in which self-efficacy and performance measures were gathered, one would expect this trend to continue. However, this hypothesis remains untested because of the limited time points utilized in the present study and the notion that positive spirals are often related to overconfidence and a subsequent downturn in future performance.

Debate on this topic is far from closed. Most research framing the self-efficacy/performance relationship with PCT (Powers, 1978, 1991) – and the subsequent rebuttals supporting SCT (Bandura, 1986, 2001) – is very young. Even though the vast amount of research supports the hypotheses of SCT, Bandura himself has found a negative relationship between self-efficacy and organizational decision-making performance in the past (Bandura & Jourden, 1991). Additionally, as outlined in Chapter 2, recent prominent studies have also produced findings showing that high self-efficacy may lead to overconfidence and lower future performances (Stone, 1994; Vancouver & Kendall, 2006; Vancouver et al., 2001; 2002; Yeo & Neal, 2006). However, even if one were to ascribe to Vancouver and colleagues' recommendations of reducing within-person self-efficacy to increase a subsequent performance, this measure would also decrease participants' between-person level of self-efficacy when compared to others. Therefore, this action would be in direct contradiction to both PCT and SCT research that claims higher levels of between-person self-efficacy elicit a greater future performance.

Contributions

In the present study, the four most important methodological recommendations of researchers from both SCT (Bandura, 1986, 2001) and PCT (Powers 1978, 1991) were implemented and are discussed below. First, this study used different tasks and populations than previous research to measure the self-efficacy/performance relationship. In recent years, as the debate between SCT and PCT has intensified, Bandura and Locke (2003) and Vancouver et al. (2002) have both called for future studies to use real-world conditions or real-work settings for participants. This was important because many researchers confined their work on self-efficacy and performance to laboratory simulations and then generalized the results beyond the laboratory (Bandura & Locke). In this study, because the day-to-day operations and physical testing dates for athletes in strength training were not altered, the findings have ecological validity.

Second, the methodology of this study incorporated a greater length of time in between each performance test. In past work by PCT (Powers, 1978, 1991) researchers, participants have been both measured and tested on self-efficacy and performance up to 30 times; however these tests occurred in one session (Vancouver et al., 2001; 2002; Yeo & Neal, 2006). While the methodological design of these studies did incorporate a simple task that allowed for some change over time, the invariant conditions present (i.e., the failure of the task at hand to produce progressive changes in participants' perceived self-efficacy) relegated these studies to actually measuring performance over a series of disjointed activities (Bandura & Locke, 2003). In the present study, the task of squat performance for Division I football athletes was a performance measure in which individuals could interact with the material on a consistent basis. This design allowed for participants to display progressive changes in both self-efficacy and performance because of the practice time all participants were allowed in between testing dates (Bandura & Locke). Therefore, because this study benefited by incorporating a greater length of time (i.e., an 8 month period) for all time points, recommendations urged by recent SCT and PCT researchers were integrated (Maddux, 1995; Vancouver & Kendall, 2006; Vancouver et al., 2001; Yeo & Neal, 2006).

Third, the reduced cognitive nature of the selected task utilized in this longitudinal study was a future research suggestion first called for by Vancouver et al. (2002). Specifically, work framed in PCT (Powers, 1978, 1991) has measured participants using computer simulations or classroom exams. Therefore, the self-efficacy/performance relationship remains ambiguous for activities that require physical exertion. Vancouver et al. hypothesized that when individuals are tested in skills/tasks for which competition and/or a desire to succeed come into play and the information provided from the task is vague concerning the hierarchy of goals necessary for a performance, high self-efficacy will likely produce lower performances over time. The previous characteristics described by Vancouver et al. were met in this study as strength training, and performing the squat, requires a great deal of physical exertion; though, being highly proficient at the squat does not necessarily translate to increased football success on the field. However, results of this study refute this previous assumption by Vancouver et al., as higher self-efficacy did not correspond to lower performance for Division I collegiate football players.

Finally, previous research developed in the framework of PCT (Powers, 1978, 1991) assessing the relationships between self-efficacy and performance did not actually measure the construct of self-efficacy (see Bandura & Locke, 2003). Specifically, past research conducted by Vancouver and Kendall (2006) and Vancouver et al. (2001) asked participants to "anticipate your letter grade..." or rate "how likely it was that a solution could be found..." both of which include an element of luck/chance and are not true self-efficacy measures. To correct this problem in past work, this study followed the guidelines put forth by Bandura (2006) and Moritz, et al. (2000), which state that self-efficacy and performance measures must align for this cognitive construct to be accurately calculated. Therefore, the SEQ-A questionnaire phrased graded statements with a stem of, "At this moment how confident are you that you can..." which yielded greater insight into one's true self-efficacy.

Limitations

While this study took important methodological steps to further the knowledge concerning the relationship between self-efficacy and performance over time, limitations were present. As previously discussed, raw past performance – instead of residualized past performance – was implemented, as a baseline control, and composite self-efficacy scores changed little over time. In addition, this study could not observe team differences at Level 3 because of a low number of distinct universities that participated, an important consideration first mentioned by Feltz and Lirgg (1998). While MLM allows for multiple levels of analysis to be conducted simultaneously, it also depends on the variance observed at each level to determine the appropriate size of the sample. Therefore, it is impossible to speculate on the number of teams that would be required to replicate the current study utilizing a 3-Level MLM model.

In the methodology for the present study, a possible limitation may have also been the lapse in time which participants had between recording their self-efficacy levels and performing a 1RM in the squat. Bandura (2006) notes that the self-efficacy/performance relationship is temporal in nature; therefore, changes in confidence could have occurred for athletes during the maximum 72 hour time period between data collection and performance testing. Unfortunately, this methodological issue could not be addressed to the satisfaction of Lirgg and Feltz (2001), who recommend a 24 hour window between self-efficacy measures and performance testing, as 4 of the 5 collegiate strength and conditioning departments who completed all three time points began their performance testing on Monday mornings. Thus, as determined by the majority of participating strength coaches, Friday afternoons were the latest possible time for questionnaires to be completed.

In addition to the maximum 72 hour time lapse between questionnaire completion and performance, a reader may question the congruency of the self-efficacy questionnaire and performance test utilized in this study (see Feltz, et al., 2008; Moritz et al., 2000). Specifically, statements in the SEQ-A asked athletes to respond with their level of confidence in bettering their previous squat performance score, while the MLM equation employed measured squat performance at each time point – while controlling for raw past performance. As discussed in Chapter 4, a variety of performance change scores were devised, but were not able to be calculated in HLM v6.04 (Raudenbush et al., 2007). Because of this fact, the proper correction would have been, for example, to ask participants, "At this moment how confident are you that you can squat 250 lbs." However, this solution was also problematic as athletes' squat scores ranged from 240 lbs. to 655 lbs. across all 3 Time Points and would have resulted in numerous questions on the SEQ-A (i.e., participants would have to respond to the same question in increments of approximately 10 lbs., resulting in at least 45 questions on the SEQ-A).

The final limitation in this study was the fact that data on participants' self-set performance goals were not collected, instead it was assumed that all participants would have the implied goal of improving on their previous performance in the squat. This limitation is important because both SCT (Bandura, 1986, 2001) and PCT (Powers, 1978,

1991) discuss contrasting viewpoints on how goals relate to impeding performances. Without data on participants' performance goals, the ability to measure and compare relationships between goals, self-efficacy, and performance to previous results by Vancouver and Kendall (2006) and Vancouver et al. (2001) was not possible.

The decision to abort the collection of data on participants' self-set performance goals was made for two reasons. First, it is uncommon that coaches in a strength training setting apportion time from the limited 8 hours per week they are allotted by the NCAA (2007) to work on goal setting with athletes. Instead, this restricted amount of time must be used on exercises that will produce actual physical performance improvements. Furthermore, there were two universities in the present study in which athletes were not privy to their estimated 1RM or their past 1RM in the squat during current performance tests. While these athletes might be able to remember their previous performance from 3-4 months ago when a new testing date approached, estimated 1RM's can change weekly based on an athlete's progress.

Future Directions

As alluded to earlier, future work measuring the self-efficacy/performance relationship should residualize the past performance of participants while maintaining the methodological advances achieved in this study (Bandura & Locke, 2003; Wood & Bandura, 1989). Past work by PCT (Powers, 1978, 1991) researchers suffers from this flaw because of the failure to include all previous suggestions into study designs when measuring self-efficacy and performance. For example, Vancouver et al. (2001) used a 3-Level MLM model but failed to accurately measure the construct of self-efficacy. Vancouver and Kendall (2006) employed a real-world task – for their sample of college students – but controlled for raw past performance and questioned the generalizability of their findings because participants could not interact with their performance material (i.e., a college exam) except during performance tests. Yeo and Neal (2006) also used a real-world task; however, they grouped all performance testing so that progressive changes in self-efficacy and performance were impossible to measure. Finally, the present study incorporated all of the methodological concerns previous addressed, except for residualizing past performance; thus, this future direction is the next logical step in research exploring the self-efficacy/performance relationship.

Ideally a longitudinal study should be conducted with MLM, where separate analyses on the same data set are performed, one analysis controlling for raw past performance and one controlling for residual past performance in comparison to current performance. This suggestion is important for two reasons. First, as Pfeiffer et al. (2007) explained, MLM has significant advantages over traditional statistical methods; however, as recently as three years ago, less than 10 studies had incorporated these methods when examining exercise and sport (Park & Schutz, 2005). Secondly, including a third level of analysis in MLM (Level 3 – Team Level) could reveal team differences in self-efficacy that have manifested themselves in performance (see Magyar et al., 2004). Though difficult to obtain because of the large number of distinct teams that would be needed, this information would be quite useful for (strength) coaches in learning about the present psychological make-up of their team and ensuing performance.

This research also reiterates the calls from previous SCT (Bandura, 1986, 2001) and PCT (Powers, 1978, 1991) studies. First, research carried out to date measuring the self-efficacy/performance relationship has largely been conducted with a task unique for a specific group of individuals. Much research is needed that replicates the methodological processes of previous work in more general settings, such as exercise and fitness, with a variety of new and untested populations (Vancouver et al., 2002; Yeo & Neal, 2006). Second, Locke and Sadler (2007) raised the question of how individuals' self-efficacy beliefs are influenced when interpersonal feedback and performance feedback are in conflict. For example, questions remain in sport settings when athletes believe they had a bad performance, but teammates, family members, and/or coaches communicate otherwise. Third, past research involving self-efficacy and performance has been limited to using low value tasks and manipulating participants' self-efficacy (Vancouver et al., 2001, 2002; Yeo & Neal, 2006) or simply observing the relationships between self-efficacy and performance in high value tasks; as was conducted in this study and Vancouver and Kendall (2006). As first suggested by Vancouver and colleagues, future work needs to involve the manipulation of self-efficacy on high value tasks for participants (Vancouver et al., 2001, 2002). Finally, in work conducted by Vancouver and associates throughout the years the focus has been on individuals with high self-efficacy and their resulting performance. Bandura and Locke (2003) point to the gap that exists in explaining the performance of individuals with low self-efficacy. While untested in a sport setting, Bandura (1986, 2001) theorizes that an abrupt withdrawal from the activity in question remains a highly probable outcome. By employing many of the future directions outlined in this section, researchers can advance present knowledge concerning self-efficacy and performance to new levels for sport participants and individuals engaged in exercise performing a variety of tasks in multiple settings.

Regardless of future directions utilized for the impending work on PCT (Powers, 1978, 1991) and SCT (1986, 2001), researchers must be careful when implementing a strong inference approach. In particular, Feltz (1989) has argued that advancing science through the disproof of theories suffers from limitations. Namely, tested theories can be abandoned prematurely if findings do not support the tenants of said theory. This approach can then result in Platt's (1964) "tree logic," where researchers, who reach a decision – or a fork in a knowledge tree – must choose to go either left or right. Once a choice is made, another fork soon presents itself and researchers must again make the same choice. This example highlights the shortcomings of relying solely on strong inference because, in essence, the rest of the "tree" is left undiscovered. To correct this problem, Feltz advocates for testing multiple theories and/or hypotheses whenever possible in future research.

Conclusion

The present strong inference study adds to the knowledge base concerning how confidence affects a future performance in strength training. More work is needed to better understand how and when the different theories of SCT (Bandura, 1986, 2001) and PCT (Powers, 1978, 1991) are relevant for specific behavior observed. However, at the present time, and from the data gathered in this study, results suggest that coaches should continue to work to build confidence in their athletes (both individually over time and compared to other competitors) to achieve better future performances.

APPENDICES

APPENDIX A
Athlete Demographic Information

Name ____
University ____________________________________
Date ______________
Position ____________

Please complete the following questions

Age __________ years

Ethnicity
_____ White/Caucasian
_____ African American
_____ Asian/Pacific Islander
_____ Hispanic/Latino
_____ Native American/Eskimo/Aleut
_____ Multiple ethnicities
_____ Other (not listed)

Current eligibility
_____ Freshman
_____ Sophomore
_____ Junior
_____ Senior

Scholarship Status
_____ Full scholarship
_____ Partial scholarship
_____ No scholarship

Last year's playing status
_____ Starter or 15+ plays per game
_____ Reserve (1 – 14 plays per game)
_____ Reserve (no playing time)

Did you suffer an injury during the last season that forced you to miss at least 3 games?
_____ Yes
_____ No

APPENDIX B

Self-efficacy Questionnaire for Athletes

Instructions: Please read each of the statements listed below and circle your response indicating how much you agree with each statement right now.

At this moment how confident are you that you can...

1. Best your performance in squat?

0	1	2	3	4	5	6	7	8	9
Not at all confident				Somewhat confident				Absolutely confident	

2. Best your performance by 10 lbs. in squat?

0	1	2	3	4	5	6	7	8	9
Not at all confident				Somewhat confident				Absolutely confident	

3. Best your performance by 20 lbs. in squat?

0	1	2	3	4	5	6	7	8	9
Not at all confident				Somewhat confident				Absolutely confident	

APPENDIX C

Self-efficacy in strength training.

Informed Consent

Michigan State University

You are invited to participate in the research study: *Self-efficacy in strength training.* The purpose of this study is to explore the relationship between confidence and performance in strength training. It is expected that numerous athletes from multiple universities with participate in this study. This research study is a dissertation in partial fulfillment of the requirements to earn a doctoral degree at Michigan State University.

Research activities. Participating athletes will complete 2 questionnaires (demographic and self-efficacy) at Time Points #1, #2, and #3 Questionnaires will take a maximum of 5 minutes to complete at each time point. A participant may withdraw from this study at any time, without penalty, and have all previously completed surveys and performance data destroyed.

Confidentiality. Your privacy in this study will be protected to the maximum extent allowable by law. Your individual identity will be kept private at all times as the researchers will use ID numbers on all surveys, except for the demographic questionnaire, which will be stored separate from all other corresponding surveys. Furthermore, all data will be stored in a locked filing cabinet/safe or on a password protected computer, only to be accessed by the investigators. Finally, once this study is completed, all master lists and any information that could link ID numbers to specific participants will be destroyed.

Risks and benefits. There is no foreseeable physical, social, legal, or economic risk to participants in this study. Benefits of this study include an increased understanding of how confidence affects performance in strength training over the off-season.

Contact information. If you have any questions about this study, please contact Todd Gilson at (517)-432-7121 or gilsonto@msu.edu or Dr. Deborah Feltz, at (517)-353-4652 or dfeltz@msu.edu. If you have questions or concerns regarding your rights as a study participant, or are dissatisfied at any time with any aspect of this study, you may contact – anonymously, if you wish – Dr. Peter Vasilenko, Chair of the Institutional Review Board (IRB) by phone: (517) 355-2180, fax: (517) 432-4503, e-mail: irbchair@ores.msu.edu, or regular mail: 202 Olds Hall, East Lansing, MI 48824.

Your signature below indicates your voluntary agreement to participate in the study: *Self-efficacy in strength training.*

Print Name ______________________________

Signature ______________________________

Date ______________________________

<u>DO NOT WRITE BELOW THIS POINT</u>

ID Number ____________

APPENDIX D
Administration Instructions

Outlined below are the instructions to administer each packet of questionnaires to athletes for each time point.

1. Distribute questionnaire packets within 72 hours of strength training testing date.
2. Read the highlighted portion of the informed consent document to athletes.
3. Inform athletes that their:
    a. Strength coach will never see their individual answers
    b. Individual name will never be used for any purpose
    c. University name will never be used for any purpose
4. Ask for questions regarding study.
5. Ask all athletes willing to participate in this study to tear off (and keep) the first page of the informed consent and then sign, print, and date the second page.
6. Instruct all athletes to answer questions based upon how they feel right now.
7. Remind athletes that questionnaire packets are double sided.
8. Gather questionnaires when completed and return to box.
9. Affix DHL pre-paid address sticker, which will return box to Michigan State University.
10. Call 1-800-225-5345 to schedule a pick-up with a DHL courier.

#2 – #5 need to be completed at Time Point #1 only.

If you have questions during this process please call my cell phone: 517-331-XXXX.

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