THE ROLE OF SELF-EFFICACY, EFFORT, AND ACHIEVEMENT GOAL ORIENTATION ON STRENGTH TRAINING PERFORMANCE IN DIVISION 1 TRACK AND FIELD ATHLETES

by

Lauren Biscardi
A Dissertation
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of
Doctor of Philosophy
Education

Committee:

______________________________________ Chair

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______________________________________ Program Director

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Fairfax, VA

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by

Lauren Biscardi
Master of Sport Science
Hofstra University, 2016
Master of Business Management
University at Albany, 2011
Bachelors in Business Management
Stony Brook University, 2009

Director: Debra Stroiney, Associate Professor
College of Education and Human Development

Summer Semester 2022
George Mason University
Fairfax, VA

Dedication

This is dedicated to my parents, who instilled in me a love of learning, the passion to pursue my interests, and the confidence to continue on my journey. And to Bishop, my biggest advocate, who has believed in me and encouraged me to pursue my goals. I am grateful for your endless support.

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Abstract

THE ROLE OF SELF-EFFICACY, EFFORT, AND ACHIEVEMENT GOAL ORIENTATION ON STRENGTH TRAINING PERFORMANCE IN DIVISION 1 TRACK AND FIELD ATHLETES

Lauren Biscardi, Ph.D.

George Mason University, 2022

Dissertation Director: Dr. Debra Stroiney

Self-efficacy and achievement goal orientations are predictors of affect, behavior, and performance in sport and exercise. These traits contribute cognitively to subjective exercise experiences, which are important for promoting behavior in the training environment. The purpose of this study was to: (a) examine the relationships between daily effort, task-specific self-efficacy, and perceived performance with positive well-being and psychological distress following a strength training workout, (b) examine the relationship between effort and perceived performance for the squat, bench press, and Olympic lift tasks, and whether trait achievement goal orientations and self-determined motivations impacted these relationships, (c) determine whether variations in daily perceptions of stress and recovery impacted task-specific self-efficacy at the beginning of a strength training workout. Data was collected from 29 National Collegiate Athletic Association Division 1 track and field athletes in a pre-season training block via electronic survey. Demographic data, 3 x 2 achievement goal orientations and self-determined motivations were collected once prior to the training block. Perceptions of stress, recovery, and task-specific self-efficacy were collected prior to each training session. Perceptions of effort, performance, and subjective exercise experiences were collected after each training session. For each research question, multilevel modeling explained variance within and between individuals. Daily measures were nested within trait measures. Findings were as follows: (a) At the day-level, increases in perceptions of effort and performance related to positive subjective exercise experiences. In addition, when self-efficacy was low, higher efforts and perceptions of performance mitigated negative subjective experiences. Athletes higher in trait self-efficacy reported more positive responses to training sessions. (b) Increases in daily effort were related to higher perceptions of performance. For the squat task, athletes with mastery-approach orientations showed a stronger relationship between daily efforts and perceived performance. The effort-performance relationship did differ between athletes for the Olympic lifts, but 3 x 2 goal orientations could not explain this difference. (c) Perceived stress moderated the relationship between perceived recovery and self-efficacy for a workout, bench press, and Olympic lift task. The relationship was significant on days athletes had average or above average stress levels, and non-significant on low stress days. In conclusion, increased perceptions of recovery, effort, performance, and self-efficacy can enhance psychological responses to strength training sessions in college athletes. Findings are discussed in relation to practical recommendations for coaches in the strength training environment.

Chapter One: Importance

Strength Training for Sport

Effective sport training results in healthy adaptation of an athlete's physiological and psychological state (Freeman, 2015). The training plan for sport should be structured to enhance performance while promoting a positive training experience that considers athlete well-being and healthy athletic development (Freeman, 2015). Strength training is an important part of any sport training program because of the documented positive relationships between strength characteristics and sport performance (Stone et al., 2002). Strength training supports primary sport training and follows a periodized approach that aligns with the overall training plan. Periodization of strength is based on the needs of the sport, with the goal of reaching peak performance during major competitions (Bompa & Buzzichelli, 2015). To maximize transfer of strength and power training to sport performance, both nonspecific and specific strength training exercises are recommended for a strength training program (Young, 2006). Development of general strength with nonspecific strength training can enhance sport performance through improvements in qualities such as body composition, core stability, and reduction of injury risk (Young, 2006). Specific strength training focusing on development of intermuscular coordination displays a more direct transfer skill performance (Young, 2006). Coaches' perceptions of general and specific strength training methods transfer to sports performance align with these scientific findings (Burnie et al., 2018).

Track and Field

In the 2020-21 academic year, 491,255 student-athletes participated in National Collegiate Athletic Association (NCAA) sports, with 184, 222 at the Division 1 (D1) level (NCAA, 2021). In 2021, 11,508 men and 13, 679 women participated in NCAA D1 track and field, with a steady increase in sport participation over the past 10 years (NCAA, 2021). In track and field, periodization guides the overall training plan to reach peak performance at indoor and outdoor championship competitions. Various studies provide evidence for the physiological effectiveness of strength training programs to improve physical qualities such as strength, power, and speed that contribute to success of track and field athletes' sport performance (Bazyler et al., 2017; McGuigan et al., 2012; Painter et al., 2012; Young, 2006). For many track and field teams, the track coach programs and supervises team strength and conditioning sessions, in contrast to team sports which may employ a separate strength coach as part of their training staff (Bolger et al., 2016). Healy and colleagues (2019) reported that 95.1% of track and field sprint coaches were directly involved in the selection of resistance training. This perception that strength training is an essential part of a track and field athlete's training program is reflected in both coaches and athletes. In a recent survey, 70.7% of sprint coaches found resistance training "very important", with no coach reporting resistance training as "not important" (Healy et al., 2019). In addition, track and field athletes felt that strength training was more important to their sport performance compared to athletes from other sports (Boyd et al., 2017). Track and field athletes were more likely to agree with the positive outcomes of strength training, such as injury prevention and enjoyment of strength training, compared to athletes participating in other sports (Boyd et al., 2017).

Generally, the periodization model for track and field in the weight room is designed to optimize power output (DeWeese et al., 2015b). This focus is supported by established relationships between specific strength qualities and sprint performance (Young et al., 1995). This begins by first developing muscular hypertrophy and work capacity, followed by basic strength training, and finally power-oriented training (DeWeese et al., 2015b). Evidence supports the use of block periodization methods for track and field athletes to optimize desired physiological adaptations (DeWeese et al., 2015a; Painter et al., 2018). Exercises that maximize transfer of training for track and field are multi-joint exercises that require quick production of high levels of force (DeWeese et al., 2015b). While some strength and conditioning training is performed in the weight room, other aspects (such as plyometrics and resisted running) are performed directly on the track in sport-specific training sessions (Bolger et al., 2016). For example, triple jumpers perform plyometrics and sprint training in their sport-specific session and then lift weights focusing on strength and power development (Cissik, 2013). As weight training is not a track and field athlete’s primary competitive outcome, selection of efficient methods of auxiliary training that manages fatigue and reduces risk of injury while providing strength gains is important to promote healthy athletic development.

Psychological Responses to Training

Athlete well-being is receiving more attention in the literature; however, psychological responses to training sessions are not well-studied in the weight room environment. Sport training elicits both performance outcomes and well-being responses of an athlete (Saw et al., 2016). Athlete monitoring techniques frequently use athlete well-being measures before practices to assess individual training responses, with the purpose of using these assessments to optimize performance and avoid adverse consequences imposed by training (Saw et al., 2017). Psychometric self-report methods are preferred over physiological biomarkers because subjective and objective measures of athlete well-being do not correlate well (Saw et al., 2016). Particularly, measures of mood disturbance, perceived stress, perceived recovery, and symptoms of stress are more sensitive than objective measures in reflecting changes in training loads (Saw et al., 2016). Disturbances in athlete well-being are associated with overreaching and overtraining and may reflect an increased risk of injury and illness; however, these are not the only reasons assessment of psychological states are important to athletics (Meeusen et al., 2013).

Psychological responses to exercise are important for exercise adherence and promoting behavior in the training environment (Kwan & Bryan, 2010). Acute responses to exercise consistently generate both a positive and a negative affective dimension, and the post-exercise affective response is typically positive (McAuley & Courneya, 1994; Watson & Tellegen, 1985; Zenko & Ladwig, 2021). An emotional response to a situation is a subjective interpretation of their experience (Roseman & Smith, 2001). The cognitive-motivational-relational theory extends this by stating the emotional response depends on a combination of cognitive evaluation, motivations, and the environment (Lazarus, 1991a, 1991b). Specific to exercise, the affective response is a result of cognitive and physiological cues in the exercise environment (Ekkekakis, 2003). Cognitive cues can include individual motivations, beliefs, and goals. Self-efficacy, the belief than an individual can perform a desired behavior in a given situation, is a well-studied cognitive component of exercise (Bandura, 1977; Elkington et al., 2017).

Beliefs and Motivations

An athlete's choices and behaviors in the training environment contribute to an athlete's training session outcomes (Freeman, 2015). These choices and behaviors are results of underlying athlete motivations, achievement goal orientations, and beliefs. It is expected that athletes with different motivations, beliefs, and mood states placed in the same training situations will likely display different responses. An athlete's cognitive appraisal of stimuli in the training environment, which is a result of mood state, personal traits, goals, beliefs, and expectations, directly relates to the athlete's behaviors, emotions, and cognitive responses in that environment (Bandura, 1977; Lazarus, 1991a, 1991b; Nicholls 1984). This can explain why one athlete leaves the same practice feeling accomplished while another leaves with a feeling of frustration, or why one athlete completes the race while another athlete stops running before the finish line. An athlete's motivations, goals, and beliefs impact their choice of, persistence with, and effort in an activity, and also influences their subjective responses and psychological well-being (Bandura, 1977; Deci & Ryan, 1985; Nicholls, 1984). As a coach, considering and understanding these personal traits in athletes may assist in creating a more positive and athlete-centered environment to promote psychological well-being in addition to objective performance outcomes.

Developing an athlete's self-efficacy in the training process is important for an athlete's positive mental state (Freeman, 2015). Self-efficacy impacts an athlete's choice of activities, their intensity and effort in those situations, and their mood states during and after the activity (Bandura, 1977). An athlete's behavior is impacted through the cognitive process of learning through reinforcement. With self-efficacy, an athlete's evaluation of their performance compared to their standards of performance motivates their behaviors and efforts (Bandura, 1977). This places importance on both beliefs in personal ability and personal definitions of success. Athlete expectations of their own capabilities primarily come from personal accomplishments and past performance but are also impacted by vicarious experiences (modeling), psychological states, and verbal influences (Bandura, 1977). Self-efficacy is a cognitive process and therefore an athlete's beliefs about consequences can be more influential than the actual consequences themselves (Bandura, 1977). In sport, perceptions of personal performance may be more influential than objective measures of performance in efficacy development. An athlete's self-efficacy can be fostered in the training environment, which is beneficial because their level of self-efficacy is a strong predictor of their performance (Bandura, 1977; Moritz et al., 2000).

Considering an athlete's definition of success with their perception of their own abilities further explains their choices, behaviors, and subjective experiences in the training environment (Nicholls, 1984). Achievement goal theory explains how an athlete is motivated by their definition of success, their ability to demonstrate competence, and the consequences of comparing their perceived ability to their defined standard of success (Nicholls, 1984). Athletes judge their competence by either comparing their abilities to others, to themselves, or to the task (Elliot et al., 2011; Mascret et al., 2015; Nicholls, 1984). Athletes also experience two areas of valence relative to demonstrating competency: approach and avoidance (Elliot et al., 2011; Mascret et al., 2015; Nicholls, 1984). An athlete's success or failure to meet a defined standard of success impacts the athlete's behavior and psychological response. This process leads to behavioral change in the performance environment. The sport of track and field provides regular opportunities to compare performance to both self and to others during practice and in competition. As such, track and field athletes may demonstrate unique achievement goal profiles that impact their athletic development and well-being.

Deci and Ryan's (1985, 2000) self-determination theory explains motivational behaviors in sport and exercise. An athlete typically has multiple, competing motives for participation in their sport. Originally defined as intrinsic and extrinsic motivations, the motivational continuum is now recognized as ranging from autonomous to controlled regulations (Deci & Ryan, 1985, 2000). Controlled motivational behaviors are regulated by extrinsic pressures, while autonomous behaviors are selected out of the athlete's personal choice. According to self-determination theory, an athlete's placement on this motivational continuum impacts their behavior in a given context. This means that two athletes with different motives may act differently in the same situation because they are driven to participate for different reasons. As motivation for participation in sport differs between athletes, so do the affective, behavioral, and cognitive consequences of those motivations (Vallerand, 2007). Not only may two athlete's behaviors in their training environment differ due to differences in behavioral regulations, but their psychological state and well-being in response to the session may differ as well simply because of their different motives for participation. Additionally, an athlete's reason for sport participation can be impacted by the fulfillment of their basic psychological needs of autonomy, competence, and belongingness (Deci & Ryan, 1985, 2000). Through interaction with their environment, an athlete's motives for participation can shift on the motivational continuum. This means that as a coach fostering an environment that supports an athlete's basic psychological needs (for example, giving an athlete choice during their workout to support autonomy) can enhance their motivations and well-being.

Conclusion

Psychological responses to training sessions are important because these responses impact an athlete's perceptions, motivations, and behaviors in that environment (Bandura, 1977; Lazarus, 1991a, 1991b; Nicholls 1984). Studying psychological responses to a strength training session from a social cognitive perspective can provide both an understanding of factors that contribute to psychological responses and present opportunities for active change in the strength training environment (Bandura, 1977, 1986, 1989). Self-efficacy contributes to cognitive appraisals and the affective response to exercise (Bandura, 1977; Ekkekakis, 2003; Elkington et al., 2017). Examining this relationship from a within-person and between-person analysis in the strength training environment can expand on existing literature. Additionally, while psychological states are primarily studied as a consequence of self-efficacy, studying the influence of psychological states on efficacy beliefs can contribute substantially to existing literature in this area.

In addition, achievement goal theory has not been given much attention in strength training literature, and the information provided mostly relies on an outdated dichotomous model of achievement goal classifications (Mascret et al., 2015). Employing a current model of achievement goal orientations that considers both demonstration of competence and valence will help advance the field of sport and exercise science. In combination with self-efficacy measures, these traits can provide a better understanding of how an athlete's definition of success impacts their perceptual responses to strength training sessions. Finally, a majority of studies investigating affective responses to resistance training sessions as the study's primary focus used recreationally trained or sedentary individuals, with no studies reporting the use of NCAA D1 athletes (Beaumont et al., 2020). The use of an NCAA D1 athlete target population can expand documented findings into the college athlete domain.

Research Questions

This research study had three aims:

Research Aim 01

Can effort, self-efficacy, and subjective self-evaluation of performance predict states of positive well-being and psychological distress following a strength training workout? Can trait variables (achievement goal orientations, self-determined motivations, aggregate self-efficacy) explain additional variance in these subjective responses to the training session?

Research Aim 02

For the squat, bench press, and Olympic lift tasks, can daily effort and daily self-efficacy levels predict an athlete's perception of their performance in those tasks? Do trait variables (achievement goal orientations, self-determined motivations, aggregate self-efficacy) explain additional variance in this perceived performance? Does the relationship between daily effort and perceived performance look the same between individuals? Can trait variables explain differences in the effort-performance relationship between athletes?

Research Aim 03

Can perceived recovery and perceived stress states explain variance in daily self-efficacy before a strength training workout? Can perceived recovery and perceived stress states explain variance in task-specific self-efficacy for the squat, bench press, and Olympic lift tasks?

Key Terms

Achievement goal orientation. The dispositional tendency regarding achievement goal focus (Duda, 2004).

Effort. An individual's perception of how hard they are trying at a task (Hutchinson, 2021).

Olympic lifts. Weightlifting exercises (the clean and snatch) and their variations.

Perceived performance. An individual's subjective rating of their performance.

Perceived recovery. An individual's biopsychosocial balance, which includes psychological, mood-related, emotional, behavioral, social, and physiological levels (Kellmann, 2002).

Perceived stress. The result or net effect of stressors on an individual, measured from a global perspective (Kellmann, 2002).

Positive well-being. A positive psychological state, which includes emotions such as positive affect (McAuley, 1994).

Psychological distress. A negative psychological state, which includes anxiety, depression, stress-related emotions (McAuley, 1994).

Self-determined motivation. The behavioral regulation underlying goal pursuits, that ranges on a continuum from autonomous to controlled regulations (Deci & Ryan, 2000).

Self-efficacy. The belief that an individual can perform a desired behavior in a specific situation (Bandura, 1977).

Strength training. The use of training to target increases in muscular strength.

Chapter Two: Literature Review

Acute Psychological Responses to Exercise

Exercise and physical activity are positively related to mood, self-esteem, and indices of psychological well-being (Biddle, 1995; Penedo & Dahn, 2005). Psychological responses to exercise participation include both positive and negative affective or emotional states (McAuley & Courneya, 1994; Watson & Tellegen, 1985; Zenko & Ladwig, 2021). Positive and negative affect are consistently the first two factors that are generated by factor analysis of self-rated mood literature (Watson & Tellegen, 1985). Regarding psychological health, these two states are known as psychological distress, which includes anxiety, depression, stress-related emotions, and psychological well-being, which includes emotions such as positive affect (McAuley, 1994). Early work on the relationship between exercise and well-being was largely based studies on anxiety and stress-related emotions. However, psychological health is more than simply an absence of negative symptoms. A multidimensional approach to the assessment of subjective responses that result from stimulus properties of the exercise environment is necessary for a better understanding of the exercise-psychological health relationship (McAuley & Courneya, 1994).

A state of well-being is defined by optimal psychological functioning and experience. Well-being is traditionally represented as a combination of the hedonic and eudaimonic perspectives; that is, happiness or feeling good, and functioning effectively (McMahan & Estes, 2011; Ryan & Deci, 2001). Subjective well-being is the common construct in evaluating the hedonic perspective, consisting of life satisfaction, presence of positive mood, and absence of negative mood (Ryan & Deci, 2001). With eudiamonic perspectives, a multidimensional approach to psychological well-being that measures positive functioning can be separated from indicators of subjective well-being. It is common in psychological theories to embrace both perspectives. Deci and Ryan's (1985, 2000) self-determination theory (SDT) embraces the self-realization perspective of well-being in combination with hedonic perspectives (Ryan & Deci, 2001). In contrast to traditional eudiamonic approaches, SDT argues that fulfillment of the three basic psychological needs promotes both subjective well-being and eudiamonic well-being (Ryan & Deci, 2001). These two approaches represent overlapping and distinct areas of well-being, and a combination of the two measures best associates with well-being (Huta & Ryan, 2010). Additionally, it is important to view well-being from both hedonic and eudiamonic perspectives, as conditions that promote one may not promote the other (Ryan & Deci, 2001). For example, a stimulus that promotes happiness (hedonic well-being) may not promote vitality (eudiamonic well-being), which must be considered in measurement of the well-being construct. Disabato et al. (2015) has shown that in measurement of well-being, a single overreaching construct of well-being that embraces both views is adequate to reflect self-reported subjective and psychological well-being.

Several theories are present that assist in interpreting psychological responses to exercise. The appraisal theory of emotion states that emotions are caused by individual evaluations of events and situations (Roseman & Smith, 2001). An individual's interpretation of a situation or event causes an emotional response that is based on their subjective interpretation of the experience. Therefore, it is not surprising that individual motivations, goals, and beliefs, which influence cognitive appraisals, impact the affective outcomes of an experience. Lazarus (1991a, 1991b) expanded on the appraisal theory of emotion with the cognitive-motivational-relational theory (CMRT), which places equal importance on the cognitive, motivational, and relational aspects in generating emotions. The CMRT emphasizes the importance of an individual's goals and environmental situations in addition to cognitive assessments in emotion generation. With respect to exercise sessions, the dual-mode theory posits that exercise-specific physiological responses and cognitive influences interact to generate affective responses to the session (Ekkekakis, 2003). A strength of this theory is its ability to expand on cognitive theories of emotion while considering the vital role of the body's physiology that contributes to exercise experiences (Ekkekakis, 2009b).

The Dual-Mode Theory: Affective Responses to Aerobic Exercise

The dual-mode theory presented by Ekkekakis (2003) explains the interindividual variability of affective response to exercise intensities, and bridges mind and body-focused approaches to the exercise intensity and affect relationship (Ekkekakis, 2009a). The continuously changing interplay between cognitive influences, such as perceptions, goals, and self-efficacy, and interoceptive cues from exercise-induced physical changes, impacts the affective response to exercise (Ekkekakis, 2003). The relative contribution of cognitive and interoceptive influences changes as a function of exercise intensity (Ekkekakis, 2009b). With aerobic exercise below and at the ventilatory or lactate threshold, cognitive factors predominantly influence affective responses. As intensity surpasses this threshold interoceptive factors predominantly contribute to affect. In general, as intensity increases the relative importance of interoceptive factors increases (Ekkekakis, 2009b).

With aerobic exercise, affective responses are predictably positive below the ventilatory threshold (moderate intensity) and predictably negative above the ventilatory threshold (severe intensity; Ekkekakis et al., 2011). For example, with self-selected aerobic exercise intensity, individuals tend to choose exercise just below the ventilatory threshold and demonstrate positive mood (Rose & Parfitt, 2010). However, responses are highly variable around the ventilatory threshold (heavy intensity) as the transition from aerobic to anaerobic metabolism occurs (Ekkekakis et al., 2005). This is where some individuals report positive while others report negative responses to exercise (Ekkekakis, 2009b). Findings support the dominant contribution of interoceptive cues to affect when homeostasis is threatened, and the dominance of cognitive influences to affective response when homeostasis is not under threat (Ekkekakis, 2003). These relationships are also observed when mood is measured as intensity changes dynamically during exercise bouts (Hall et al., 2002). These affective responses to intensity level of exercise are independent of the level of work completed, as shown when comparing affect between two exercise bouts matched for caloric expenditure but differing in intensity (Kilpatrick et al., 2007). These findings are relevant to understanding in-task hedonic responses to changes in exercise intensity.

Affective response to intensity during exercise appears independent of the affective response following exercise (Kilpatrick et al., 2007). Following exercise, positive mood tends to improve and negative mood is reduced, and these continue to change during cooldown and recovery (Hall et al., 2002). Post-exercise mood states can be influenced by several factors. Preference for the mode of exercise has been shown to moderate post-exercise affect (Miller et al., 2005). Support for modality preference impacting both in-task and post-exercise mood was shown when intraindividual variation in hedonic state was higher than between-person variation across participants who completed three different exercise session modalities (Schmid et al., 2021). Manipulation of post-exercise affective expectations can also impact the post-exercise response (Helfer et al., 2015). In addition, mood response to exercise has been linked to pre-exercise mood states (Guérin et al., 2013; Parfitt et al., 2000; Rose & Parfitt, 2010). Pre-exercise mood can explain a large amount of variance in post-exercise mood and should be considered when assessing post-exercise mood states (Guérin & Fortier, 2013).

Factors other than exercise intensity can also impact affective responses to exercise. Relationships between RPE and both during-exercise mood and post-exercise mood have been reported (Farias-Junior et al., 2020; Guérin et al., 2013). McAuley and Courneya (1992) also reported that individuals with higher self-efficacy showed lower in-task RPE and more positive in-task affect. An individual's physical activity level is related to in-task affective responses to exercise, and in-task affective response is predictive of current and future physical activity behaviors (Farias-Junior et al., 2020; Williams et al., 2012). Positive mood is positively associated with daily exercise session duration, and exercise duration positively predicts mood in the evening (Schöndube et al., 2016). While acute aerobic exercise can reduce psychological distress in healthy individuals, it may increase psychological distress in inactive individuals, emphasizing the importance of training status on exercise-induced mood states (Elkington et al., 2017).

Acute Psychological Responses to Resistance Exercise

While much of the literature surrounding affective responses to exercise has studied aerobic exercise, limited evidence exists regarding psychological responses to resistance training sessions (Elkington et al., 2017). Early evidence shows that resistance exercise positively impacts affect both during and following exercise, with a similar rebound effect as observed in aerobic exercise, and as such may increase exercise adherence (Cavarretta et al., 2019). Cavarretta et al. (2019) found that improved affect peaks 5 minutes following resistance exercise and remains elevated up to 30 minutes following a resistance training session, supporting the affective rebound noted in aerobic exercise studies (Ekkekakis et al., 2011).

A recent review that studied acute affective, anxiety, and mood responses to resistance training sessions focused on recommendations to maximize feelings of pleasure following resistance exercise (Cavarretta et al., 2018). This review also identified inconsistencies in resistance training literature and areas for improvement for future studies investigating the affective response to a resistance training session. Inconsistencies are apparent in existing literature studying the affective response to resistance training in terms of reporting volume and rest periods between sets (Cavarretta et al., 2018). However, low to moderate intensities appear to promote improvements in affect, similar to findings in aerobic exercise. Using the RIR-based RPE scale in 10RM testing in novice lifters, affective valence was positive and constant for different intensities, but less positive at maximal intensities (100% 10RM; Cavarretta et al., 2022). In addition, large variability was observed in affective response to self-selected resistance training loads (55% 1RM) in novice resistance trained men, however results were generally neutral to positive (Elsangedy et al., 2016). While some responses are less positive than others, responses to resistance exercise in empirical studies range from neutral to positive. Additionally, variations in rest between sets can influence affect. Bibeau et al. (2010) reported greatest increases in affect in the low-intensity, long-rest resistance exercise group, and greatest increases in anxiety in the high-intensity, short-rest group.

Like aerobic exercise investigations, there is evidence to suggest resistance exercise mode impacts post-exercise affect. This includes choices between machines and free weights, multi-joint and single-joint exercises, the muscles utilized in workouts, and exercise order. Cavarretta et al. (2022) reported higher affect for upper body compared to lower body exercises. However, findings regarding affective response to resistance exercise of different modes is frequently mixed. Carraro et al. (2018) reported that free weights showed higher affective response compared to machine training recreationally trained men while Cavarretta et al. (2022) reported more positive affective response for machines than free weights, and other studies have found no differences between the two modes (Cavarretta et al., 2019). The impact of repetition tempo and contraction type on acute mood response to a resistance training session are still unclear (Cavarretta et al., 2018).

Each of these exercise variables impacts the physiological response to a resistance training session. The dual-mode theory posits that affective response is a result of both cognitive and physiological reactions during exercise, meaning the varying physiological responses as a result of training type likely factors into affective response. Physiological responses to exercise variables differ according to resistance training experience. In addition, the cognitive aspect contributing to affective responses is likely to differ between individuals. Therefore, it is recommended that exercise preference and lifting experience should both be considered with resistance exercise variables to maximize affective response (Cavarretta et al., 2018).

Much of the rationale for studying affective response to resistance training sessions is attributed to long-term exercise adherence. However, to the author's knowledge, no experiment has directly tested the theory of the relationship between affect during resistance training exercise and future exercise adherence, meaning these claims are largely theoretical (Cavarretta et al., 2018). Literature surrounding affective responses to resistance exercise supports of the dual-mode theory, self-efficacy, and self-determination theory (SDT) when considering these affective responses (Cavarretta et al., 2018). It appears that cognitive theories are essential in understanding affective, emotional, and mood responses to acute bouts of resistance exercise. While preliminary studies are beginning to document affective responses to resistance training sessions, researchers note a need for continued development in this area.

Measures of Subjective Exercise Experiences

The Subjective Exercise Experiences Scale (SEES) is designed to measure global psychological responses to exercise stimulus (McAuley & Courneya, 1994). The Profile of Mood States and the Positive and Negative Affect Scale are used to quantify responses to exercise; however, these measures are not exercise-specific assessments of mood states. The Feeling Scale relies on a single measure of affect that oversimplifies the relationship between positive and negative mood states. The SEES was designed to assesses subjective experiences specific to the exercise domain before, during, and after exercise sessions. Exploratory factor analysis produced a three-factor structure of the SEES: positive well-being, psychological distress, and fatigue (McAuley & Courneya, 1994). The moderate correlation between positive well-being and psychological distress is expected based on theory.

Self-Efficacy

Self-efficacy and motivation are interrelated concepts in sport psychology that can enhance athletic performance. Bandura's (1977) self-efficacy is the foundation for research in self-confidence and sport (Feltz et al., 2008). Self-efficacy is a component of social cognitive theory. Bandura's (1986) social cognitive theory (SCT) is a theory of human behavior in psychology that spans the education, healthcare, business, and sport and exercise settings. The SCT model represents human behavior as a reciprocal triad of three determinants: personal, behavioral, and environmental (Bandura, 1986). SCT acknowledges the human as an agent that dynamically interacts with these three determinants to guide behavior (Bandura, 1989). Self-efficacy is rooted in SCT as a determinant of motivation, affect, and action of the individual (Bandura, 1989). It impacts an individual's actions as a cognitive, motivational, and affective influence (Bandura, 1986). Cognitive processes can include things like goal setting and judgements of ability or likelihood of success; motivational processes can include effort and perseverance in the face of obstacles; and affective process can include experiences of stress and anxiety (Bandura, 1986). Sport performance, persistence, and behavior have been studied from the self-efficacy perspective (Moritz et al., 2000).

Self-efficacy is a task-specific form of self-confidence. Self-efficacy is the belief that an individual can perform a desired behavior in a specific situation (Bandura, 1977). The perception of an athlete’s own ability influences their choice, level of effort, and persistence in an activity (Bandura, 1977). It is related to both goal pursuits and enhanced well-being (Ryan & Deci, 2001). When an individual has sufficient skills and motivation for a task, self-efficacy will be a major determinant of an individual’s performance (Bandura, 1977). In sport and exercise, it shows a reciprocal relationship with performance. Task-specific self-efficacy influences sport performance, and prior task performance influences athlete self-efficacy (Gayton et al., 1986; George, 1994; Moritz et al., 2000). Additionally, self-efficacy is positively related to the effort exerted by athletes in both strength training sessions and in competitive sport settings (George, 1994; Gilson, Reyes, et al., 2012).

An individual’s efficacy expectations differ from their outcome expectations (Bandura, 1977). Efficacy expectations are the belief that an individual can successfully perform a given behavior required to produce certain outcomes, while outcome expectations are a person’s estimate that a given behavior will lead to specific outcomes. Therefore, an individual can believe that a particular course of action will produce specific outcomes, but if they doubt their ability to perform these activities, they will not initiate or persist in this behavior. In a sport setting, if an athlete believes that to get stronger, one must lift weights, but the athlete believes they are unable lift weights properly, this athlete may not engage in strength training.

Efficacy expectations, or self-efficacy beliefs, can vary in magnitude, generality, and strength (Bandura, 1977). Magnitude refers to the level of difficulty or complexity of a task; generality refers to applicability of one domain to another; and strength refers to varying levels of certainty in self-efficacy beliefs. These self-efficacy beliefs can result from four sources: performance accomplishments, vicarious experience (or modeling), verbal persuasion, and psychological states (Bandura, 1977). The impact on an individual's behavior depends on how it is cognitively appraised by the individual.

Experiences based on performance accomplishments result in higher, more generalized, and stronger self-efficacy than the other three sources (Bandura, 1977; Bandura et al., 1977). In addition, the interaction of the individual and the environment is important to how cognitive appraisals impact the interpretation of the efficacy information (Bandura, 1977). If an athlete perceives their successes resulting from their own ability rather than external aids, they are more likely to experience improvements in self-efficacy as a result of the experience. Conversely, if they felt their successes were more due to external circumstances, the experience will likely result in a reduced magnitude of perceived self-efficacy changes. The same effects are proposed for experiencing failures. An athlete who feels their failure was due to an external aid is less likely to see as much of a reduction in self-efficacy as if they attributed their failure to personal abilities.

Interpretations of efficacy information are also impacted by the amount of effort that was put forth to attain the outcome (Bandura, 1977). Successes that are achieved through less effort are proposed to enhance self-efficacy, while successes achieved with more effort will likely exhibit a lesser effect. In addition, cognitive perceptions of the difficulty of a task in which success was achieved will impact self-efficacy. Mastery of challenging tasks will enhance self-efficacy, while successes with simpler tasks may not have the same effect. The perception of independence of performance that results in success is essential to enhancing efficacy and behavior in the long-term; meaning, the athlete must feel that they can perform these capabilities themselves without aid to develop higher levels of self-efficacy (Bandura, 1977).

While performance accomplishments are the largest contributor to changes in self-efficacy, cognitive appraisals of vicarious experiences, verbal persuasion, and psychological states also impact the value of efficacy information (Bandura, 1977). Vicarious experiences are judged by similarities between models and observers, the situational aspects in which they are observed, and perceived difficulty of task. Verbal persuasion is judged by the perceived credibility of the person giving feedback. Psychological states such as emotional reactions impact the interpretation of efficacy information because physiological arousal and emotions can be interpreted differently in different situations. Bandura (1977) points out that cognitive processing of efficacy information, and the relationship between efficacy expectations and an individual's actions are particularly relevant areas of research in this field of study.

Self-Efficacy and Behavior

An individual's perceptions of self-efficacy are constantly evolving. This is because learning through response consequences, or reinforcement, is a cognitive process, and humans are dynamic agents that can alter their behavior (Bandura, 1977, 1986). Cognitive processes mediate behavioral change and play an important role in the acquisition and retention of behavior patterns. An individual's behavior is driven by global consequences, rather than immediate effects, meaning individuals process information from repeated consequences over time to form their efficacy expectations (Bandura, 1977). Importantly, because consequences impact behavior through thought, individual's beliefs about reinforcement can exert more of an influence on behavior than the reinforcement itself (Bandura, 1977).

Motivation, which is concerned with initiation and persistence of behavior, is linked to self-efficacy because it is partially rooted in cognitive activities (Bandura, 1977). Reinforcement acts as a motivational device by creating expectations for an individual that behaving a certain way will produce anticipated effects. Motivation also contributes the cognitively based influences of goal setting and self-evaluative reactions to behavior (Bandura, 1977). Self-motivation creates the standards against which to compare performance, and self-rewarding reactions are conditional of achieving a specific behavior. These motives encourage a person to persist in their efforts until their performances match their self-prescribed standards (Bandura, 1977). Self-evaluations of an individual's performance compared to their standards of success are what motivates behavioral changes.

Self-Efficacy and Psychological Responses to Exercise

Among the cognitive components of affective exercise response, self-efficacy is the most studied (Ekkekakis, 2003; Ekkekakis, 2009b). Self-efficacy is related to both goal pursuits and enhanced well-being (Ryan & Deci, 2001). Evidence suggests that changes in an individual's positive well-being during and following aerobic exercise depends on their perceived self-efficacy (Elkington et al., 2017). Individuals with higher self-efficacy experience greater positive feeling states during and following exercise than low efficacy individuals when exercising at a similar RPE and heart rate (Bozoian et al., 1994). Participants high in self-efficacy also show an enhanced affective response to a handgrip task (Hutchinson et al., 2008). Higher levels of self-efficacy are related to more positive affective states, and lower levels of self-efficacy with more negative affective states prior to competition (Treasure et al., 1996). These findings are important in that an individual's psychological state prior to exercise may impact their feelings during exercise, and these exercise-induced feelings can impact long-term program adherence.

Self-efficacy is also related to perceived exertion and perceptions of fatigue with exercise. Individuals high in self-efficacy report lower perceptions of aches and exertion and were able to tolerate an exertive task for longer than their low-efficacy counterparts (Hutchinson et al., 2008). In addition, perceived fatigue was reduced following exercise for individuals with high levels of self-efficacy, but perceived fatigue also depends on activity status of the individual, mode of exercise, and acute/chronic responses (Elkington et al., 2017). Low self-efficacy levels can result in higher RPE during exercise, particularly at submaximal intensities (Knicker et al., 2011). In aerobic exercise at or below the ventilatory threshold, self-efficacy shows a negative relationship with RPE (Hall et al., 2005). Individuals with high self-efficacy show a more constant positive relationship between exercise intensity and RPE during a bout of exercise, while individuals with lower self-efficacy exhibit a slower rate of change at low intensity followed by a more dramatic increase at higher intensities (Hu et al., 2007).

Self-Efficacy, Performance, and Effort in Sport

Self-efficacy has been studied as a determinant of performance in sport (Moritz et al., 2000). The reported relationship between self-efficacy and performance in sport is low to moderate. Self-efficacy shows the strongest relationships with subjective assessments of performance, followed closely by self-report measures, and finally objective measures (Moritz et al., 2000). Correlations of self-efficacy with performance measures tend to be higher with concordant measures, measures that are task-specific, with familiar tasks to the participant, and when self-efficacy is measured after performance rather than before (Moritz et al., 2000). Much of the literature surrounding self-efficacy and sport focuses on a performance outcome, however the relationship between self-efficacy and psychological states experienced during training warrants more attention (Fitzsimmons et al., 1991).

The relationship between self-efficacy and effort is reciprocal, meaning that higher levels of self-efficacy will result in more efforts. Persistence under adverse conditions will improve self-efficacy while a reduction of efforts in these conditions will reduce self-efficacy. As an example, self-efficacy was positively related to the effort that NCAA D1 athletes (football, volleyball, soccer, basketball) put into their strength training sessions during off-season training (Gilson, Reyes, et al., 2012). For this study, Gilson, Reyes, et al. (2012) used a multilevel modeling approach in which a positive relationship was found at both within- and between-person levels of the analysis. Self-efficacy was shown to be more influential than stress, value of strength training, or demographic variables on the amount of effort athletes provided during training sessions (Gilson, Reyes, et al., 2012). This study supports the theory that positive changes in self-efficacy in NCAA D1 athletes may result in improvements in performance and more adaptive behaviors (Gilson, Reyes, et al., 2012). Gilson, Reyes, et al. (2012) in contrast found that past effort did not directly impact behavior. Instead, the evidence from this study supported the theory that cognitive appraisal of the past behavior is more influential on beliefs about current capabilities (Bandura, 1977). Future research investigating how self-efficacy influences strength training performance from a multilevel modeling approach, that includes both psychological and physiological measures to connect measures of effort and performance, is recommended because self-efficacy beliefs alone are not sufficient to determine performance. Adequate skills and incentives must exist to produce desired performance. Given the adequate abilities and motivations, perceptions of self-efficacy are a major determinant of choice of activities, effort expended, and persistence in adverse conditions (Bandura, 1977).

Perceived Effort in Sport and Exercise

Effort and exertion are frequently used interchangeably in sport and exercise science research (Pageaux, 2016). However, while these two constructs are related, they are not the same; nor should they have the same operational definition (Abbiss et al., 2015; Hutchinson, 2021; Hutchinson & Tenenbaum, 2019; Smirmaul, 2012). Exertion is defined as the “degree of heaviness and strain experienced in physical work” (Borg, 1998, p. 8). This definition has been used in weightlifting studies employing RPE scales (Hackett et al., 2019). Effort is defined as the "amount of mental or physical energy being given to a task" (Abbiss et al., 2015, p. 1237). Recent explanations clarify that perceived exertion relies on and considers the sensory information from exercise, while perception of effort is generated by the central nervous system (Hutchinson, 2021; Smirmaul, 2012). Therefore, an individual's perception of how hard they are trying at a task is a subjective experience of effort (Hutchinson, 2021).

Several empirical studies provide support that perceptions of effort are distinguishable from perceptions of exertion. Hutchinson and Tenenbaum (2006) were able to isolate sensory-discriminative (muscle aches), motivational-affective (determination), and cognitive-evaluative (effort) dimensions during exercise in participants. Each dimension showed different changes over time during exercise in both a handgrip and aerobic exercise task, and participants were able to perceive different dimensions distinctly during exercise (Hutchinson & Tenenbaum, 2006). Peñailillo et al. (2018) measured perceived effort, exertion as separate constructs during eccentric and concentric cycling tasks. The authors presented the formal definitions of each to their participants prior to measurement. Perceived exertion differed while amount of effort remained similar for participants completing tasks of different physiological stress (Peñailillo et al., 2018). In addition, the neurological mechanisms underlying effort and exertion differ. Marcora (2009) found that perceptions of effort were unrelated to afferent feedback from the body during aerobic exercise. Lab studies support that effort is independent of afferent feedback, while exertion incorporates this sensory feedback during exercise (Abbiss et al., 2015; Smirmaul, 2012).

In sport and exercise settings, the RPE scale has been used to measure both constructs: perceptions of exertion and perceptions of effort (Abbiss et al., 2015; de Morree & Marcora, 2015; Pageaux, 2016). Borg's RPE scale is one of the most applied in sport and exercise science to assess whole-body perceived exertion, or perceived physiological stress, during exercise (Borg, 1982, 1998). Ratings on Borg's RPE scale are a result of multiple factors, that can include fatigue, pain, discomfort, effort, and strain (Borg, 1982, 1998; Hutchinson, 2021). Peñailillo et al. (2018) reported that when participants are provided with definitions, RPE can be used to measure perceived exertion separately from perceptions of effort. Jones et al. (2015) separately measured physical perceptions of exertion using Borg's RPE scale and mental perceptions of effort using a task effort and awareness scale. Participants were specifically instructed to report how heavy and strenuous the exercise felt, not the psychological effort required to exercise, for the Borg RPE scale. Participants were also instructed the task effort and awareness scale was a feeling that represents mental or psychological effort required to continue exercise at a chosen intensity, including attention, difficulty, and level of consciousness in the effort. Jones et al. (2015) did not find significantly different scores between perceptions of effort and perceptions of exertion during the exercise session. While the findings may support a lack of distinction between constructs, it may instead be that perceptions of exertion encompass effort as a contributing factor while perceptions of exertion do not contribute to perceptions of effort (Jones et al., 2015; Pageaux, 2016).

When studying perceptions of effort in relation to self-efficacy, perceptions of effort in sport and exercise science studies have generally measured subjective effort as an individual's perception of how hard they are trying at a task (Hutchinson, 2021). Effort has been studied as a consequence of self-efficacy in a weight room setting during offseason training (Gilson, Reyes, et al., 2012). In this study, athletes were asked to self-report their confidence in their ability to give effort for the upcoming week, and afterwards how much effort they perceived they gave in their workouts over the past week. In this setting, effort self-efficacy was more impactful than stress, value of resistance training, or demographic variables in predicting athlete effort (Gilson, Reyes, et al., 2012).

Effort has also been studied as a consequence, specifically a behavioral outcome, of self-determined motivation at the situational and contextual level (Vallerand, 2007). Perceived effort is a consequence of more autonomous forms of self-determined motivation in football athletes (Monteiro et al., 2018). Motivational variables as well as expectancies of success should be considered when studying subjective effort as an outcome in athletes (Mudrak et al., 2021). Self-efficacy, task orientation, and integrated regulation positively predicted subjective effort in athletes, while amotivation was a negative predictor (Mudrak et al., 2021). Ego orientation and remaining self-determined motivations did not predict subjective effort. An interesting finding was an interaction effect between self-efficacy and a fixed mindset. Athletes with low self-efficacy and fixed mindsets were lower in subjective effort while athletes with low self-efficacy and growth mindsets reported more subjective effort (Mudrak et al., 2021). Perceived effort is also an important consequence of the motivational climate created by the coach. Pope and Wilson (2012) found that perceptions of a coach's motivational style impacts basic need satisfaction, which in turn fosters autonomous motivation, which increases perceptions of effort.

Achievement Goal Theory

Murray (1938) defined the psychogenic need for achievement in his personality theory. Achievement motivation reflects an individual's efforts to master a task, achieve excellence, overcome obstacles, perform better than others, and take pride in exercising talent (Murray, 1938). Understanding an athlete's achievement goals is valuable to understanding athlete behaviors because an individual's achievement motivation impacts their choice of activity, direction and intensity of effort, and perseverance when confronting challenges (Nicholls, 1984).

Achievement goal theory is rooted in Nicholls' (1984) conceptual framework and can help coaches understand what motivates athletes in both sport-specific and strength training settings (Gilson et al., 2008; Nicholls, 1984). Central to achievement goal theory is an athlete's demonstration of their ability, and therefore their perception of their ability (Lochbaum et al., 2016; Nicholls, 1984). Achievement goal theory states that an individual is motivated by their interpretation of what it takes to achieve success. With this theory, an individual's achievement goals, interpretation of environmental demands, and perceived ability interact to determine their motivations and behaviors. Achievement behavior occurs when the goal is to demonstrate competence or a perception of competence (Nicholls, 1984). Subjective experiences and behavior differ predictably with each achievement behavior, as each achievement orientation shows different judging criteria for demonstrating ability.

As achievement goal theory has developed, the ways in which competence is measured and interpreted has evolved. The first model was the dichotomous model, which differentiated between two achievement goals: mastery and performance (Nicholls, 1984). With mastery goals, individuals demonstrate competence by mastery and improvement in a task. With performance goals, individuals demonstrate competence relative to others. In sport, orientation towards mastery goals are referred to as task-oriented and towards performance goals are known as ego-oriented (Nicholls, 1984). Ego orientations focus on comparing performance to and winning against others, while task orientations focus on comparing performance with personal standards and improvement. Following the dichotomous model, the trichotomous model specified an approach and avoidance valence distinction for performance goals (Elliot & Harackiewicz, 1996). The performance-approach goal classification referred to demonstrating competence by doing well compared to others, while the performance-avoid goal referred to demonstrating competence by not doing poorly compared to others. The 2 x 2 model followed the trichotomous model, adding an approach-avoid distinction for mastery goals (Elliot, 1999).

The 3 x 2 achievement goal orientation model is the current model in the field of achievement goal theory (Elliot et al., 2011). The demonstration of competence is unique from the valence of competence, and both are considered in the 3 x 2 achievement goal model. There are 3 categories of demonstrating competence (task, self, other), and 2 categories of valence (approach, avoid). Mastery-based goals are separated into task-based (demonstrating competence relative to the absolute demands of a task) and self-based (demonstrating competence relative to one's one performance trajectory) categories. Other refers to performance-based goals. The distinction between approach motivation and avoidance motivation is that these two motivations differ in valence of achievement (Elliot, 1999). Approach goals refer to attaining competence for a task, while avoid goals refer to not failing at a task. The six categories are task-approach, task-avoid, self-approach, self-avoid, other-approach, and other-avoid.

Achievement Goal Theory in Sport

While the 3 x 2 achievement goal model is the current accepted standard in achievement goal theory, it has received little attention in sport achievement literature (Mascret et al., 2015). Many studies in sport and exercise science still defer to the dichotomous model of achievement goal orientations. Findings from a meta-analysis report relationships between achievement goals and performance measures that are two times stronger in sport than in education literature (Lochbaum & Gottardy, 2015). A moderate positive relationship was reported between the mastery approach goals and performance measures (Lochbaum & Gottardy, 2015). The performance goal contrast, meaning the absolute difference between approach and avoidance goal scores for an individual, may be a better predictor of sport performance than mastery or performance goals (Lochbaum & Gottardy, 2015). However, most literature evaluates the individual contributions of mastery and performance goals.

Duda (1989) reported that task orientation in sport was related to beliefs that sport should enhance self-esteem and teach people to try their best. Task-oriented individuals are more intrinsically motivated and are more resilient to adversity and failure. Task orientation can protect someone against disappointment and frustration when performance of others is superior. In contrast, ego-oriented individuals struggle to maintain high levels of perceived competence. To protect self-worth, these individuals are more likely to choose easily achievable tasks. Ego-oriented individuals are also more likely to reduce effort or make excuses. Individuals higher in task orientation will perceive effort as an end, while those higher in ego orientation perceive effort as a means to an end (Nicholls, 1984). In addition, Duda (1989) found that ego orientation in sport was related to the view that sport involvement should enhance one's self-esteem and social status. These concepts are supported in track and field athletes, where task orientations were linked to the view that working hard leads to success, while individuals with ego orientations attributed success to ability and external factors (Veligekas et al., 2007).

An individual can have both task and ego goals for a given context because the goals are considered independent yet related constructs, although individuals tend to be higher on one than the other (Nicholls, 1984; Ntoumanis, 2001; Roberts et al., 1996). Athletes competing in individual sports tend to have higher ego orientations than team sport members, females tend to score higher in task orientation than males, and males tend to score higher in ego orientation than females (Duda, 1989; Hanrahan & Cerin, 2009). Ego orientation should not be viewed as negative for athletes, despite some undesirable correlations drawn in existing literature because both task and ego orientation of an individual are important to task satisfaction and performance (Gilson et al., 2008; Hoffman & Strickland, 1995). Individuals with a high ego orientation and low task orientation show less task satisfaction, but the presence of at least a moderate task orientation with a high ego orientation buffers these negative effects (Hoffman & Strickland, 1995).

Goal orientations impact perceptions of weight training in NCAA athletes. Athletes with higher competitiveness were associated with the perception that weight training should be a part of training programs for all sports and that weight training is essential for student-athlete development (Poiss et al., 2004). Athletes with a win goal orientation did not show higher levels of participation in non-required training activities (Poiss et al., 2014). Rather, student-athletes that showed confidence in their weight training abilities were more likely to weight train (Poiss et al., 2004).

Achievement Goal Theory and Self-Determined Motivation in Sport

Ntoumanis (2001) argued that a task orientation could fulfill the basic psychological needs outlined in SDT, thereby enhancing self-determined motivation, while a high ego orientation would not meet these needs. Findings were supported, showing that task orientation can predict higher levels of self-determined motivation, ego orientation can predict introjected regulation and external regulation, while neither could predict amotivation (Ntoumanis, 2001). Additionally, the interaction effect of the two orientations could predict external regulation (Ntoumanis, 2001). The relationship between task orientation and external regulation differed when ego orientation was lower or higher. In individuals with low levels of task orientation, ego orientations did not impact external regulation. In individuals with high levels of task orientation, higher ego orientations related to higher external regulation, while lower ego orientations related to lower external regulation. High task orientation predicted high self-determined motivation, regardless of ego orientation.

In adolescent track and field athletes, higher ego orientation was reported for males compared to females and rural athletes compared to urban athletes (Chin et al., 2012). Older athletes (16-18 yrs) showed higher task orientation than younger athletes (13-15 yrs).

Urban athletes and male athletes were higher in intrinsic motivation, and male athletes were higher in extrinsic and amotivation. Moderate relationships were shown between task orientation and intrinsic and extrinsic motivation, and between ego orientation and intrinsic, extrinsic, and amotivation. In addition, the three motivation types were shown to predict 30.5% of the variance in task orientation, with intrinsic motivation showing the strongest influence. The three motivation types were also found to predict 17.7% of the variance in ego orientation, with extrinsic motivation showing the strongest influence.

In the workplace and educational contexts, self-determined motivations that underlie achievement goal orientations are more effective than achievement goals alone in predicting well-being (Gillet et al., 2014). A performance-approach pursued for autonomous reasons resulted in higher goal attainment than when the performance-approach was pursued for controlled reasons (Gillet et al., 2014). These findings were supported in the sport setting. Performance-approach goals show stronger relationships with sport satisfaction and positive affect when pursued for autonomous reasons compared to controlled reasons (Gaudreau & Braaten, 2016). In addition, relationships between both mastery-approach and performance-approach goals with perceived goal attainment were stronger for individuals pursuing these goals for autonomous reasons (Gaudreau & Braaten, 2016). These findings suggest that considering self-determined motivations in addition to achievement goal orientations may be useful when studying positive well-being as an outcome.

Achievement Goal Measures in Sport

Measures for achievement goal orientation were initially developed in education and extended to the sport domain (Conroy et al., 2003; Elliot & Church, 1997; Elliot & Conroy, 2005; Elliot & McGregor, 2001). Mascret et al. (2015) extended the 3 x 2 achievement goal structure developed by Elliot et al. (2011) into the sport domain, where it was shown that like educational settings, task and self-based goals are distinct in the sport domain. Many studies implementing the 3 x 2 achievement goal orientation structure report on the structure of the measure itself, and studies implementing the measure are lacking.

The 3 x 2 structure has been confirmed in recreational sport, but future research is needed to confirm the 3 x 2 model in other sport domains (Lower & Turner, 2016). Wang et al. (2017) demonstrated measurement invariance across gender and sport for the 3 x 2 achievement goal orientation structure in college athletes. However, correlations between the six achievement goal categories differed between Wang et al. (2017) and Mascret et al. (2015). These differences can be attributed to cultural differences between Eastern and Western countries and how these cultures interpret approach and avoidance valences.

In recreational sport, task-approach goals are positively related to social, intellectual, and fitness benefits of sport participation (Lower et al., 2016). Entity theory is related to other-approach and other-avoidance goals, while incremental theory and intrinsic interest are related to task-approach and self-approach goals (Mascret et al., 2015). In general, task and self-based goals in sport are related to constructs with expected associations to mastery goals, while other-based goals were related to constructs with expected associations to performance-based goals.

The 3 x 2 achievement goals may differ based on level of sport participation. Lower and Turner (2016) found differences in the 6 achievement goal categories between collegiate intramural and club sport participants. The club sport participants scored higher on the mastery-based goals (task-approach, task-avoid, self-approach, self-avoid) than the intramural participants, with no differences between the two groups for performance-based goals.

Intrinsic and Extrinsic Motivation

Motivation, the direction and intensity of one's effort, affects both an athlete's performance and their desire to train and compete. Motivation guides an athlete's behavior during training sessions and competition. Understanding the relationships between an athlete's motivations, training behaviors, and performance can enhance a coach's effectiveness in selection of training strategies for athletes. The interactional view of motivation is the most widely recognized by sport and exercise psychologists. This view suggests that the best way to understand motivation is to evaluate the interaction between individual and situational factors, as neither one alone can determine motivation. In some situations, individual factors predominate, while in others situational factors predominate. The interactional theory of motivation is based on Lewin's (1951) field theory of behavior. Lewin's theory proposed that behavior is the function of the environment and the individual. In sport and exercise, personal factors can be personality, needs, interests, and goals, while situational factors can be a coach's style or win-loss record of a team. Sorrentino and Sheppard (1978) supported the interactional theory of motivation when they analyzed swimmer's affiliation motivation and whether they swam individually or as a relay team on resulting 200m-freestyle performance. The authors found that performance in the 200-m freestyle was not explained solely by either situational or individual attribute. Instead, the trait and situation interaction was most important in explaining performance for swimmers, with both approval-oriented and rejection-threatened traits and for the individual and group competition situations.

Based on the interactional view, studies investigating motivation within athletes must consider the impact of both the situational and trait factors. When exposed to the same situational factors, such as a specific training environment, athletes with different motivational contributions will display different behaviors and responses. When studying an athlete's motives for participation in sport, Deci and Ryan's (1985, 2000) framework is most frequently used. It is important to consider that athletes participate in sport for more than one reason, and that these motives for involvement may be competing. While some motives may be shared among athletes, others may be unique. As motivation influences perceptions of effort and performance, it is reasonable to suggest that an athlete's motivation level may influence their training session outcomes, including the psychological responses to a training session.

Self-Determination Theory

Deci and Ryan (1985, 2000) introduced self-determination theory (SDT), a framework that is used to understand and promote exercise behavior. This theory suggests that an individual's motivation lies on a continuum, which varies in degrees of autonomy. The continuum was initially described in terms of extrinsic to intrinsic motivation but is better described by the extent to which the motivation is controlled or autonomous (Deci

& Ryan, 1985, 2000, 2008). That individual's position along the motivational continuum is determined by the degree to which three basic psychological needs are fulfilled: autonomy, competence, and relatedness. Greater fulfillment of these needs results in a higher position on the self-determined continuum. SDT is an organismic approach, which accepts that individuals interact with their environment and these interactions can enhance or inhibit an individual's motivational behaviors.

SDT is comprised of several mini theories (Deci & Ryan, 2012). Cognitive evaluation theory describes properties that undermine and support intrinsic motivation (Deci & Ryan, 2012). Organismic integration theory distinguishes between motivational types, and describes their properties, determinants, and consequences (Deci & Ryan, 2012). This theory considers autonomous and controlled properties of motivation. Causality orientations theory describes individual differences in trait-like characteristics that reflect an individual's beliefs about their ability to cause change (Deci & Ryan, 2012). Basic psychological needs theory describes three psychological needs, competence, autonomy, and relatedness, that are essential to an individual's psychological well-being (Deci & Ryan, 2012). Goal content theory describes how the content of a goal lead to different outcomes that affect behavior and well-being (Deci & Ryan, 2012). Finally, relationships motivation theory suggests that individuals with higher-quality social support promote well-being.

From the SDT perspectives, individuals engage in activities that satisfy their basic psychological needs. Like the established relationship between teachers and students in the classroom, a coach's behaviors and situational training factors impact an athlete's motivation through fulfillment of these needs (Freeman, 2015; Gillet et al., 2010; Pope & Wilson, 2012). In sport, competence can be experienced through success or failure of a task, or as a function of feedback. Autonomy can be fostered by giving athletes a choice in training variables, such as exercise, load, or exercise order. Relatedness can be fostered through the environment, coaching staff, and teammates. Understanding which training factors can be modified to enhance motivation can assist in developing effective training programs. An athlete's motivation is related to their training behaviors and ultimately their performance, which further emphasizes the need to study relationships between athlete behaviors and motivations in the training environment. Another consideration is that when basic psychological needs are not met, psychological health is weakened (Deci & Ryan, 2000; Vallerand, 2007). Autonomy loss in exercise intensity selection negatively impacted affect, even when the prescribed intensity is the same as the self-selected intensity (Vazou-Ekkekakis & Ekkekakis, 2009).

The fulfillment combination of these three basic psychological needs (autonomy, competence, relatedness) places individuals on a continuum of motivation, and this motivation level serves to regulate behavior. The motivational continuum ranges from less self-determined, or controlled, to more-self-determined, or autonomous, behavior (Deci & Ryan, 1985, 2000). Controlled behaviors are completed without volition and caused by external forces, while autonomous behaviors are volitional and inherent. As the basic psychological needs are met, an individual's motivation becomes more self-determined and shifts towards intrinsic motivation. At the continuum's lowest is amotivation, a controlled and non-self-determined form of regulation. With amotivation, an athlete does not value the activity and participates in the activity because it is required. The next four levels are variants of extrinsic motivation, in which an athlete chooses to perform the activity for reasons other than simply pleasure. External regulation is one step above amotivation, in which an individual's participation is a means to an end. An athlete who is externally regulated may participate in an activity because of external rewards, such as promised playing time if they attend practices. Introjected regulation is the next non-self-determined stage on the continuum. With introjected regulation, individuals participate in an activity due to self-imposed pressures; for example, an athlete who attends practice because they would feel guilty missing. Identified regulation is the first behavior completed out of choice, in which the individual elects to engage in the activity, even though the activity is not viewed as pleasant itself. This could occur when an athlete chooses to attend weight room sessions because they view it as beneficial to their sport success. Integrated regulation is the most self-determined form of extrinsic motivation, in which the individual participates by choice because they view the activity as a sense of self. This could be an athlete who elects to foam roll after practice to enhance recovery for their performance in the next session. Finally, intrinsic regulation is the most self-determined and autonomous behavior on the continuum. An intrinsically regulated athlete participates in an activity for self-enjoyment and fulfillment, such as an athlete who completes a strength training session because they inherently enjoy the experience. In general, autonomous forms of motivation are better predictors of health behaviors and intentions than controlled forms of motivation (Hagger et al., 2014).

Hierarchical Model of Intrinsic and Extrinsic Motivation (HMIEM)

The Hierarchical Model of Intrinsic and Extrinsic Motivation (HMIEM) expands on the SDT conceptual framework to integrate self-determined motivation research at different levels of generality. The HMIEM is comprised of five postulates and five corollaries that explain the motivational relationships, determinants, and consequences at three separate levels of generality: general, contextual, and situational motivations (Vallerand, 2007). Determinants and consequences are specific at the separate levels of generality, and top-down and bottom-up effects are present in relationships between the levels.

The first postulate states that motivational analysis must include the full range of amotivation, extrinsic motivation, and intrinsic motivation, and the second postulate states that intrinsic and extrinsic motivation exist at all three levels of generality. Postulate three states that motivation is determined by social factors, resulting from any of the three levels of generality, and is determined by top-down effects from motivation at the proximal level in the hierarchy. The perception of the three basic psychological needs mediates the impact of social factors on motivation. Postulate four states that a bottom-up relationship also exists between any level and the next level higher up. The fifth postulate states that motivation leads to important affective, behavioral, and cognitive consequences, which are decreasingly positive from intrinsic motivation to amotivation. In addition, consequences can occur at all levels (global, contextual, situational) and the degree of the consequences depends on the level that produces them.

Situational motivation describes an individual's motivational experience during a specific activity at a specific point in time, such as an athlete practicing penalty kicks. At the situational level, motivational determinants include rewards, competition, positive and negative feedback, and choice. Important consequences of situational motivation include occurrence of positive affective outcomes, self-esteem, increased attendance, and impacts on perceived exertion, effort, and performance. Contextual motivation is one's motivation toward a specific life context, for example, the general motivation for sport participation or for academics. At the contextual level, motivational determinants include coach, motivational climate, scholarships, and sport structures. Consequences of contextual motivation include relationships with burnout, exercise dependence, self-esteem, satisfaction, interest, and enjoyment, in addition to relationships with proactive tendencies, effort, persistence, and performance. Motivation at the global level has been less studied. Consequences of global motivation include psychological adjustment and adaptive functioning, protective function from external pressures, and integration among life contexts.

In each one of these levels, social factors influence the mediating psychological needs of autonomy, competence, and relatedness, which then impact motivation and result in affective, cognitive, and behavioral consequences at that level. In addition, top-down and bottom-up effects between the levels occur, including effects between different contextual motivations in the contextual level. Top-down and bottom-up effects were observed between contextual motivation for basketball and situational motivation during games over the span of a season (Blanchard et al., 2007). Additionally, contextual motivation for health did not predict contextual motivation to exercise in male exercisers (González-Cutre et al., 2011). The dynamic relationship between different levels of generality is an important consideration when studying a specific level of self-determined motivation. Contextual motivation for sport can show a top-down effect on the situational level of practicing a drill, which can impact affective outcomes at that moment.

The Cognitive-Motivational-Relational Theory and Self-Determination Theory

The cognitive-motivational-relational theory (CMRT) is an extension of cognitive appraisal theory of emotion that states appraisals, goals, and external factors interact to generate emotion (Lazarus, 1991b). Ntoumanis et al. (2009) studied conceptual links between Lazarus's (1991a, 1991b) CMRT and Deci and Ryan's (1985, 2000) SDT. As Lazarus (1991b) proposed, motivation is essential to understanding emotional responses to appraisals of goal progress or attainment. Ntoumanis et al. (2009) proposed a model that shows relationships between variables in both theories, and the final model illustrates how motivational factors are essential to understanding cognitive appraisals in the coping process. The CMRT is also the foundation of the first pillar of Kellmann's (2002) scissors model, which explains relationships between perceived stress and recovery states in athletes. The key connection of Lazarus's (1991b) emphasis of cognitive appraisals in the reaction to a stressor shows a potential relationship between an athlete's recovery-stress state and their motivations, and how this impacts their health-related, affective, and behavioral outcomes.

Ntoumanis et al.'s (2009) model of stress, coping, and motivation suggests that several factors contribute to stress appraisals. This includes an individual's demands, constraints, and available resources. An autonomy-supporting social environment also impacts stress appraisals, both directly and indirectly via fulfillment of psychological needs. Psychological needs satisfaction and motivational regulations, both contextual and goal-specific, also impact stress appraisals. Finally, personality traits and dispositions can also contribute. Ntoumanis et al. (2009) proposed that stress appraisals, emotions, psychological responses, and personality traits all influence an individual's coping strategies. This model supports a multidimensional structure in understanding the relationship between motivations, goal orientations, and mood states and an athlete's behaviors in a training environment.

Motivations and Psychological Responses to Exercise

A major posit of self-determination theory is that when basic psychological needs are not met, psychological health is weakened (Deci & Ryan, 2000; Vallerand, 2007). As an example, autonomy loss in exercise intensity selection negatively impacts affect, even when the prescribed intensity is the same as the self-selected intensity (Vazou-Ekkekakis & Ekkekakis, 2009). Several studies have linked behavioral regulations to the affective outcomes of exercise. The interaction of situational behavioral regulations based on SDT (specifically intrinsic, identified, and introjected regulation for running) and intensity (sRPE) during a 30-minute self-paced treadmill run in healthy, active women was able to predict change in positive affect post-run (Guérin & Fortier, 2012). A significant interaction was found between sRPE and introjected regulation when predicting positive affective change, but not for intrinsic or identified regulation. This interaction explained an additional 9% of the variance in positive affect change. The impact of perceived intensity on change in positive affect was greater for runners with low introjection, with higher sRPE related to greater positive change in affect, while runners with high introjected regulation showed little fluctuation. Overall, runners with high levels of introjected regulation showed greater gains in affect. Findings of this study support the suggestion that self-determined motivation should be considered when assessing positive affect and exercise.

A two-week field study examining situational self-determined motivation and exercise intensity on affective change found that intrinsic motivation was related to immediate post-run positive affect, and identified regulation was related to affect measures 3-hours following running (Guérin et al., 2013). Introjected and external regulations were not associated with affect, but introjected regulation was related to session RPE (sRPE). As sRPE was strongly associated with affective change immediately following activity the authors suggested this may not be undesirable. In another study examining the exercise-affect relationship in running, seven percent of the variance in post-run positive affect was explained by situational SDT motivations (Guérin & Fortier, 2013). Introjected regulation, but not self-determined regulations, moderated the relationship between running and affect, and identified regulation uniquely contributed to explaining an increase in positive affect following running (Guérin & Fortier, 2013).

Achievement goal orientations also contribute to the relationships between self-determined motivation and affect (Gaudreau & Braaten, 2016). Specifically, self-determined motivation moderated the relationship between goal orientations and perceived goal attainment, sport satisfaction, and affect. The positive relationship between both mastery and performance approach goals with perceived goal attainment was stronger in athletes with high autonomous motivation (Gaudreau & Braaten, 2016). The relationship between performance-goals with sport satisfaction and positive affect was stronger in athletes with high autonomous motivation. Self-determined motivation should be considered when studying relationships between achievement goals and affective outcomes.

Measurement of Intrinsic and Extrinsic Motivation

The Sport Motivation Scale (SMS) is the most widely cited motivation scale for sport (Clancy et al., 2017). The original Sport Motivation Scale (SMS) assesses contextual motivation multidimensionally based on SDT (Pelletier et al., 1995). While the SMS has reported acceptable reliability and validity in many studies, some studies reported concerns with the scale. The SMS-6 was introduced to address the issues of the SMS with the identified regulation subscale and to add an integrated regulation scale (Mallet et al., 2007). Additionally, this version may be more suitable for older and more experienced athletes. Like the SMS, the initial validation still showed issues with discriminant validity for identified regulation (Mallett et al., 2007). Due to the raised concerns by Mallett et al. (2007) and Lonsdale et al. (2008), the original authors of the SMS addressed these issues. They consulted a panel of SDT and sport motivation experts to review the original SMS and assist in the revisions (including Deci, Pelletier, Vallerand, and Ryan). Pelletier et al. (2013) introduced a revised SMS, the SMS-II, adding the integrated regulation subscale and a single intrinsic subscale to replace the three intrinsic motivation subscales on the SMS. The SMS-II has a reduced length of the scale for easier implementation purposes and is the current survey for measuring self-determined motivation in sport (Pelletier et al., 2013).

Perceived Recovery and Stress States

Kellmann's (2002) scissors model provides a foundation for understanding the interrelationship between stress states and recovery demands for athletes (Kellmann, 2002). An athlete's recovery-stress state represents the extent to which the athlete is physically and/or mentally stressed, as well as their capability for using recovery strategies (Kellmann, 2002). A balanced recovery-stress state is desirable for optimal performance and athlete well-being, while an imbalance in this state can lead to detrimental consequences.

The Scissors Model

Kellmann's (2002) scissors model has two foundational pillars. The first pillar of this model is based on Lazarus's (1991a) cognitive-motivational-relational theory (CMRT) of coping, which suggests that an individual's subjective perception of external demands results in an individualized stress response (Lazarus, 1991a). While stressors are situational factors that contribute to stress, stress is the result or net effect of the stressors on the individual (Kellmann, 2002). Stress is traditionally defined as a deviation from an individual's psychophysical balance or homeostasis. The CMRT links emotions with motivation and highlights the importance of cognitive appraisals in an individual's reaction to stressors (Ntoumanis et al., 2009). In this way, a specific stressor can result in different degrees of stress between individuals. The same stressor can also result in different degrees of stress within the same individual on separate occasions because the current state and circumstances surrounding the person influences their response. Variations in the intensity, duration, distribution over time, and nature of the stress can impose different responses from the same stressor, and the interaction of multiple stressors can produce a different response than a single stressor (Kellmann, 2002). Stress can exert both positive or negative effects and is accompanied by emotional symptoms, hormonal responses, alterations in nervous system activation, immune functioning, and behavior. All these effects impact an individual's well-being and their capacity to handle additional imposed stressors (Kellmann, 2002). Due to the individualized stress response, stress is best measured as an overall perception or experience, rather than summing the frequency or occurrence of individual stressors.

In athletics, stress is experienced as the accumulation and interaction of both training and non-training related stressors. Athletes are constantly exposed to training-related stressors as part of their participation in sport. Athletes will respond differently to the same training-related stressor, due to the nature of inter- and intra-individual variations of perception, response, and impact of current conditions. Unfortunately, many studies related to athletic performance focus only on training-related stressors, such as internal and external training loads, and have ignored the impact of stress from outside the athletic event (Felsten & Wilcox, 1992). Non-training related stressors for student-athletes, such as life events and academic pressures, are shown to impact perceptions of stress in student-athletes. Academic stress impacts perceived stress in collegiate student-athletes, particularly during periods of heavy exams (Hamlin et al., 2019; Mann et al., 2016; O'Flynn et al., 2018). Periods of increased academic stress were also able to predict injury and align with illness during training (Hamlin et al., 2019; Mann et al., 2016). It is evident that approaches to measuring perceived stress must consider both training and non-training related stressors to adequately assess the stress state of the athlete from a global perspective.

The second pillar of the scissors model states that while recovery and stress are interrelated, recovery cannot be defined as simply the absence of stress (Kentta & Hassmen, 1998). An individual's recovery status reflects their biopsychosocial balance, which includes psychological, mood-related, emotional, behavioral, social, and physiological levels, that all must be considered to adequately assess recovery (Kellmann & Kallus, 1999; Kellmann et al., 2018). Recovery is defined as an umbrella term that encompasses multiple modes of practice (Kellman et al., 2018). First, recovery is a gradual and continuous process in which relativity to time is essential. Recovery depends on a break from, reduction of, or increase or decrease in stress. Recovery is specific to the individual, depends on the individual's needs, and is tied to situational conditions. Recovery is multidimensional, comprised of psychological, physiological, behavioral, social, and environmental levels. Processes that contribute to stress in the body can occur before, during, after a stimulus. This means that the timing and magnitude of each subprocess may be predictable. Finally, engaging in recovery practices is a self-determined process (Kellmann, 2002).

When referring to physiological recovery, modalities that follow physical fatigue induced by training recovery is referred to as "regeneration". In sport, recovery practice may consist of regenerative strategies include cold water immersion, nutritional interventions, and sleep (Kellmann et al., 2018). To address mental fatigue, psychological recovery strategies are employed. These strategies can include cognitive self-regulation, psychological relaxation techniques, and resource activation (Kellmann et al., 2018). In both areas, approaches to recovery can be passive, active, or proactive. Massage is an example of a passive recovery strategy. A session of cooldown and stretching is an example of an active recovery strategy. Participating in a recovery run outside of practice time is an example of a proactive recovery strategy. An athlete's involvement and participation in recovery strategies, as well as the coach's programmed recovery modes, will impact the athlete's fluctuating recovery state and the athlete's ability to cope with perceived stress and additional stressors.

This second pillar of the scissors model relies on Kentta and Hassmen's (1998) assessment of recovery, in which the main factor responsible for staleness in training is a lack of sufficient recovery to match the experienced stress. Recovery practices must be sufficient to meet the athlete's current state of stress for an individual's stress level to remain stable (Kellmann, 2002). In a state of adequate recovery, athletes can cope with their current stress levels without the need for additional recovery resources. However, as an athlete's stress level increases, the athlete's demand for recovery increases. When the increase in stress gets too large and exceeds the athlete's recovery resources, the athlete's recovery is inadequate to meet an athlete's current stress levels and the imbalance leads to more accumulated stress. This accumulation of stress without proper recovery intervention can lead to detrimental states of under-recovery, overreaching, overtraining, injury, and illness (Kellmann, 2002). In this model, high levels of stress require high levels of recovery interventions. This means that high levels of stress, such as those seen in heavy training periods, are not theoretically unfavorable if proper recovery resources are available for the athlete. If, however, the adequate recovery resources are not available to the athlete, an imbalance will occur. An extended imbalance of these demands leads to elevated stress, which can not only reduce performance but also lead to undesirable health and wellness conditions for the athlete (Kellmann & Kolling, 2019).

This model promotes the assessment of recovery-stress states of an athlete to inform and assist the training process. Of particular importance and novelty in this model are the acknowledgement that non-sport stressors impact an athlete’s biopsychosocial state, and the organismic approach to recovery activities (Kellmann et al., 2018). Sensitivity to an athlete’s daily recovery-stress balance can contribute to individualization of programming necessary to maintain the performance and well-being of the athlete (Kellmann, 2002). Recovery can compensate fatigue and allow for the re-establishment of performance abilities (Kellmann & Kallus, 2001; Kellmann et al., 2018). While non-training related factors may be out of the athlete or coach’s control, part of a coach’s responsibilities is to create and implement a training program for the athlete; meaning, the coach can alter pieces of a training program to react to or impact the recovery-stress state. In addition, the athlete can proactively engage in recovery activities to anticipate or meet stress states/demands. In this way, the athlete can impact their recovery state and their recovery-stress balance. When properly monitored, coaches and athletes can assess and address imbalances in the athlete’s recovery-stress state to enhance athlete well-being.

Recovery and Stress State Sensitivity to Training Loads

Recovery-stress states are sensitive to changes in training loads, both between training cycles and at an acute level. Changes in recovery-stress states have been documented following both increased and reduced training volumes and with changes in training intensity. When monitored periodically (weeks to months), recovery-stress states reflect the athlete's general response to changes in training load for a specific training cycle (Coutts & Reaburn, 2008; Coutts et al., 2007; Freitas et al., 2014; Horta et al., 2019; Jürimäe et al., 2002; Kellmann & Gunther, 2000). When monitored daily, recovery-stress states reflect acute alterations in daily training loads (Collette et al., 2018; Flynn et al., 2017).

Weekly and bi-weekly monitoring of the recovery-stress state can detect changes in response to both increased and reduced training loads, as quantified by session duration and session RPE (Coutts & Reaburn, 2008; Coutts et al., 2007; Freitas et al., 2014; Horta et al., 2019; Jürimäe et al., 2002; Kellmann & Gunther, 2000). Increases in stress and reductions in recovery are observed following periods of intensified training, while reductions in stress and improvements in recovery are observed following periods of reduced training. Recovery-stress alterations are also observed following specific training block manipulations. Following a 12-week training block of reduced volume and increased intensity in elite swimmers, general stress was lower and recovery was higher compared to traditional training (Elbe et al., 2016). These studies show that the recovery-stress state of an athlete is likely to change based on their training cycle and that stress imposed by training load selection of the coach can impact the recovery-stress state of an athlete.

Additionally, recovery-stress imbalances have been linked to performance. Triathletes who followed a more intensified training period initially showed lower performances and more imbalanced recovery-stress states than the triathletes who followed the less intensified period; however, their performance improvements and recovery-stress state were greater following the taper (Coutts et al., 2007).

More frequent assessments of recovery-stress states demonstrate highly individualized responses to training load alterations (Collette et al., 2018). Use of the Acute Recovery Stress Scale to monitor swimmers daily over a 17-week span showed relationships between recovery-stress states and internal training loads with a 1-day ARSS lag (Collette et al., 2018). Findings support the sensitivity of the ARSS to respond to acute changes in training load, particularly in the physical and overall scales. Lower correlations with the emotional and mental scales indicate that these subscales may be more affected by non-training related factors. Stronger correlations with session RPE compared to acute-to-chronic workload ratio suggests the ARSS is more sensitive to detecting acute changes in internal load. Interactions between training load and recovery-stress state display high inter- and intra-individual differences and confirms a necessary multi-level approach to this data analysis (Collette et al., 2018).

Daily monitoring of volleyball athletes for 18 consecutive days with the Short Recovery Stress Scale (SRSS) showed moderate-to-strong correlations between total training load (quantified as sRPE) and SRSS questions (Flynn et al., 2017). The SRSS showed stronger correlations for a 1-day compared to a 2-day lag with training load, indicating the training load of the day before is related to the athlete's recovery-stress state the following morning. The SRSS can sensitively detect acute changes in training load, and interpretation of a single recovery dimension and single stress dimension, rather than individual items, may increase practicality of the SRSS as a daily monitoring tool (Flynn et al., 2017).

Acute assessments of recovery-stress states can sensitively detect changes in daily training load. Studies support the use of acute recovery-stress measures to detect states from non-training related factors. Therefore, use of acute recovery-stress assessments to monitor athletes daily is a practical, informative method of detecting recovery-stress imbalances in athletes. These tools can be used to inform training variable manipulations by coaches, as well as highlight the need for recovery protocols in an athlete, in effort to maintain the recovery-stress balance.

The Scissors Model and Self-Determination Theory

Deci and Ryan's (1985, 2000) self-determination theory supports a potential relationship between athlete recovery-stress states and their motivations, particularly with their self-determined behavioral regulations. Connections have been established between Deci and Ryan's (1985, 2000) self-determination theory and Lazarus's (1991b) CMRT, and the CMRT is a foundational principle in explaining the recovery-stress state (Ntoumanis et al., 2009). In addition, the scissors model takes an organismic approach to recovery, which posits that athletes actively engage in recovery interventions (Kellmann, 2010). The model's organismic approach to recovery allows athletes to be proactive in response to increased stress levels. Recovery from stress is viewed as a process of self-regulation (Beckmann & Kellmann, 2004). Differences in athlete self-regulation impact the athlete's selection and implementation of recovery methods in the recovery process (Beckmann & Kellmann, 2004). Volitional components of self-regulation, including self-determination, positive self-motivation, emotion control, self-relaxation, initiative, and self-efficacy, promote recovery states (Beckmann & Kellmann, 2004). Individuals higher on these self-regulation components are more likely to achieve high recovery states than those with lower self-regulatory abilities. Self-regulation can help athletes cope with adverse conditions and disturbances to recovery strategies, and further that athlete's recovery. Employing proactive recovery techniques, compared to passive techniques, require high levels of athlete self-determination (Kellmann, 2002). Therefore, it is reasonable to suggest that athletes with higher levels of self-determined motivation may experience fewer fluctuations or imbalances in the recovery-stress state and may be able to tolerate higher levels of perceived stress than individuals with lower self-determined motivation.

Few studies investigate relationships between self-determined motivation and recovery-stress states in athletes. Stoa et al. (2020) found that external regulation may be a more appropriate indicator of general stress among student-athletes than intrinsic motivation. In this study extrinsic regulation, but not intrinsic motivation for sport, predicted life stress over a season, with no difference between genders (Stoa et al., 2020). Additionally, assessing self-determined motivation combined with recovery-stress states could be a better predictor of training states. Fagundes et al. (2019) showed that amotivation and sport-specific stress together best predicted burnout in different training periods for soccer players. These preliminary studies provide support for impactful relationships between motivational orientations and recovery and stress states.

Acute Measures of Perceived Recovery and Stress

The assessment of perceived recovery-stress states in sport settings is frequently accomplished using psychometric self-report measures (Taylor et al., 2012). While 84% of coaches use self-report questionnaires to monitor fatigue and recovery, 80% of those coaches use self-designed rather than validated forms due to the lengthy survey completion time in real-world settings (Taylor et al., 2012). Although many coaches use self-designed forms to collect this data, validated tools are recommended above unvalidated custom psychometric questionnaires (Kölling & Kellmann, 2020; Saw et al., 2017). Psychometric self-report methods are preferred over physiological biomarkers because generally, subjective and objective measures of athlete well-being do not correlate well (Saw et al., 2016). Subjective measures reflect the impact of acute and chronic training loads better than objective measures for athlete well-being (Saw et al., 2016). Particularly, measures of mood disturbance, perceived stress, perceived recovery, and symptoms of stress were more sensitive than objective measures in detecting these changes (Saw et al., 2016). Subjective measures are also inexpensive and easy to implement in practical training settings. Implementation of athlete self-report measures can be facilitated by collecting measures with technology such as a smartphone rather than pen and paper with an easy-to-use interface (Saw et al., 2014).

The Short Recovery Stress Scale (SRSS) was designed to assess the multidimensional acute recovery and stress state of an athlete on emotional, mental, physical, and overall levels in a sport-specific manner (Kellman & Kolling, 2019). The SRSS is an abridged version of the Acute Recovery and Stress Scale (ARSS), designed to be implemented more economically in practical settings. The typical completion duration for this survey is 40-60 seconds. As the SRSS is an acute measure, the time or context of measurement greatly influences the SRSS results; therefore, these should be kept constant when comparison of results is desired (Kellman & Kolling, 2019). For example, the time of day an assessment is completed or the current training cycle will influence results. Completing the survey at the same time every day can ensure longitudinal data is appropriate for comparison.

Correlations with the RESTQ-Sport showed positive correlations among related items and negative correlations among opposite items. Correlations were found between the DOMS and the Muscular Stress subscale. Tension, depression, anger, fatigue, and confusion POMS mood states correlated negatively with recovery items and positively with stress items. Vigor POMS mood state correlated positively with recovery items and negatively with stress items.

Strength Training

A well thought out annual training plan is essential for an athlete's success. Traditionally, the annual plan is organized with a periodized overview and programming details focusing on developing desired physiological adaptations and performance goals (DeWeese et al., 2015a). Periodization is the planned progression and sequencing of training, while programming choices drive the periodization model (Hornsby et al., 2020). Programming is particularly important in managing fatigue and ensuring progress toward planned phase goals. A recent survey of over 150 strength and conditioning coaches showed that 96% of coaches used periodization strategies to structure their programs (Weldon et al., 2020). Periodization of auxiliary training such as the weight room should align with the overall training plan (Haff & Haff, 2012). In track and field, periodization guides the training plan to reach peak performance at indoor and outdoor championship competitions. Development of physiological adaptations that support sport performance is a key component of strength training programs. Generally, the conceptual periodization model for track and field in the weight room is designed to optimize power output (DeWeese et al., 2015b). This begins by first developing muscular hypertrophy and work capacity, followed by basic strength training, and finally power-oriented training (DeWeese et al., 2015b). Exercises that maximize transfer of training for track and field are multi-joint exercises that require quick production of high levels of force (DeWeese et al., 2015b). Evidence supports the use of block periodization methods for track and field athletes to optimize desired physiological adaptations (DeWeese et al., 2015a).

Powerlifting and Weightlifting for Sport

Powerlifting and weightlifting exercises are commonly used in strength training programs to develop strength and power in sports at all competitive levels (Chiu & Schilling, 2005; Duehring et al., 2009; Ebben et al., 2004; Simenz et al., 2005; Weldon et al., 2020). Powerlifting exercises include the squat, bench press, and deadlift, while weightlifting movements include the snatch and the clean and jerk (Chiu & Schilling, 2005; Ferland & Comtois, 2019). The snatch is more technical than the clean and jerk, while the clean and jerk requires more strength and force production (Chiu & Schilling, 2005).

Strength and conditioning programs often use variations on competitive weightlifting exercises (Suchomel et al., 2015; Suchomel et al., 2020). The hang (barbell not on the floor) and power (on the floor) versions of the clean and snatch are popular in strength training programs (Chiu & Schilling, 2005). Weightlifting exercises and their derivatives are also referred to as Olympic-style lifts, Olympic weightlifting, and Olympic lifting in literature. Powerlifting exercises primarily develop strength, while weightlifting exercises rely on and develop power (Stone et al., 2006).

The squat exercise and Olympic-style lifts are consistently reported as the most frequently used exercises in strength and conditioning programs and are recommended for track and field athletes (Bolger et al., 2016; Cissik, 2013; Duehring et al., 2009; Ebben et al., 2004; Ebben & Blackard, 2001; Simenz et al., 2005). For track and field, it is recommended that Olympic lift and squat exercises be performed at the beginning of the strength training session (Cissik, 2010). This aligns with general strength training programming recommendations (Ratamess, 2012). Multi-joint exercises that recruit large muscle groups should be performed at the beginning of the training session while the individual is in a non-fatigued state (Simao et al., 2012). This allows for more repetitions in an unfatigued state for primary exercises that maximize transfer to sport. Olympic lifts, due to their technical demands and explosive force production, should be performed first while the athlete is in a non-fatigued state (Ratamess, 2012). Primary multi-joint strength movements, such as the squat and bench press, should follow (Ratamess, 2012). Smaller muscle groups and single-joint movements should be programmed after the primary power and strength movements.

Conclusion

Psychological responses to exercise include both positive and negative subjective exercise experiences (McAuley & Courneya, 1994; Watson & Tellegen, 1985; Zenko & Ladwig, 2021). These psychological responses are important for exercise adherence and guiding future behavior in the exercise environment (Kwan & Bryan, 2010). Both cognitive and physiological aspects during exercise contribute to the affective exercise response (Ekkekakis, 2003). Cognitive components that contribute to the psychological responses can include motivations, beliefs, and goals. A well-studied cognitive component in the exercise-affect relationship is self-efficacy (Ekkekakis, 2003; Ekkekakis, 2009b; Elkington et al., 2017). Individuals with higher self-efficacy report more positive responses to exercise sessions, give more effort during exercise, and perform better (Bozoian et al., 1994; Gilson, Chow, et al., 2012; Hutchinson et al., 2008; Moritz et al., 2000). Past performance strongly influences an individual's self-efficacy. An individual's perceptions of their performance may be more impactful than objective performance measures in impacting future behavior in the exercise environment. Self-evaluations of performance compared to an individual's definition of success is what drives behavioral change (Bandura, 1977). Achievement goal orientations define how an individual demonstrates competence (compared to self, task, or others) and valence (approach or avoidance; Elliot et al., 2011). With each achievement goal orientation, subjective exercise experiences and behavior are predictable (Duda, 2004; Nicholls, 1984). Therefore, it can be expected that an individual's self-efficacy will impact their psychological responses to exercise in the strength training environment, and that more insight to these relationships can be provided when considering how these individuals define success. Fluctuations in daily psychological states may also impact an individual's self-efficacy and should be considered in relation to the strength training session. These insights may be particularly informative for NCAA D1 athletes in the strength training environment.

Purpose Statement and Hypotheses

Purpose Statement

The purpose of this study was to examine the relationships of daily effort, daily self-efficacy, and athlete daily subjective self-evaluations of performance with athlete positive well-being and psychological distress following a strength training workout in the weight room. A secondary purpose of this study was to study the relationships between daily self-efficacy and effort with subjective performance in the squat, bench press, and Olympic lift exercises, and whether these relationships vary between individuals with different motivational traits. Finally, this study sought to determine whether athlete's daily perceptions of recovery and stress impacted their daily self-efficacy before a strength training workout.

Statistical Hypotheses

Research Aim 01. H_0: Daily effort, self-efficacy and perceived performance do not explain variance in positive well-being and psychological distress following a strength training workout. Achievement goal orientations, self-determined regulations, and aggregate self-efficacy do not explain additional variance in the dependent variables. H_A: Daily effort, self-efficacy and subjective performance do predict variance in positive well-being and psychological distress following a strength training workout. Achievement goal orientations, self-determined regulations, and aggregate self-efficacy explain additional variance in the dependent variables.

Research Aim 02. H_0: Daily effort and daily self-efficacy levels cannot explain variance in an athlete's subjective performance evaluation for the squat, bench press, and Olympic lift exercises. Achievement goal orientations, self-determined motivations, and aggregate self-efficacy do not explain additional variance in subjective performance. The relationship between daily effort and subjective performance is the same between individuals. Trait variables cannot explain individual differences in the effort-performance relationship. H_A: Daily effort and daily self-efficacy levels can explain variance in an athlete's subjective performance evaluation for the squat, bench press, and Olympic lift exercises. Achievement goal orientations, self-determined motivations, and aggregate self-efficacy help explain additional variance in subjective performance. The relationship between daily effort and subjective performance is not the same between individuals. Trait variables can explain individual differences in the effort-performance relationship.

Research Aim 03. H_0: Perceived stress and perceived recovery states cannot explain variance in daily self-efficacy before a weight room workout. Perceived stress and perceived recovery states cannot explain variance in daily self-efficacy for the squat, bench press, and Olympic lift exercises. H_A: Perceived stress and perceived recovery states can explain variance in daily self-efficacy before a weight room workout. Perceived stress and perceived recovery states can explain variance in daily self-efficacy for the squat, bench press, and Olympic lift exercises.

Chapter Three: Methods

Participants and Setting

Participants in this study were NCAA Division 1 track and field student-athletes from the strength and power events. Forty-four participants volunteered for this study. Twenty-nine participants were included in the final analysis. Participants included 12 males and 17 females between the ages of 18 and 23. This was a convenience sample, as the athletes from George Mason University were selected. There was no assignment to conditions. All volunteers participated in all sessions.

To be included in this study, participants had to currently be on the track and field team at an NCAA institution and currently participating in team training. Participants had to be part of the strength and power events to ensure homogeneity of training in the sample. Participants were required to be able to successfully complete the required weight room lifts with correct technique, assessed by a certified strength and conditioning coach. Participants had to be injury-free and healthy to participate in practice and competition, as evaluated by the university's athletic training staff. Participants were excluded if they had existing medical conditions or chronic diseases that required medical supervision during exercise. Participants could not have current musculoskeletal injuries that prevented them from full team practice participation.

Research was conducted in the student-athletes' regularly scheduled practice environment. Weight room sessions were completed in the university's athletic weight room, during the student-athletes regularly scheduled strength training sessions, allowing the data to be collected in the student-athlete's natural training setting.

Data Sources

Self-report descriptive, state, and trait variables for each athlete were measured with an electronic survey. All scales used for data collection are included in the Appendices. Athletes were asked to self-report the following descriptive information: gender, age, years of sport experience, years of resistance training experience, year in school, competitive event, and value of strength training (see Appendix B).

Measured trait variables included self-determined motivation and achievement goal orientation. Self-determined motivation was measured with the Sport Motivation Scale II (SMS-II) questionnaire, based on Deci and Ryan's self-determination theory (Pelletier et al., 2013). Achievement goal orientation was measured using the 3 x 2 Achievement Goal Questionnaire for Sport (Mascret et al., 2015). These measures were expected to be stable over the 4-week period of this study and were therefore collected once prior to the daily data collection period.

Measured state variables included acute measures of perceived recovery, perceived stress, task-specific self-efficacy, effort, perceived performance, positive well-being, and psychological distress. These measures were collected at every training session. Perceived recovery and perceived stress states were assessed prior to each training session with the Short Recovery and Stress Scale (SRSS). Task-specific self-efficacy was assessed prior to the training session with customized, task-specific questions. Subjective performance and effort were assessed following the training session with a single question each. Self-efficacy, effort, and subjective performance were collected for the overall workout, the squat, the bench press, and the Olympic lift exercises. Positive well-being and psychological distress were collected once prior to each workout session and once following each workout session using the Subjective Exercise Experiences Scale (SEES).

Instruments

The following instruments were used to measure the constructs in this study.

Self-determined Motivation (SMS-II)

Contextual motivation for strength training was measured using the Sport Motivation Scale II (Pelletier et al., 2013). The scale verbiage was adapted context-specific to strength training (see Appendix C). The stem "In general, why do you practice your sport?" was customized to "In general, why do you strength train?" For each item, participants were asked to indicate their response on a 7-point Likert scale, ranging from "Does not correspond at all" to "Corresponds exactly". The SMS-II has six subscales: amotivation; external regulation, introjected regulation, identified regulation, integrated regulation and intrinsic regulation. Each subscale contains 3 items.

A confirmatory factor analysis indicated good fit for the data for both men and women, and for individuals above and below 40 years old ($\chi^2(120) = 231.88$, $p < 0.001$; CFI=.94; RMSEA=.06, 90% CI=.04-.06). Cronbach's alpha for the factors ranged between .70 and .88, with introjected regulation at .70, and correlational analysis verified the existence of a simplex pattern between factors.

3x2 Achievement Goal Questionnaire for Sport (3x2 AGQ-S)

The 3x2 Achievement Goal Questionnaire in Sport (3x2 AGQ-S) was used to measure achievement goal orientations (see Appendix D; Mascret et al., 2015). The 3x2 AGQ-S has six subscales: task-approach, task-avoid, self-approach, self-avoid, other-approach, and other-avoid. The questionnaire contains 18 items, with 3 items loading on each scale. The stem provided for each item was "In the weight room, my goal is…". For each item, participants were asked to indicate their response on a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree).

Confirmatory factor analysis supports the six-factor structure of the 3x2 AGQ-S in the sport setting (Lower & Turner, 2016; Mascret et al., 2015). A high level of internal consistency for each subscale was reported, with Cronbach's alpha exceeding .80 (Lower & Turner, 2016; Mascret et al., 2015). Validity of the 3x2 AGQ-S subscales has been shown through relationships with constructs that are expected to be correlated with each subscale (Mascret et al., 2015). Entity theory is positively related to other-approach and other-avoid goals, while incremental theory and intrinsic motivation was positively related to task-approach and self-approach goals (Mascret et al., 2015).

Recovery and Stress States (SRSS)

The Short Recovery and Stress Scale (SRSS) was used to measure perceived recovery and perceived stress states (see Appendix E; Kellman & Kolling, 2019). The mean recovery score and the mean stress score was used to represent perceived recovery and perceived stress (Flynn et al., 2017). The SRSS consists of eight items based on the ARSS scales (Physical Performance Capability, Mental Performance Capability, Emotional

Balance, Overall Recovery, Muscular Stress, Lack of Activation, Negative Emotional State, Overall Stress) which are grouped into two scales (Short Recovery Scale, Short Stress Scale). Items are presented as multidimensional (ex: "Physical Performance Capability (*strong, physically capable, energetic, full of power*)"). Athletes are asked to rate how they feel "right now in relation to their best ever" recovery state and "right now in relation to their highest ever" stress state. Items are rated on a 7-point Likert scale ranging from 0 (does not apply at all) to 6 (fully applies). Higher values on stress scales represent more subjective stress, while higher scores on recovery scales represent more recovery activity.

High test-retest reliability for the SRSS should not be expected, as the measure is designed to be sensitive to acute changes (Kellman & Kolling, 2019). Test-retest reliability for each item shows low to moderate correlations. The highest correlations for test-retest reliability are observed under similar conditions (ex: same time of day and same training cycle; Kellman & Kolling, 2019). Internal consistency for the Short Recovery Scale and the Short Stress Scale in a sample of North American athletes was good (Short Recovery Scale α=.87; Short Stress Scale α=.83). Cronbach's α ranges from .78 to .84 in North American samples (Kellman & Kolling, 2019). Improved homogeneity was observed over time, suggesting reliability can be improved as participants become more familiar with this scale (Kellman & Kolling, 2019). Concurrent validity for the SRSS has been established by correlations with the RESTQ-Sport, the DOMS, and the POMS.

Self-Efficacy

Task-specific self-efficacy measures were collected for each strength training session (see Appendix F). Self-efficacy was quantified using a custom, domain-specific measure, based on the recommendations of Bandura (2006). Each single item response was presented on a 0 to 10 scale. Bandura suggests that scales of perceived self-efficacy should be domain-specific, and as such many researchers use their own variations of Likert-based self-efficacy scales. Bandura (2006) provides widely used guidelines for researchers constructing their own self-efficacy scales. These guidelines were used in the creation of this study's self-efficacy measures.

Perceived Performance

A measure of perceived performance, subjectively self-reported by the athlete, was also collected for each athlete (see Appendix H). The subjective performance measure was collected following each resistance training session. Consistent with sport psychology studies, a single-item rating of subjective performance on a Likert-based scale was used (Arnold et al., 2018). Prior studies have assessed subjective performance in various ways. For example, athletes can be asked to rate their performance in relation to their personal best, relative to their personal goals, or relative to their rank on their athletic team (Arnold et al., 2018; Cox et al., 2010). In this study, athletes were asked to report how they felt their day's performance was on a 0-10 scale.

Perceived Effort

Perceived effort was also rated on a 0-10 Likert-based scale (see Appendix G). Studies in sport and exercise have used custom Likert-scales and the Effort/Importance subscale of the Intrinsic Motivation Inventory to assess perceived effort (Monteiro et al., 2018; Pope & Wilson, 2012). This study used a custom-worded Likert scale for each task to ensure concordance of self-efficacy, effort, and performance measures (Moritz et al., 2000). Athletes were asked to report much effort they felt they gave in the strength training session or task.

Subjective Exercises Experiences Scale (SEES)

Positive well-being and psychological distress were measured using the Subjective Exercise Experiences Scale (SEES; see Appendix I). The SEES is designed to measure global psychological responses to exercise stimulus (McAuley & Courneya, 1994). The 12-item scale measures 3 exercise experiences: positive well-being (PWB), psychological distress (PD), and fatigue (FAT). The instructions ask participants to respond to each adjective by indicating "the degree to which you are experiencing each feeling now, at this point in time" on a Likert scale of 1 ("Not at all") to 7 ("Very much so"), with 4 labeled "Moderately".

Confirmatory factor analysis confirmed the 3-factor structure of the SEES pre-exercise ($\chi^2(51) = 73.69$, $p < 0.05$; GFI = .89; RMSR = .05) and post-exercise ($\chi^2(51) = 81.06$, $p < 0.05$; GFI = .88; RMSR = .06) (McAuley & Courneya, 1994). Internal consistency was acceptable and ranged from .84 to .92. Criterion validity of the SEES was assessed with the PANAS, State Anxiety Inventory, and the Feeling Scale (McAuley & Courneya, 1994). Nonsignificant correlations between the FAT dimension and the feeling scale, PANAS, and state anxiety inventory show discriminant validity of this measure. The PWB dimension correlates well with measures of positive affect in the PANAS and Feeling

Scale, while the PD dimension correlates well with negative dimensions of the PANAS and state anxiety inventory. These moderately strong correlations (.60 to .70) suggest the PWB and PD scales adequately represent positive and negative affective states.

Research Design

This research was a quantitative diary-style design that relied on questionnaires to collect self-reported repeated measures data from participants. None of the predictor variables were manipulated by the researcher. Multiple data points from each participant were collected over a 4-week training cycle. The decision was made against manipulating this state in a controlled laboratory setting to study these variables in the natural environment. All subjects acted as their own control.

Procedures

Approval from the university Institutional Review Board, athletic department, and track and field coaching staff was acquired following university protocols prior to data collection. Athletes were recruited for this study at a team meeting, where the purpose and procedure of the study were detailed. Volunteers provided contact information (an email address) and completed an informed consent. Data collection for questionnaires was conducted via electronic survey using Google Forms. Each volunteer was provided a QR code to access the electronic questionnaires for the duration of the study.

Anonymity and confidentiality of each participant's response was protected using an assigned participant ID number, used on all data collection materials. Personally identifying information was not included or requested on the electronic questionnaires. The identification key was stored in a locked filing cabinet and only the researchers had access to this identification key. Data collected from surveys was stored in a spreadsheet using only the participant ID.

Prior to the beginning of data collection, all athletes participated in a 4-week familiarization period in the weight room. In this time, athletes became familiar with correct lifting technique for all required lifts. Required lifts for this study included the squat, the bench press, and the Olympic-style lifts. Olympic-style lifts included hang and power variations of the clean and snatch exercises. The familiarization period was supervised by a certified strength and conditioning specialist. The researchers did not receive a copy of the athlete's training protocols, however were informed by the strength and conditioning specialists that the order of exercises was as follows: Olympic lifts, squat, bench press. Athletes identified in the self-report surveys whether they performed each lift in a strength training session. Athletes were instructed to leave questions blank for lifts that they did not perform in the training session.

Data collection was conducted over a four-week period in the team's preseason general preparation phase. Athletes continued sport-specific training assigned by their event-specific coach outside of this study's data collection. Sport-specific training occurred five to six days per week. Within their regularly scheduled strength training, athletes completed two primary weight training sessions per week. Each primary weight training session was a full body multi-joint training session, as prescribed by the athlete's coach. The researchers did not dictate the exercise prescription of these sessions. The researcher did not manipulate the periodization plan of the event coach or the technical practices. The researcher did not supervise each weight room session. Volunteers in this study were required to remember to fill out their surveys before and after each weight training session on their own using their provided QR codes. Participants were instructed not to engage in additional training methods. The athlete's nutrition, sleep, and hydration were not controlled.

Volunteers first completed a one-time baseline questionnaire prior to the collection of daily weight room work out questionnaires. Next, state variables were collected at each documented strength training session during the four-week training period. Prior to each training session, athletes completed a survey containing the SRSS and SEES. Athletes were instructed to respond to measures of task-specific self-efficacy after viewing their daily exercise prescription. Athletes then completed their prescribed workout. The athletes participated in a team-structured standardized warmup of dynamic stretching, mobility, and exercise-specific barbell warm-up prior to their workouts. Following the workout session, athletes completed a second questionnaire including measures of effort, subjective self-report performance evaluation, and the SEES before they left the training area.

Data Analysis

The following procedures were used for the data analysis portion of this study.

Variables. All research variables included in this study were continuous variables measured on a Likert scale. State predictor variables measured were perceived recovery, perceived stress, positive well-being, psychological distress, task-specific self-efficacy, perceived effort, and perceived performance. Task-specific self-efficacy, perceived effort, and perceived performance were measured for the overall workout, and for three specific tasks: the squat, the bench press, and the Olympic lifts. Trait predictor variables were self-determined motivations and achievement goal orientations. Aggregated self-efficacy for each participant was calculated from daily self-efficacy measures and used as a level 2 predictor. Descriptive variables collected included gender, age, year in school, competitive event, number of years of sport participation, number of years of resistance training experience, and value of strength training.

Data Cleaning and Assumption Checking. While 42 participants completed an informed consent and completed at least one day of data collection, 15 of those participants did not provide more than one day of daily data collection. To be included in the diary-style analysis for this study, participants were required to have at least two daily data collection points. Consequently, these 15 participants were removed prior to analysis, leaving 29 participants in the final multilevel model. Each participant included in the final analysis provided a minimum of 2 data points, with a maximum of 10 data points. The mean number of daily data points for participants was 6.

Assumptions for multilevel modeling were tested for each model. Data was checked for linearity to ensure each predictor was related to the dependent variable in a linear fashion. Homoscedasticity was checked using Levene's test and visually with a scatterplot of residuals. Data was examined for influential outliers using Q-Q plots. Residuals at level 1 and residuals at level 2 were both checked for normal distribution using histograms.

Power and Sample Size. The following information is helpful for considering power of a multilevel model. In this model, average cluster size was 6 time points per individual. The total number of clusters (individual participants) was 29. The within-cluster variation and between-cluster variation differed with each research question and dependent variable.

These values are presented in the results section. These values were calculated and reported for each model using the intraclass coefficient calculation. In addition, variables at level 1 were group mean centered.

Descriptive Statistics. Descriptive statistics (mean and standard deviation) were calculated for each continuous variable in this study. Correlations were run to determine relationships between continuous research variables using Pearson's r. Correlation tables were run separately for variables at level 1 and variables at level 2.

Inferential Statistics. Multilevel modeling with restricted maximum likelihood estimation was used to model within-person (state variables) and between-person (trait variables) variance in the dependent variables. Data was collected at two levels of analysis. Level 1 variables were day-level measures, and level 2 variables were person-level measures. Daily weight room sessions were nested within individual athletes. Due to the limited time span of data collection, a growth model with the repeated measures data was not expected. This multilevel modeling approach followed a diary-style analysis. Predictors were group mean centered at level 1 and grand mean centered at level 2.

For each dependent variable, an unconditional model was run and the intra-class coefficient was calculated. Models with a larger proportion of variance at the within-persons level focused on explaining variance at level 1, while models with a larger proportion of variance at the within-persons level of analysis were guided by explaining variance at level 2. Predictors were added one at a time at level 1 into the model. Predictors at level 1 were modeled with both fixed and random effects, and non-significant effects were removed from the model. After the level 1 model was finalized, predictors were added at level 2. Each level 2 predictor was entered into the model for all significant level 1 coefficients, which included both intercepts and slopes. When a predictor at level 1 contained a statistically significant random effect, a cross-level interaction was tested with the level 2 predictor as the moderator. As with level 1, each level 2 predictor was tested one at a time and checked for significance. Non-significant predictors were dropped from the model. Demographic factors were tested as control variables. However, none of the measured demographic characteristics were predictors of any dependent variable. Therefore, these demographic variables were not included in further analyses. Detailed statistical procedures for each model are outlined by each research question as follows:

Research Aim 01. Positive well-being and psychological distress were the dependent variables. One model was run separately for each dependent variable. For each model, pre-workout mood state was first entered as a control variable with a fixed effect only. Level 1 predictors in this model were daily self-efficacy, daily effort, daily perceived performance. Level 2 predictor variables were aggregated self-efficacy, 3 x 2 achievement goal orientations, and self-determined motivations.

Based on theory, additional models with level 1 interaction terms were tested one at a time for each dependent variable, with daily self-efficacy as a moderator. As differences between individuals were not the focus of these models, no random effects were included. A simple slopes analysis was run where significant interaction effects were found. Simple slopes were run for 1 standard deviation below average, average, and 1 standard deviation above average of the moderator daily self-efficacy.

Research Aim 02. Multilevel modeling was used to predict perceived performance for three specific weight room tasks: the squat, the bench press, and the Olympic lifts. One model was run separately for each exercise. Level 1 predictors were daily task-specific self-efficacy and daily effort. Level 2 predictors were aggregated self-efficacy, 3 x 2 achievement goal orientations, and self-determined motivations.

Research Aim 03. Four separate models were run on each dependent variable: overall workout self-efficacy, squat self-efficacy, bench press self-efficacy, and Olympic lift self-efficacy. Model predictors included daily perceived recovery, daily perceived stress state, and an interaction term of perceived recovery and perceived stress at level 1. No level 2 predictors were added to this model. A simple slopes analysis was run where significant interaction effects were found. Simple slopes were run for 1 standard deviation below average, average, and 1 standard deviation above average of the moderator perceived stress.

Chapter Four: Results

Descriptive Statistics

The 29 participants included in the final analysis of this study were NCAA D1 college athletes participating in track and field strength and power events. Participants had 7.6 ± 3.0 years of sport experience and 5.3 ± 2.6 years of resistance training experience. Seventeen participants were females and 12 were males. Four participants were freshmen, seven were sophomores, five were juniors, seven were seniors, and six were graduate students. The average value of resistance training for these participants is 6.6 ± 0.6, measured on a 7-point Likert scale. Descriptive statistics, including means, standard deviations, and correlations for research variables are presented in Table 1 and Table 2. Table 1 contains level 1 variables and Table 2 contains level 2 variables.

Table 1: Means, Standard Deviations, and Correlations with Confidence Intervals at Level 1

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Stress	2.42	1.33																	
2. Recovery	3.91	1.27	-.66**																
			[-.74, -.57]																
3. Workout Self-efficacy	8.03	2.10	-.55**	.61**															
			[-.65, -.44]	[.50, .69]															
4. Squat Self-efficacy	7.22	2.50	-.55**	.58**	.83**														
			[-.66, -.43]	[.46, .68]	[.78, .88]														
5. Olympic Lift Self-efficacy	7.21	2.49	-.49**	.51**	.75**	.82**													
			[-.60, -.35]	[.38, .62]	[.67, .81]	[.75, .87]													
6. Bench Press Self-efficacy	7.85	2.25	-.43**	.46**	.81**	.73**	.78**												
			[-.55, -.29]	[.32, .58]	[.75, .86]	[.64, .80]	[.70, .83]												
7. Overall Performance	8.27	1.64	-.23**	.23**	.39**	.41**	.29**	.38**											
			[-.38, -.07]	[.07, .38]	[.23, .52]	[.25, .55]	[.11, .45]	[.22, .52]											
8. Squat Performance	8.12	2.13	-.36**	.27**	.55**	.59**	.57**	.43**	.50**										
			[-.51, -.18]	[.08, .43]	[.40, .67]	[.45, .70]	[.42, .69]	[.26, .57]	[.35, .63]										
9. Olympic Lift Performance	8.19	1.93	-.30**	.19	.54**	.55**	.51**	.42**	.56**	.82**									
			[-.47, -.12]	[-.00, .37]	[.39, .66]	[.40, .68]	[.35, .64]	[.24, .57]	[.41, .68]	[.74, .87]									
10. Bench Press Performance	8.15	2.10	-.26**	.20*	.44**	.35**	.33**	.43**	.61**	.36**	.44**								
			[-.42, -.09]	[.02, .36]	[.28, .57]	[.18, .51]	[.15, .49]	[.27, .56]	[.48, .71]	[.19, .52]	[.27, .59]								
11. Overall Effort	8.47	1.61	-.34**	.30**	.40**	.35**	.34**	.34**	.54**	.50**	.44**	.38**							
			[-.48, -.18]	[.14, .44]	[.26, .53]	[.18, .50]	[.17, .49]	[.17, .48]	[.41, .64]	[.35, .63]	[.27, .58]	[.22, .52]							
12. Squat Effort	8.09	2.26	-.31**	.24*	.50**	.58**	.54**	.36**	.42**	.80**	.74**	.28**	.65**						
			[-.47, -.12]	[.05, .41]	[.34, .63]	[.44, .70]	[.38, .67]	[.18, .52]	[.25, .56]	[.73, .86]	[.63, .82]	[.10, .45]	[.53, .75]						
13. Olympic Lift Effort	8.37	1.98	-.34**	.27**	.52**	.55**	.47**	.40**	.43**	.73**	.77**	.34**	.67**	.86**					
			[-.50, -.16]	[.08, .44]	[.36, .65]	[.39, .67]	[.31, .61]	[.22, .55]	[.26, .57]	[.61, .81]	[.68, .84]	[.15, .50]	[.55, .76]	[.80, .90]					
14. Bench Press Effort	8.25	1.89	-.27**	.21*	.37**	.36**	.41**	.27**	.36**	.46**	.48**	.56**	.66**	.60**	.64**				
			[-.43, -.10]	[.04, .38]	[.20, .51]	[.18, .51]	[.24, .56]	[.10, .43]	[.20, .50]	[.29, .59]	[.31, .62]	[.42, .67]	[.55, .75]	[.46, .71]	[.51, .74]				
15. Positive Well-being Pre-workout	4.50	1.39	-.64**	.77**	.68**	.65**	.56**	.56**	.27**	.30**	.21*	.24**	.43**	.27**	.25*	.29**			
			[-.72, -.54]	[.70, .82]	[.58, .75]	[.55, .74]	[.44, .66]	[.44, .66]	[.11, .42]	[.12, .46]	[.02, .39]	[.07, .41]	[.29, .56]	[.08, .44]	[.06, .43]	[.11, .44]			
16. Psychological Distress Pre-workout	1.99	1.12	.68**	-.64**	-.58**	-.53**	-.51**	-.43**	-.15	-.26**	-.25**	-.33**	-.26**	-.25*	-.39**	-.35**	-.62**		
			[.59, .75]	[-.72, -.54]	[-.67, -.47]	[-.64, -.40]	[-.63, -.38]	[-.55, -.29]	[-.31, .02]	[-.43, -.07]	[-.43, -.06]	[-.48, -.16]	[-.41, -.10]	[-.42, -.06]	[-.54, -.21]	[-.50, -.19]	[-.70, -.51]		
17. Positive Well-being Post-workout	5.04	1.23	-.40**	.57**	.47**	.45**	.32**	.41**	.58**	.42**	.34**	.35**	.49**	.32**	.29**	.27**	.70**	-.31**	
			[-.53, -.25]	[.45, .67]	[.33, .59]	[.29, .58]	[.14, .47]	[.25, .54]	[.46, .68]	[.25, .56]	[.16, .50]	[.19, .50]	[.35, .60]	[.14, .48]	[.10, .45]	[.10, .42]	[.60, .77]	[-.45, -.15]	
18. Psychological Distress Post-workout	1.65	0.87	.61**	-.55**	-.54**	-.51**	-.40**	-.52**	-.38**	-.26**	-.27**	-.40**	-.27**	-.21*	-.29**	-.21*	-.49**	.72**	-.50**
			[.49, .70]	[-.65, -.42]	[-.65, -.41]	[-.63, -.36]	[-.54, -.23]	[-.64, -.38]	[-.51, -.23]	[-.42, -.07]	[-.43, -.08]	[-.54, -.24]	[-.41, -.11]	[-.38, -.02]	[-.45, -.11]	[-.37, -.04]	[-.61, -.36]	[.63, .79]	[-.62, -.37]

Note. *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (Cumming, 2014). * indicates $p < .05$. ** indicates $p < .01$.

Table 2: Means, Standard Deviations, and Correlations with Confidence Intervals at Level 2

Variable	*M*	*SD*	1	2	3	4	8	9	10	11	12	13	14	15	16	17	18
1. Age	20.44	1.55															
2. Sport Experience	7.61	2.95	.43*														
			[.05, .69]														
3. Resistance Training Experience	5.26	2.57	.48*	.52**													
			[.12, .73]	[.18, .75]													
4. Value of Resistance Training	6.60	0.63	-.09	-.02	-.13												
			[-.45, .30]	[-.40, .36]	[-.49, .26]												
8. Intrinsic	5.22	1.31	-.18	-.19	.05	.24											
			[-.53, .21]	[-.53, .20]	[-.34, .42]	[-.15, .57]											
9. Integrated	4.75	1.57	-.17	-.16	.17	.20	.57**										
			[-.52, .22]	[-.51, .23]	[-.23, .51]	[-.19, .54]	[.24, .78]										
10. Identified	5.46	1.54	.00	-.14	-.06	.50**	.40*	.52**									
			[-.38, .38]	[-.49, .26]	[-.43, .33]	[.15, .74]	[.02, .68]	[.17, .75]									
11. Introjected	5.16	1.54	-.24	-.13	-.07	.43*	.43*	.64**	.74**								
			[-.57, .15]	[-.49, .26]	[-.44, .32]	[.06, .69]	[.06, .70]	[.34, .82]	[.51, .88]								
12. External	2.62	1.82	.06	-.03	-.04	.16	.20	.32	.43*	.50**							
			[-.33, .43]	[-.40, .36]	[-.42, .34]	[-.24, .51]	[-.19, .54]	[-.07, .62]	[.06, .69]	[.14, .74]							
13. Amotivated	1.42	1.20	.19	.10	.24	.16	.30	.33	.20	.36	.53**						
			[-.21, .53]	[-.29, .46]	[-.15, .57]	[-.23, .51]	[-.09, .61]	[-.05, .63]	[-.19, .54]	[-.03, .65]	[.19, .76]						
14. Task Approach	6.26	1.06	-.13	.03	-.10	.49**	.25	.12	.20	.19	.13	.19					
			[-.49, .26]	[-.35, .41]	[-.46, .29]	[.14, .74]	[-.14, .58]	[-.27, .48]	[-.20, .54]	[-.20, .53]	[-.27, .48]	[-.21, .53]					
15. Self Approach	6.47	0.74	-.05	-.03	-.26	.51**	.20	-.07	.21	.27	.07	.16	.65**				
			[-.43, .33]	[-.41, .35]	[-.58, .14]	[.16, .74]	[-.19, .54]	[-.44, .32]	[-.19, .55]	[-.13, .59]	[-.32, .44]	[-.23, .51]	[.36, .82]				
16. Other Approach	4.43	2.01	-.08	-.40*	-.27	.30	.29	.18	.18	.24	.51**	.32	.45*	.53**			
			[-.45, .31]	[-.68, -.02]	[-.59, .12]	[-.09, .61]	[-.10, .60]	[-.22, .52]	[-.21, .53]	[-.15, .57]	[.17, .75]	[-.07, .62]	[.09, .71]	[.18, .76]			
17. Task Avoid	5.38	1.91	-.26	-.29	-.37	.32	.26	.10	.06	.19	.33	.20	.56**	.64**	.71**		
			[-.58, .13]	[-.60, .11]	[-.65, .02]	[-.07, .62]	[-.13, .58]	[-.29, .46]	[-.33, .43]	[-.21, .53]	[-.06, .63]	[-.20, .54]	[.23, .78]	[.34, .82]	[.45, .86]		
18. Self Avoid	5.44	1.98	-.21	-.23	-.41*	.30	.26	-.01	.02	.13	.32	.20	.63**	.69**	.74**	.96**	
			[-.55, .18]	[-.56, .17]	[-.68, -.03]	[-.09, .61]	[-.13, .58]	[-.39, .37]	[-.36, .40]	[-.26, .49]	[-.07, .63]	[-.20, .54]	[.33, .81]	[.42, .85]	[.50, .87]	[.91, .98]	
19. Other Avoid	4.42	2.34	-.17	-.21	-.33	.30	.16	.10	.01	.14	.41*	.27	.48*	.49**	.87**	.76**	.80**
			[-.52, .22]	[-.54, .19]	[-.63, .05]	[-.09, .61]	[-.23, .51]	[-.29, .47]	[-.38, .38]	[-.25, .49]	[.03, .68]	[-.12, .59]	[.12, .73]	[.13, .73]	[.73, .94]	[.53, .88]	[.61, .91]

Note. *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (Cumming, 2014). * indicates $p < .05$. ** indicates $p < .01$.

At the day level of analysis, moderate positive correlations were found between measures of daily self-efficacy and perceived performance. Correlations were stronger for task-specific measures (squat r = .59; bench press r = .43; Olympic lift r = .51) than for overall workout measures (r = .39). Moderate positive correlations were found between measures of daily effort and daily self-efficacy. Correlations were stronger for task-specific measures (squat r = .58; bench press r = .27; Olympic lift r = .47) than for overall workout measures (r = .40). Moderate to strong positive correlations were found between measures of daily effort and perceived performance. Correlations were stronger for task-specific measures (squat r = .80; bench press r = .56; Olympic lift r = .77) than for overall workout measures (r = .54). The strongest relationships were consistently found for the squat, followed by Olympic lifts, bench press, and overall workout. For each task, the strongest relationships were found in the daily effort and perceived performance relationship.

Daily measures of task-specific self-efficacy, effort, and performance showed low to moderate relationships with positive well-being and psychological distress following a workout. Correlations were stronger between overall workout measures and subjective exercise experiences than for task-specific (squat, bench press, Olympic lift) measures with subjective exercise experience measures following a workout. As expected, moderate to strong correlations were found for positive well-being and psychological distress before a workout with measures after a workout. States of perceived stress and perceived recovery showed moderate to strong correlations with psychological distress and positive well-being both before and after a workout. Correlations were stronger with pre-workout measures than post-workout measures. Stress was negatively correlated with positive well-being and positively correlated with psychological distress. Recovery was negatively correlated with psychological distress and positively correlated with positive well-being.

Mean daily measures were generally higher for positive well-being than for psychological distress, with more variation in positive well-being than psychological distress. Mean daily effort was highest for the overall workout, and lowest for the squat. The squat is the task that showed the most variability in daily effort. These trends were similar for daily performance. Mean perceived performance was highest for the overall workout, and lowest for the squat. Again, the squat is the task that showed the most variability in perceived performance. Mean daily self-efficacy was the highest for the overall workout and lowest for the squat and Olympic lifts. The squat and Olympic lifts also showed the most variability in self-efficacy. The mean perceived recovery score was higher than the mean perceived stress score, with similar variability in the two measures.

Research Aim 01

The purpose of the first research question was to determine whether effort, self-efficacy, and subjective evaluation of performance could predict states of positive well-being and psychological distress following a weight room workout. In addition, to test whether trait variables (achievement goal orientations, self-determined motivations, aggregate self-efficacy) could explain additional variance in these subjective responses to exercise.

Positive Well-being. The intra-class correlation coefficient for the null model was 52.0%. The addition of pre-exercise positive well-being as a control variable explained within-subject variance in the model. The statistically significant fixed effect for pre-exercise positive well-being indicated that when athletes started their workout with higher positive well-being, they experienced higher positive well-being following their workout.

The model resulted in a statistically significant fixed and random effect for perceived performance. An increase in perceived performance increased a participant's positive well-being following the workout, and this relationship differed between participants. No 3 x 2 achievement goal orientations or self-determined motivations could explain this variation between individuals. Daily self-efficacy was not a significant predictor of positive well-being. The fixed effect for daily effort was statistically significant, however the random effect was not statistically significant. An increase in effort resulted in an increase in positive well-being post-workout. This relationship did not differ between participants. The addition of these variables explained more within-person variance in positive well-being. Aggregate self-efficacy had a statistically significant fixed effect. An increase in trait self-efficacy resulted in higher positive well-being following a weight training session. The addition of this variable explained between-person variance in positive well-being.

This statistical analysis evaluated whether positive well-being after a weight room training session varied as a function of state (daily self-efficacy, daily effort, and daily subjective performance), and trait (aggregate self-efficacy, 3 x 2 achievement goal orientations, and self-determined motivations) variables. After controlling for pre-workout positive well-being, we found that daily effort, perceived performance, and trait self-efficacy were predictors of positive well-being post-exercise. Higher values on each variable result in a higher value of positive well-being. Daily self-efficacy was not a predictor of positive well-being. The relationship between perceived performance and post-workout positive well-being looked different for different individuals; however, no 3x2 achievement goal orientations or self-determined motivations could explain this relationship.

Table 3: Summary of Parameter Estimates for Two-Level Model of Positive Well-Being Post-Workout

	Null Model		Control Variables		Level 1 Model		Full Model	
Parameter	Parameter Est.	SE	Parameter Est.	SE	Parameter Est.	SE	Parameter Est.	SE
Fixed Effects								
Intercept	5.02***	0.19	5.01***	0.19	5.00***	0.19	4.99***	0.15
Day Level								
Positive Well-being Pre-workout	---	---	0.39***	0.07	0.25***	0.05	0.26***	0.05
Perceived Performance			---	---	0.34***	0.07	0.34***	0.07
Effort					0.19***	0.05	0.18***	0.05
Person level								
Self-Efficacy	---	---	---	---	---	---	0.53***	0.12
Random Effects								
Within-subject (σ^2)	0.76	---	0.62	---	0.27	---	0.27	---
Between-subject (τ^2)	0.83	---	0.89	---	0.97	---	0.56	---
Perceived Performance	---	---	---	---	0.06	---	0.06	---

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Psychological Distress. The intra-class correlation coefficient for the null model was 47.1%. The statistically significant fixed effect for pre-exercise psychological distress indicated a higher psychological distress before the workout yielded a higher state of psychological distress following the workout. Perceived performance had a statistically significant fixed and random effect. An increase in perceived performance resulted in reduced psychological distress following the workout. This relationship differed between participants, but no 3 x 2 achievement goal orientations or self-determined motivations could explain this variation between individuals. Daily self-efficacy was not a significant predictor of psychological distress. The fixed effect for daily effort was statistically significant, however the random effect was not statistically significant. This indicated that an increase in effort resulted in a decrease in psychological distress for all participants. When an athlete gave more effort in their workout session, their psychological distress following the session was lower. Aggregate self-efficacy showed a statistically significant fixed effect. An increase in trait self-efficacy resulted in lower psychological distress following a weight training session.

After controlling for pre-exercise psychological distress, the higher an athlete's daily perceived performance, the lower their psychological distress following the workout. This relationship did not look the same for everyone. No level interactions were found with 3 x 2 goal orientations or self-determined motivations to explain this variation. Daily self-efficacy did not contribute to psychological distress following a workout. As daily effort increased, psychological distress was reduced. Trait self-efficacy contributed to psychological distress post-workout, with individuals that had higher trait self-efficacy resulting in lower psychological distress post-workout.

Table 4: Summary of Parameter Estimates for Two-Level Model of Psychological Distress Post-Workout

	Null Model		Control Variables		Level 1 Model		Full Model	
Parameter	Parameter Est.	SE	Parameter Est.	SE	Parameter Est.	SE	Parameter Est.	SE
Fixed Effects								
Intercept	1.67***	0.13	1.67***	0.12	1.67***	0.13	1.68***	0.11
Day Level								
Psychological Distress Pre-workout	---	---	0.42***	0.05	0.33***	0.04	0.34***	0.04
Perceived Performance			---	---	-0.15*	0.06	-015*	0.06
Effort					-0.10*	0.04	-0.10*	0.04
Person level								
Self-Efficacy	---	---	---	---	---	---	-0.30***	0.07
Random Effects								
Within-subject (σ^2)	0.41	---	0.27	---	0.14	---	0.14	---
Between-subject (τ^2)	0.37	---	0.38	---	0.42	---	0.30	---
Perceived Performance	---	---	---	---	0.07	---	0.06	---

Note: * p < .05, ** p < .01, *** p < .001

Based on theory surrounding self-efficacy, it was expected that daily self-efficacy would contribute to subjective exercise responses to a workout. Therefore, level 1 within-person interactions between daily self-efficacy with subjective performance and daily self-efficacy and daily effort were also tested. One model was run with subjective performance as the predictor and self-efficacy as the moderator. Another model was run with effort as the predictor and self-efficacy as the moderator.

Self-efficacy as a moderator in the perceived performance-psychological distress relationship. The interaction term between self-efficacy and perceived performance at level 1 was statistically significant. The region of significance for the simple slopes analysis was between 0.02 and 816.27 for the moderator daily self-efficacy. Simple slopes for average (b = -0.16, $p < .05$) and below-average daily self-efficacy (b = -0.22, $p < .05$) were significant.

The relationship between perceived performance and psychological distress depended on a participant's daily self-efficacy level. For individuals with below average or average daily self-efficacy levels relative to their mean, a higher perceived performance related to a lower state of psychological distress. For individuals with above average daily self-efficacy relative to their mean, perceived performance did not contribute to psychological distress following a weight room workout.

Self-efficacy as a moderator in the effort-psychological distress relationship. The interaction term between self-efficacy and effort at level 1 was statistically significant. The region of significance for the simple slopes analysis was between 0.0002 and 1715.87 for the moderator daily self-efficacy. Simple slopes for average (b = -0.09, $p < .05$) and below-average daily self-efficacy (b = -0.13, $p < .05$) were significant.

The relationship between effort and psychological distress depended on a participant's daily self-efficacy level. For individuals with below average or average daily self-efficacy levels relative to their mean, a higher effort was related to a lower state of psychological distress. For individuals with above average daily self-efficacy relative to their mean, effort did not contribute to psychological distress following a weight room workout.

Table 5: Summary of Parameter Estimates for Two-Level Model of Psychological Distress Post-Workout with Level 1 Interaction Terms

	Model 1		Model 2	
Parameter	Parameter Est.	SE	Parameter Est.	SE
Fixed Effects				
Intercept	1.65***	0.12	1.65***	0.12
Day Level				
Psychological Distress Pre-workout	0.36***	0.06	0.36***	0.06
Perceived Performance	-0.16***	0.03	---	---
Effort	---	---	-0.08	0.04
Self-efficacy	-0.01	0.03	-0.02	0.04
Perceived Performance * Self-Efficacy	0.06**	0.02	---	---
Effort * Self-Efficacy	---	---	0.05**	0.02
Random Effects				
Within-subject (σ^2)	0.20	---	0.24	---
Between-subject (τ^2)	0.37	---	0.36	---

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

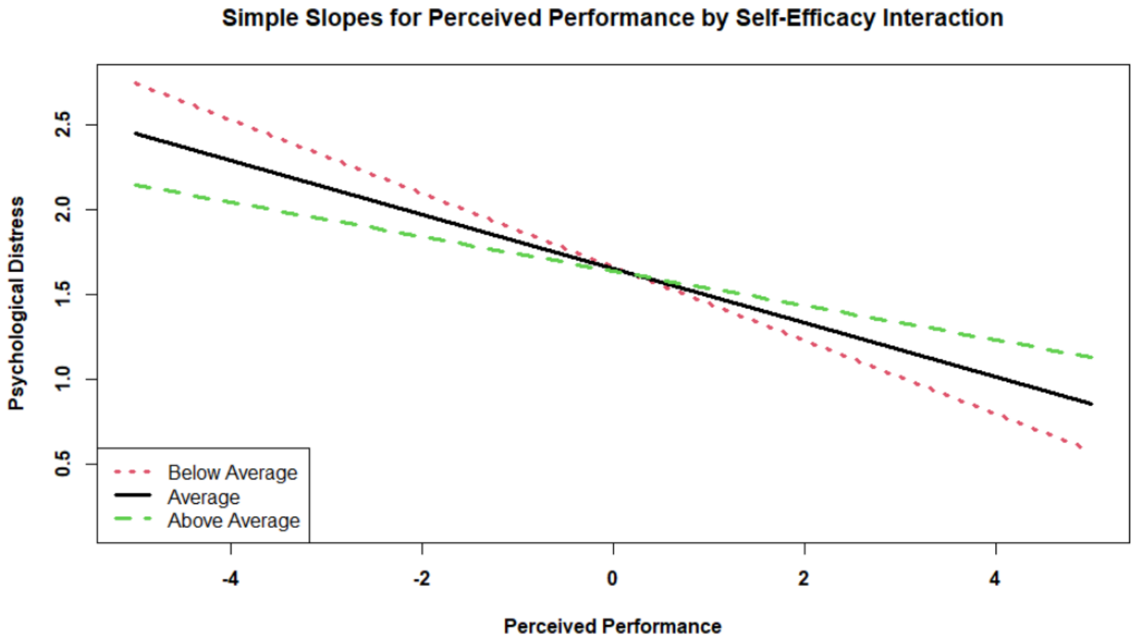

Figure 1: Simple Slopes for Perceived Performance and Psychological Distress Relationship

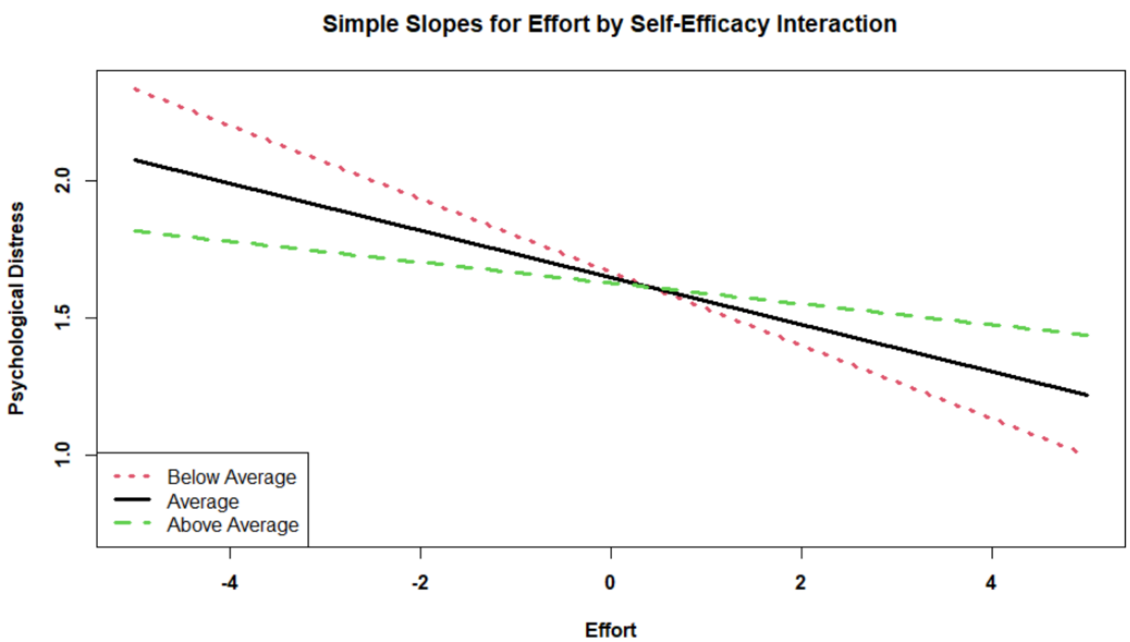

Figure 2: Simple Slopes for Effort and Psychological Distress Relationship

Research Aim 02

The purpose of the second research question was to examine the research variables that contributed to an athlete's task-specific perceived performance. The tasks included in this research study were the squat, bench press, and Olympic lift exercises. This research question investigated whether daily effort and daily self-efficacy could predict an athlete's perceived performance, and whether trait variables (achievement goal orientations, self-determined motivations, aggregate self-efficacy) could help explain additional variance in this performance. A secondary purpose of this research question was to determine whether the relationship between daily effort and perceived performance evaluation is the same between individuals, and if not, whether trait variables could help explain differences in this effort-performance relationship.

Squat. The intra-class correlation coefficient for the null model was 48.2%. The fixed effect and random effect for daily effort were both statistically significant. An increase in effort resulted in an increase in perceived performance. The relationship between effort and subjective performance was not the same between individuals. The fixed effect for daily self-efficacy was not significant. The fixed effect for aggregate self-efficacy was significant, indicating an increase in aggregate self-efficacy resulted in an increase in perceived performance.

The fixed effects for the 3 x 2 goal orientations were not significant. The cross-level interaction was significant for the task avoid, self-avoid, other-avoid, and other-approach achievement goal orientations. These variables buffered the effort-perceived performance relationship. Individuals who scored higher on these trait variables had less of an increase in subjective performance with an increase in effort.

Table 6: Summary of Parameter Estimates for Two-Level Model of Squat Perceived Performance

	Null Model		Effort Model		L1 and L2 Model	
Parameter	Parameter Est.	SE	Parameter Est.	SE	Parameter Est.	SE
Fixed Effects						
Intercept	8.23***	0.31	8.24***	0.30	8.16***	0.25
Day Level						
Effort	---	---	0.47**	0.12	0.47**	0.12
Person level						
Self-Efficacy	---	---	---	---	0.45**	0.13
Random Effects						
Within-subject (σ^2)	2.17	---	1.01	---	1.04	---
Between-subject (τ^2)	2.02	---	2.16	---	1.35	---
Effort	---	---	0.12	---	0.12	---

Note: * p < .05, ** p < .01, *** p < .001

Table 7: Summary of Parameter Estimates for Two-Level Model of Squat Perceived Performance with Achievement Goal Interactions

	Model	Model	Model	Model

Parameter	Parameter Est.	SE	Parameter Est.	SE	Parameter Est.	SE	Parameter Est.	SE
Fixed Effects								
Intercept	8.03***	0.23	8.03***	0.24	8.03***	0.24	8.02***	0.23
Day Level								
Effort	0.38**	0.10	0.37**	0.10	0.44**	0.10	0.43**	0.11
Person level								
Self-Efficacy	0.60***	0.13	0.60***	0.13	0.61***	0.14	0.60***	0.13
Task Avoid	0.05	0.12	---	---	---	---	---	---
Self-Avoid	---	---	0.01	0.12	---	---	---	---
Other-Approach	---	---	---	---	-0.02	0.12	---	---
Other-Avoid	---	---	---	---	---	---	0.04	0.10
Cross-level Interaction								
Task-Avoid * Effort	-0.15*	0.04	---	---	---	---	---	---
Self-Avoid * Effort	---	---	-0.15*	0.05	---	---	---	---
Other-Approach * Effort	---	---	---	---	-0.13*	0.05	---	---
Other-Avoid * Effort	---	---	---	---	---	---	-0.11*	0.05
Random Effects								
Within-subject (σ^2)	1.00	---	0.99	---	1.02	---	1.03	---
Between-subject (τ^2)	1.10	---	1.11	---	1.10	---	1.09	---
Effort	0.04	---	0.05	---	0.06	---	0.07	---

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Bench Press. The intra-class correlation coefficient for the null model was 44.1%. Compared to squat subjective performance, more variance in bench press subjective performance is attributed to within-person variations. The fixed effect for daily effort was significant, indicating an increase in effort resulted in improvement in perceived performance. The random effect for daily effort was not significant, indicating that this relationship does not vary between individuals. The fixed effect for daily self-efficacy was not significant. The fixed effect for aggregate self-efficacy was significant, indicating a 1-unit increase in aggregate self-efficacy resulted in a 0.51 unit increase in perceived performance. Introjected regulation and external regulation showed significant fixed effects. Individuals higher in both introjected and external regulations result in a lower perceived performance value. No other self-determined motivation or 3 x 2 achievement goal orientation had significant effects.

Table 8: Summary of Parameter Estimates for Two-Level Model of Bench Press Perceived Performance

	Null Model		Effort Model		L1 and L2 Model		Introjected		External	
Parameter	Parameter Est.	SE	Parameter Est.	SE	Parameter Est.	SE	Parameter Est.	SE	Parameter Est.	SE
Fixed Effects										
Intercept	8.12***	0.31	8.19***	0.30	8.07***	0.26	7.97***	0.24	7.94***	0.23
Day Level										
Effort	---	---	0.32**	0.11	0.33**	0.11	0.33**	0.11	0.32**	0.11
Person level										
Self-efficacy	---	---	---	---	0.51**	0.16	0.68***	0.16	0.69***	0.15
Introjected Regulation	---	---	---	---	---	---	-0.40*	0.17	---	---
External Regulation	---	---	---	---	---	---	---	---	-0.34*	0.13
Random Effects										
Within-subject (σ^2)	2.57	---	2.36	---	2.36	---	2.33	---	2.37	---

Between-subject (τ^2)	2.03	---	1.88	---	1.24	---	0.89	---	0.70	---

Note: * p < .05, ** p < .01, *** p < .001

Olympic Lifts. The intra-class correlation coefficient for the null model was 58.1%. Compared to squat and bench press subjective performance, more variance in Olympic lift subjective performance was attributed to between-person variations. The fixed effect and random effect for daily effort was significant. An increase in effort resulted in improvement in perceived performance. The random effect for effort indicated that this relationship differed between individuals. No 3 x 2 achievement goal orientations or self-determined motivations could explain this variance. Daily self-efficacy was not significant at level 1. The fixed effect for aggregate self-efficacy was significant, indicating an increase in aggregate self-efficacy results an increase in perceived performance.

Table 9: Summary of Parameter Estimates for Two-Level Model of Olympic Lift Perceived Performance

	Null Model		Effort Model		L1 and L2 Model	
Parameter	Parameter Est.	SE	Parameter Est.	SE	Parameter Est.	SE
Fixed Effects						
Intercept	8.32***	0.30	8.33***	0.30	8.24***	0.26
Day Level						
Effort	---	---	0.44**	0.13	0.46**	0.13
Person level						
Self-efficacy	---	---	---	---	0.38*	0.14
Random Effects						
Within-subject (σ^2)	1.43	---	0.94	---	0.96	---

Between-subject (τ^2)	1.99	---	2.07	---	1.52	---
Effort	---	---	0.12	---	0.12	---

Note: * p < .05, ** p < .01, *** p < .001

Research Aim 03

Overall Workout. The intra-class correlation coefficient for the null model was 20.6%. The intercept value for overall workout self-efficacy was higher than for the intercept in the task-specific self-efficacy in the squat, bench press, and Olympic lift models. The interaction term between perceived recovery and perceived stress at level 1 was statistically significant. The region of significance for the simple slopes analysis was between -15.21 and -0.27 for the moderator perceived stress. Simple slopes for average (b = 0.85, $p < .05$) and above-average perceived stress (b = 1.28, $p < .05$) were significant.

For individuals with average or above average perceived stress levels relative to their mean, a higher perceived recovery was related to higher self-efficacy. For individuals with below average perceived stress relative to their mean, perceptions of recovery did not contribute to self-efficacy before a weight room workout. The relationship between perceptions of recovery and self-efficacy was stronger for above average stress levels. An increase in perceived recovery for individuals with higher levels of stress had a stronger positive effect on the individual's self-efficacy.

Table 10: Summary of Parameter Estimates for Two-Level Model of Daily Self-Efficacy

	Overall Workout	Squat	Bench Press	Olympic Lifts

Parameter	Parameter Est.	SE	Parameter Est.	SE	Parameter Est.	SE	Parameter Est.	SE
Fixed Effects								
Intercept	8.25***	0.24	7.18***	0.35	7.85***	0.35	7.15***	0.37
Day Level								
Recovery	0.84***	0.15	0.79***	0.21	0.65***	0.18	0.76***	0.19
Stress	-0.33*	0.14	-0.38*	0.19	-0.23	0.16	-0.36*	0.18
Recovery * Stress	0.44***	0.10	0.17	0.13	0.33**	0.12	0.26*	0.13
Random Effects								
Within-subject (σ^2)	1.83	---	2.70	---	2.22	---	2.57	---
Between-subject (τ^2)	1.24	---	2.72	---	2.76	---	3.11	---

Note: * p < .05, ** p < .01, *** p < .001

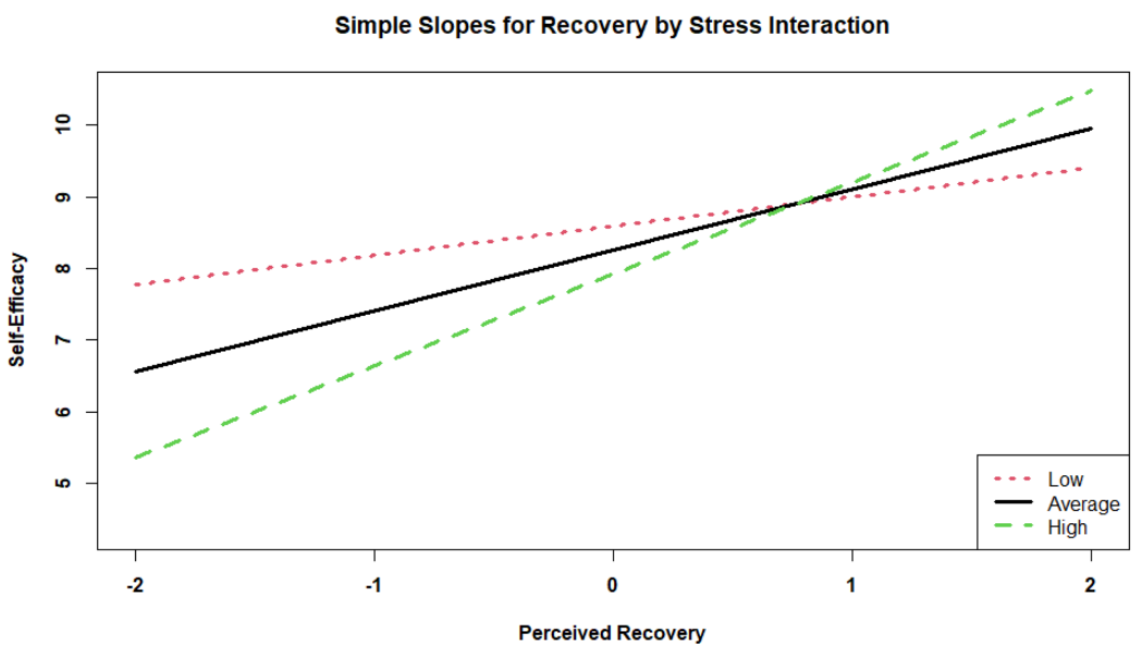

Figure 3: Simple Slopes for Perceived Recovery and Self-Efficacy Relationship

Squat. The intra-class correlation coefficient for the null model was 38.2%. While a greater proportion of variance was present at level 1, squat daily self-efficacy showed a greater proportion of variance at level 2 than overall workout self-efficacy. The interaction term for perceived recovery by perceived stress was non-significant. The fixed effects for perceived stress and for perceived recovery were significant. An increase in perceived recovery predicted a higher level of self-efficacy for the squat exercise, while an increase in perceived stress predicted a reduction in self-efficacy for the squat exercise.

Bench Press. The intra-class correlation coefficient for the null model was 41.6%. Bench press self-efficacy showed a greater proportion of variance at level 2 than overall workout self-efficacy. The interaction term between perceived recovery and perceived stress at level 1 was statistically significant. The region of significance for simple slopes analysis was between -39.29 and -0.15 for the moderator perceived stress. Simple slopes for average (b = 0.65, $p < .05$) and above-average perceived stress (b = 0.98, $p < .05$) were significant.

The relationship between perceived recovery and bench press self-efficacy depended on a participant's perceived stress level. For individuals with average or above average perceived stress levels relative to their mean, a higher perceived recovery was related to higher bench press self-efficacy. For individuals with below average perceived stress relative to their mean, perceived recovery did not contribute to bench press self-efficacy. The relationship between perceptions of recovery and self-efficacy was stronger for above average stress levels, meaning an increase in perceived recovery positively impacted bench press self-efficacy more when individuals had higher levels of stress.

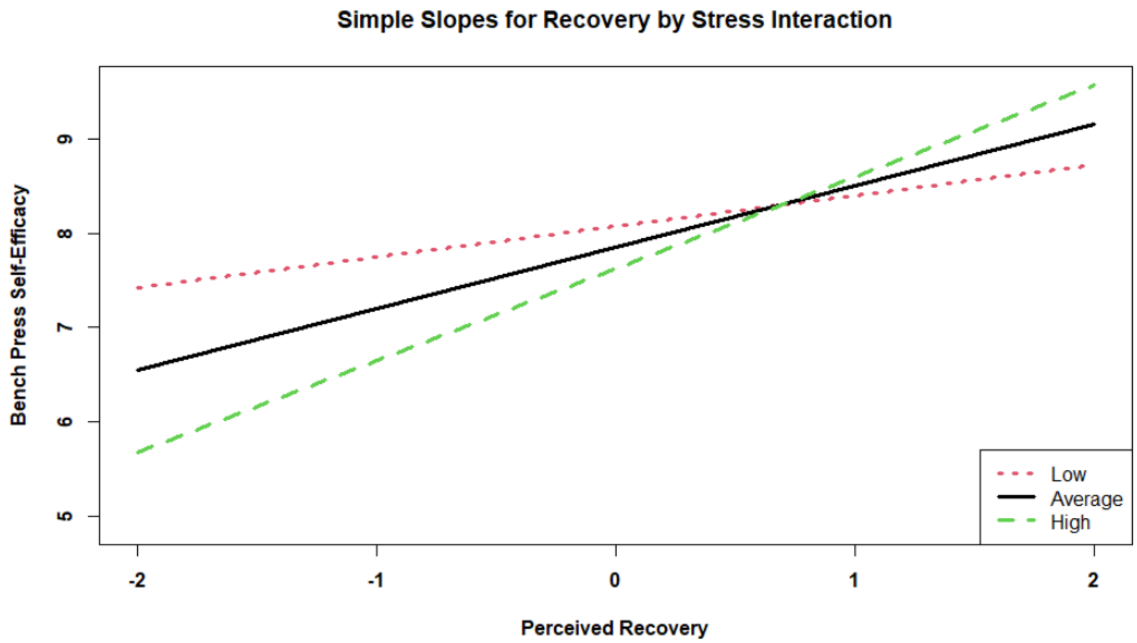

Figure 4: Simple Slopes for Perceived Recovery and Bench Press Self-Efficacy Relationship

Olympic Lifts. The intra-class correlation coefficient for the null model was 41.1%. Olympic lift self-efficacy showed a greater proportion of variance at level 2 than overall workout self-efficacy. The interaction term between perceived recovery and perceived stress at level 1 was statistically significant. The region of significance for the simple slopes analysis was between -1144.85 and -0.19 for the moderator perceived stress. Simple slopes for average (b = 0.76, p < .05) and above-average perceived stress (b = 1.02, p < .05) were significant.

For individuals with average or above average perceived stress levels relative to their mean, a higher perceived recovery was related to higher Olympic lift self-efficacy. For individuals with below average perceived stress relative to their mean, perceived recovery did not contribute to Olympic lift self-efficacy before a weight room workout. The relationship between perceptions of recovery and Olympic lift self-efficacy was stronger for above average stress levels, meaning an increase in perceived recovery positively impacted self-efficacy more when individuals had higher levels of stress.

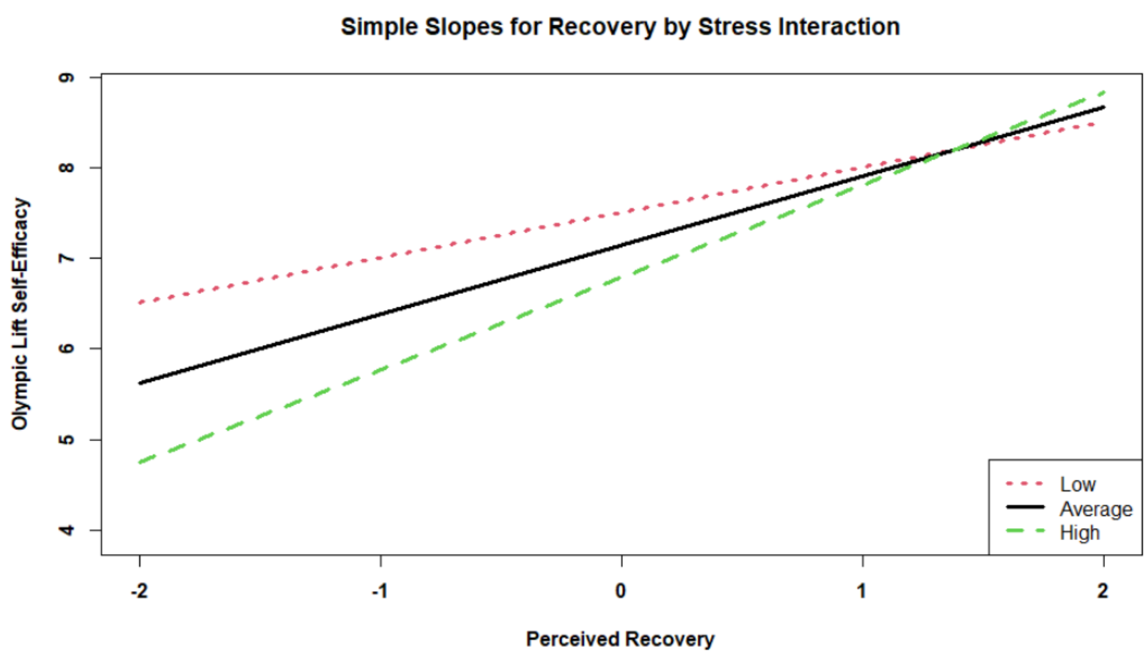

Figure 5: Simple Slopes Analysis for Perceived Recovery and Olympic Lift Self-Efficacy Relationship

Chapter Five: Conclusion

This research study had three objectives. The primary aim of this study was to examine the relationships of daily effort, task-specific self-efficacy, and athlete perceptions of performance with athlete positive well-being and psychological distress following a strength training workout. A secondary aim of this study was to study the relationships between daily self-efficacy and effort with perceived performance in the squat, bench press, and Olympic lift exercises, and whether these relationships vary between individuals with different motivational traits. The final aim of this study sought to determine whether an athlete's daily perceptions of recovery and stress impacted their daily self-efficacy before a weight room workout.

Existing literature surrounding self-efficacy and effort suggests that individuals higher in self-efficacy should also put in more effort and have higher perceptions of performance, largely studied from a between-person context (Moritz et al., 2000). Our data shows moderate, positive correlations of daily task-specific self-efficacy with perceived effort and perceived performance, which supports prior literature in the between-person context and extends these findings to a within-person context.

Research Aim 01

After controlling for pre-workout psychological state, daily effort and perceived performance predicted both post-exercise positive well-being and psychological distress. Increased efforts and higher perceptions of performance contributed to higher states of positive well-being and reduced psychological distress. In addition, athletes who were higher in task-specific self-efficacy compared to others showed higher states of well-being and lower states of psychological distress following the strength training workout. These findings agreed with our hypothesis. Changes in daily task-specific self-efficacy, trait self-determined motivations, and trait achievement goal orientations did not predict athlete states of post-workout positive well-being or psychological distress. These findings did not support our hypothesis.

Acute psychological responses to exercise include both positive and negative states (McAuley & Courneya, 1994; Watson & Tellegen, 1985). Self-efficacy is a well-studied cognitive component of affective exercise outcomes. Most studies report a relationship between self-efficacy and positive psychological states following exercise, and our findings support this literature (Bozoian et al., 1994; Elkington et al., 2017). Of the predictors examined, trait self-efficacy showed the strongest relationship with both dimensions of psychological responses to a strength training workout. Athletes with higher self-efficacy beliefs about their workout compared to other athletes experienced more positive and less negative subjective responses to their exercise sessions. These findings agree with prior literature, where manipulation of efficacy beliefs led to more positive and less negative affective response to an exercise session in the higher-efficacy group (McAuley et al., 1999). Additionally, trait task-specific self-efficacy showed a stronger relationship with the positive dimension of psychological response than the negative dimension, indicating that athletes with higher trait task-specific self-efficacy realized larger benefits on the positive well-being component of subjective exercise responses. To the author’s knowledge, limited research has examined the predictive strength of these relationships between positive and negative psychological responses with trait self-efficacy. Prior research has compared dichotomous high- and low-efficacy groups using difference scores, which makes a comparison between our study findings using a multilevel model difficult (McAuley et al., 1999). Within our findings an athlete's daily fluctuations in self-efficacy did not predict psychological responses to exercise, suggesting that overall trait task-specific self-efficacy is more important to affective outcomes of a training session.

These findings highlight the importance of developing athlete self-efficacy in the weight room environment to promote positive psychological responses to a strength training session. Self-efficacy beliefs can be influenced by past performance results, vicarious experiences, verbal influences, and psychological states, and practitioners can use these sources of efficacy information to enhance exercise behavior (Bandura, 1997; Jackson, 2010). Practitioners can encourage efficacy information generated by performance by providing opportunities for mastery experiences and goal setting with athletes in the weight room (Jackson, 2010). Strategies such as use of exercise logs to track progress, use of short-term SMART goals, and manipulating programming to enhance self-efficacy beliefs can all be used by the practitioner with their clients. Practitioners can also use techniques of modeling and imagery as vicarious experiences that can enhance self-efficacy (Jackson, 2010). For example, combined use of mental imagery, self-modeling via videotape recordings, and viewing a model lifter with correct technique can increase an individual's front squat self-efficacy and subsequent front squat performance (Buck et al., 2016). When individuals in a strength training setting are surrounded by others who can perform an exercise correctly or can see themselves in a mirror successfully performing a task, these can contribute to building self-efficacy for these exercises (Jackson, 2010). Verbal acknowledgement and social persuasion by trainers have also been shown to influence self-efficacy (Jackson, 2010). Several studies have manipulated self-efficacy with verbal feedback during exercise sessions, including strength training sessions (Fitzsimmons et al., 1991; Gernigon & Delloye, 2003; Hutchinson et al., 2008; McAuley et al., 1999). Specifically, false positive verbal feedback has been shown to improve self-efficacy and subsequently, objective performance and affective state. Some of the most effective strategies used by coaches to enhance athlete self-efficacy include encouraging positive self-talk, modeling confidence themselves, instruction drilling, and use of reward statements (Gould et al., 1989).

Our findings also showed that better psychological responses to a strength training session occurred with higher perceived efforts, meaning athletes who felt they gave more effort in their training session psychologically responded more positively to the workout. Athlete effort can change with athlete perceptions of a coach’s motivational climate (Monteiro et al., 2018; Pope & Wilson, 2012). When athletes perceive coaches as more supportive, they report greater need fulfillment, more autonomous regulations for sport, and therefore put more effort into playing their sport (Pope & Wilson, 2012). Similarly, when coaches foster a task-involved motivational climate, fulfillment of the athletes’ basic psychological needs are higher, autonomous forms of self-determined motivation are higher, and therefore perceived effort is higher in the sport (Monteiro et al., 2018). These studies suggest that coaches who foster a mastery climate in the training environment can positively impact an athlete's effort in their strength training session, and with our results suggest that this increase in effort can positively impact subjective responses to the training session. Reinboth and Duda (2004) also found that athlete perceptions of the motivational climate impact their mental wellness, as measured by self-esteem, and physical wellness, measured by indicators of physical ill-being. Their findings provide support for the psychological consequences of athlete perceptions of the motivational climate in training (Reinboth & Duda, 2004). Additionally, satisfaction of basic psychological needs can predict athlete perceived performance in sport (Claver et al., 2016). Claver et al. (2016) showed that the basic psychological need of relatedness was an important predictor of perceived performance in volleyball athletes; however, determinants of performance were predicted by cognitive variables. Findings indicate that perceptions of performance may be more influenced by emotional, rather than cognitive, states. This again highlights the importance of the environmental climate in impacting an athlete's psychological responses to a strength training session.

Our findings reported a positive relationship of perceived performance with positive well-being and a negative relationship of perceived performance with psychological distress. There was a stronger relationship for the positive dimension than for the negative dimension, suggesting perceptions of performance can greatly enhance positive psychological responses to a strength training session. This relationship between perceived performance and positive psychological responses to exercise is supported in literature. Bartholomew and Miller (2002) showed that while all participants in an aerobic dance class reported a positive affective response to the exercise session, participants who displayed higher perceptions of performance following the class showed a greater increase in positive valence than those with lower perceptions of performance. However, negative valence responses were not affected by perceptions of performance, in contrast to our findings which showed perceptions of performance to impact both positive and negative dimensions (Bartholomew & Miller, 2002).

Coaches, trainers, and practitioners can influence individual's perceptions of their performance in various ways. An athlete's relationship with a coach can influence the athlete's perceptions of performance (Moen et al., 2019; Zhang & Chelladurai, 2013). Zhang and Chelladurai (2013) reported that athlete trust in their coach directly influences perceptions of athlete performance. Szedlak et al. (2018) supported these findings, reporting that coach's characteristics and behaviors directly impact trust and respect for the coach, which then influences athlete's cognitions, affect, and behaviors. Additionally, Moen et al. (2019) reported a positive relationship between the coach-athlete relationship and athlete perceptions of performance. Moen et al. (2019) used the working alliance inventory, to measure three dimensions of the coach-athlete relationship: goal, task, and bond. These factors quantified agreement between the coach and athlete on the goal being pursued, the tasks to be accomplished to achieve these goals, and development of a personal bond between the coach and athlete. Each individual aspect, as well as a composite score, was positively related to athlete perceived performance in sport (Moen et al., 2019). These findings suggest that both the personal relationship between a coach and athlete, as well as congruence in goal setting are important to enhancing an athlete's perceptions of their performance in sport. Combined with these studies, our findings provide further support that coaches can increase athlete subjective responses to a strength training session by building a good rapport with the athletes and earning their trust and respect. Athlete perceptions of a coach's justice, benevolence, integrity, and competence are antecedents to building trust in the coach, and developing these qualities may enhance the coach-athlete relationship (Zhang & Chelladurai, 2013). In addition, Szedlak et al. (2015) identified athlete-perceived behaviors of strength and conditioning coaches that contribute to enhancement of the relationship between an athlete and their coach. These themes included relatedness and closeness, authenticity and sincerity, and perception of the coach as a role model (Szedlak et al., 2015). Therefore, self-reflection of strength and conditioning practitioners on their professional conduct can impact an athlete's psychological responses to strength training sessions. Szedlak et al. (2019) recommends this constructivist approach, which includes learning and professional development through processes of self-reflection, communities of practice, and situated learning, for strength and conditioning coaches to develop their psychosocial coaching behaviors and characteristics.

In our study, the relationship between perceived performance and post-workout positive well-being differed between athletes. However, no trait constructs measured in this study (achievement goal orientation, self-determined motivation, trait self-efficacy) were able to explain why these relationships differ. Due to the documented impact of coach-athlete relationship on perceptions of performance, it is possible that athletes' perceptions of their coaches in the strength training environment could impact the strength of these relationships. Future studies could seek to document how the strength of the relationship between perceived performance and psychological responses to a strength training workout change as a function of the coach-athlete relationship.

A secondary finding of interest is that fluctuations in daily self-efficacy did not moderate the relationships between effort or perceived performance with positive well-being. Regardless of daily fluctuations in self-efficacy, giving more effort and feeling better about the day's performance increases an athlete's positive psychological response to the training session. However daily fluctuations in self-efficacy influence how daily effort and perceived performance contribute to the negative subjective response to a strength training session. When an athlete's self-efficacy levels are average or below average, giving more effort during a workout can reduce psychological distress following that strength training session. Similarly, when athlete's self-efficacy levels are low, higher perceptions of their performance can reduce the negative psychological response to the workout. However, when athlete's self-efficacy entering the workout session are above average, changes in effort and evaluations of performance do not impact the psychological distress response.

It is particularly interesting that fluctuations in daily self-efficacy moderate the relationships between effort and perceived performance with psychological distress but not with positive well-being following a strength training workout. This could indicate that when athletes are not confident in their abilities to perform a task, giving more effort reduces their negative subjective response to a workout. Rejeski and Lowe (1980) reported an interaction nearing significance between ability and effort in affective response to a cycle ergometer task. Regardless of effort, the high ability group reported positive affect.

In the low ability group, giving higher efforts produced positive affect, like the high ability group, while giving lower efforts produced more negative affect (Rejeski & Lowe, 1980). When individuals were high in either ability or effort, affect was more positive, but the combination of low ability and low effort resulted in more negative affect (Rejeski & Lowe, 1980). Like Rejeski and Lowe's (1980) findings, our findings suggest that high self-efficacy could be sufficient to mitigate an individual's negative psychological responses to exercise while low self-efficacy requires higher efforts to reduce these effects. However, it is important to note that Rejeski and Lowe (1980) used a bipolar feeling scale, while our study measured each positive and negative dimension individually.

In conclusion, athlete psychological responses to a strength training session can be enhanced with changes in athlete effort, perceived performance, and self-efficacy, which all can be influenced by the coach's behaviors and characteristics in the strength training environment. Future research should study applied interventions that impact a coach's influence on these variables in both the strength training environment and through professional development opportunities.

Research Aim 02

As perceived performance was a substantial contributor to both positive well-being and psychological distress following a strength training workout, our second research question sought to further investigate the task-specific relationships between daily effort and self-efficacy with perceptions of performance for specific strength training tasks: the squat, the bench press, and the Olympic lifts. Task-specific aggregated self-efficacy was a significant predictor for each lift, indicating that athletes higher in self-efficacy for the task resulted in higher perceptions of their own performance with the task. These findings support our hypothesis. Daily self-efficacy was not a predictor of perceived performance for any task, contradicting our hypothesis. This suggests that within a 4-week training cycle, trait self-efficacy is more important than daily fluctuations in self-efficacy in impacting an individual's daily perceptions of their performance.

Our findings for aggregate self-efficacy agree with prior research showing a moderate, positive relationship between self-efficacy and performance in sport (Moritz et al., 2000). A small body of research has suggested a negative relationship between self-efficacy and performance exists at the within-person level of analysis. These studies have investigated self-efficacy from a perceptual control theory perspective, which contradicts the positive relationship posited by self-efficacy theorists (Bandura & Locke, 2003; Vancouver et al., 2002). While this small body of research suggests a negative relationship between self-efficacy and performance exits in other fields, an overwhelming body of literature demonstrates the positive relationship between the two (Bandura & Locke, 2003; Vancouver et al., 2002). These theories were directly tested by Gilson, Chow, et al. (2012) over a period of 8 months in the strength training environment. Gilson, Chow, et al. (2012) used multilevel modeling to assess the contribution of self-efficacy at between-person and within-person levels in squat 1RM performance in an ecologically valid study. This study controlled for raw past performance and showed that self-efficacy was positively related to performance both between and within persons for the squat task in the weight room (Gilson, Chow, et al., 2012). Studies supporting the negative relationship of self-efficacy and performance within individuals shows that this relationship may differ based on level of confidence, with individuals who are overconfident in their abilities showing a negative relationship between self-efficacy and subsequent performance (Moores & Chang, 2009; Vancouver et al., 2002). Overconfidence was not measured in this study but should be examined in future research.

While Gilson, Chow, et al. (2012) found positive relationships between both daily and aggregated self-efficacy with 1RM performance for the squat, our findings only support the relationship of aggregated self-efficacy with perceived performance. There are several methodological differences between the two studies that may contribute to this discrepancy at the within-person level. First, the differences observed may simply be due to the measure of performance employed in the study. While Gilson, Chow, et al. (2012) used an objective measure of performance (the 1RM), our study used a subjective, self-report measure of perceived performance. Differences have been documented in the strength of relationships between objective, subjective, and self-report measures (Moritz et al., 2000). Future research should seek to measure both objective and subjective performance measures in the same experiment. Alternatively, the time frame and frequency of assessment could also contribute to the difference in findings between these two studies. Gilson, Chow, et al. (2012) measured self-efficacy and performance 3 times over an 8-month period, while our study measured self-efficacy and performance an average of 6 times over a 4-week period of data collection. It is expected that 1RM performance should change over a period of 8 months, however smaller changes in strength are expected over an 8-week period.

Supporting our hypothesis, increases in daily effort were related to higher perceptions of performance with all tasks. Giving higher efforts for a task are related to higher personal evaluations of performance for the squat, bench press, and Olympic lifts. The strength of this effort-performance relationship differed between individual athletes for the squat and the Olympic lift tasks, but the relationship looked the same for all athletes in the bench press task, partially supporting our hypothesis. Prior research from basketball shooting tasks has found that individuals who perceive their performance as more successful reported giving higher effort for the task (McAuley & Tammen, 1989). These findings were not reported for the objective measures of performance in the shooting tasks, indicating effort may be an important component for perceived task success rather than measured objective performance (McAuley & Tammen, 1989).

For the squat task, 3 x 2 achievement goal orientations of athletes helped explain why the strength of the relationship between effort and perceived performance differed between athletes. The positive relationship between effort and perceived performance was buffered for athletes higher in task-avoidance, self-avoidance, other-avoidance, and other-approach orientations. Athletes who defined competence as demonstration of ability compared to others, rather than to themselves or to the task, and athletes who were motivated to avoid failure, rather than to achieve success in the task, showed a weaker relationship between effort given and perceptions of performance. For these athletes, increases in effort for the squat task did not result in as much of an increase in perceptions of performance. This could be due to how giving effort in a task is perceived and valued by different goal orientations. In early dichotomous models of achievement goal orientations, it was proposed that individuals high in task or mastery orientation perceive effort as an end outcome, while individuals high in ego or performance orientation perceive effort as a means to an end (Nicholls, 1984). Studies have supported these beliefs about effort's role in success in sport by showing these relationships with task and ego orientations (Lochbaum & Roberts, 1993). Other studies have shown task orientation, but not ego orientation, as a predictor of subjective effort in athletes (Mudrak et al., 2021). While achievement goal theory has advanced from the dichotomous model, this theory can help explain the differences in the strength of the effort-perceived performance relationship between different 3 x 2 achievement goal orientations. For athletes who demonstrate competence by comparison to personal standards and improvement, such as individuals high in task-approach and self-approach orientations, giving high efforts may be a key component in how they define success. As effort is closely linked to these athlete's definition of success, giving higher efforts will result in these athletes subjectively rating their performance higher. This definition is supported in track athletes, where task and mastery orientations were associated with the view that working hard leads to success, while ego and performance orientations attributed success to ability and external factors (Pietrzak & Tokarz, 2019; Veligekas et al., 2007). For performance-oriented individuals where effort is distinct from the end goal or outcome, effort may not be considered or valued as heavily in the athlete's assessment of their personal performance.

In addition, athletes who are motivated to avoid failure or compare their successes to others may view giving increased efforts as an indicator of being less successful. Bandura (1977) proposes that successes achieved with less efforts enhance self-efficacy beliefs more than successes achieved with more efforts. Therefore, if these athletes give more effort for a task to achieve the same result as they have in the past, or if these athletes give more effort than another individual who achieves the same outcome, their cognitive evaluation of the result may perceive this as a failure. This is because giving high efforts to achieve a performance standard can be cognitively evaluated as having low ability (Sarrazin et al., 2002). Literature suggests that both self-worth theory and causal attribution theory can help explain feelings of shame through effort and ability perceptions (Covington & Omelich, 1985). Covington (1984) suggests that effort is an important contributor to self-worth by how it impacts perceptions of ability. In situations where individuals try hard and fail at demonstrating their abilities, their self-worth is lowered (Covington, 1984). Causal attribution theory is complimentary to this theory, suggesting that in situations where individuals give low effort to achieve an outcome, they may feel guilty due to lack of effort, but their self-worth is not harmed because it is not seen as a true demonstration of their ability (Covington & Omelich, 1985).

Unlike the squat task, achievement goal orientations could not explain the differences in the effort-performance relationship between athletes for the Olympic lift exercises. Trait self-efficacy contributed almost twice as much to perceptions of performance in the squat compared to the Olympic lift task, even though self-efficacy and perceptions of performance for both tasks were similar. Therefore, factors other than belief in one's ability to perform the task may be important to an individual's perceptions of performance for the Olympic lifts. This could be attributed to perceptions of task complexity or task difficulty, both of which are variables that were not measured in this study. Subjective task complexity reflects how difficult an individual perceives the task, which is influenced by the objective characteristics of the task in addition to other subjective factors (Campbell, 1988). Subjective task complexity explains a substantial amount of variance in self-efficacy (Mangos & Steele-Johnson, 2001). Goal orientation has been shown to influence subjective task complexity, thereby influencing self-efficacy and subsequent performance (Mangos & Steele-Johnson, 2001). However, subjective task complexity is not the same as ability, which may be another contributing factor to performance (Mangos & Steele-Johnson, 2001).

Task difficulty has also been shown to impact effort and performance on a task when both achievement goal orientation and perceptions of ability are considered (Sarrazin et al., 2002). Sarrazin et al. (2002) found that effort exerted depends on the difficulty of the task in addition to perceptions of ability. As tasks become more difficult, individuals with high task orientation and high perceived ability give more effort, while individuals high in ego orientation and low in perceived ability give the least effort (Sarrazin et al., 2002). As tasks become more difficult, individuals with higher perceptions of ability give more effort than individuals with lower perceptions of ability, regardless of achievement goal orientation (Sarrazin et al., 2002).

Individuals' perceptions of ability, task difficulty, and task complexity may impact the relationship between effort and their perceived performance and explain differences in this relationship between individuals. Specific to strength training, individuals may perceive the Olympic lifts as more difficult or more complex, may perceive their abilities as lower in the task, and may be less confident in their abilities for the task overall compared to the squat. An examination of the Olympic lifts and the squat movements show that Olympic lifts require more skill and technique than the squat, which may influence perceptions of difficulty and complexity of the task. While both powerlifting and weightlifting exercises are multi-joint movements that involve large muscle mass recruitment, powerlifting exercises are traditionally executed for maximal strength, while weightlifting exercises rely more on power and technique (Garhammer, 1993). When examining objective complexity of the task, the Olympic lifts begin with an upward movement phase (first pull), transition, second pull, and catch (Haff & Triplett, 2016). The catch in the power clean and power snatch is described similar to a quarter squat position, and in the full squat clean and snatch is described similar to a parallel squat position (Haff & Triplett, 2016; Hendrick, 2004). The Olympic lifts require an athlete to be able to successfully execute several steps before engaging in a squat task, making the Olympic lifts more complicated movements. In addition, teaching the clean is more difficult than teaching the squat or bench press (Hendrick, 2004). It is documented that beginners may have difficulty learning Olympic lifting techniques, and individuals learning these lifts may require a breakdown of several steps prior to being proficient in the full movements (Hendrick, 2004; Hori et al., 2005). In addition, a tradeoff between teaching complex weightlifting movements and using less complex movements to develop explosive strength is a frequent consideration for coaches (Janz et al., 2008). Investigation of these factors and how they contribute to individual differences in the effort-performance relationship for each lift should be examined in future research.

Trait motivation variables were only significant for the bench press task, which contradicted our hypothesis. Self-determined regulations in this study were measured contextually for strength training overall, while performance in this case was situationally task specific. These measures were collected at two different measures of generality, may be a reason these relationships were not found for all tasks (Vallerand, 2007). Mediating variables may help explain the relationships between different levels of generality, such as situational motivation measures. For the bench press task, self-determined motivations contributed to explaining task-specific perceptions of performance. Specifically, introjected regulation and external regulation for strength training contributed to perceptions of bench press task performance. Athletes higher in introjected and external regulations as motives to participate in strength training showed lower perceived performance on the bench press task. Athletes participating in strength training motivated by introjected regulation are participating due to internal pressures, such as guilt, shame, or pride. Athletes participating in strength training for external regulations are participating due to external pressures or obligations, such as being required to participate as part of sport participation activities.

Relative to the squat and Olympic lifts in this study, daily self-efficacy for the bench press was higher and perceived performance was similar. While upper body explosive strength is a well-documented contributor to sport performance in the throwing events, evidence is lacking for the effective transfer to the sprinting and jumping events (Sakamoto et al., 2018; Takanashi et al., 2022). This may contribute to a lack of perceived importance of this task as it contributes to success in sport. Individuals who are participating in strength training for more controlled reasons may also view the bench press as a less important exercise relative to their overall success in sport. This may also impact their attitudes and emotional states surrounding the bench press task specifically. Athletes participating in strength training as a means to an end or due to self-imposed pressures may be less satisfied with their performance in a task that shows less direct transfer to sport. However, evidence is needed to support these suggestions and is a recommended area for future research.

The amount of variance explained at each level of analysis in squat performance differed from the findings of Gilson, Chow, et al. (2012). Gilson, Chow, et al. (2012) reported 82% of the variance in squat performance at the between-persons level, while our study showed 48% of variance at the between-persons level. However, an objective measure of 1RM performance was used in Gilson, Chow, et al. (2012), while a subjective measure of perceived performance was used in our study. Together, these studies support the need for inclusion of both objective and subjective measures of performance in future research to understand why variation between and within individuals differs with objective compared to subjective measures of performance.

Research Aim 03

With our previous research questions, task-specific self-efficacy levels between persons contributed to post-workout subjective responses and perceptions of performance, while daily fluctuations within an individual did not contribute to these outcomes of a training session. However, daily self-efficacy was a moderator of the relationships between effort and perceived performance with psychological distress, showing that higher efforts and perceptions of performance can reduce psychological distress when an athlete has below average or average daily self-efficacy. Therefore, daily levels of task-specific self-efficacy appear important for athletes, particularly to states of distress. Our analysis showed that a substantial proportion of daily self-efficacy for a strength training workout could be explained by variability within an individual, rather than attributed to trait differences between individuals. Self-efficacy beliefs can come from four sources: past performance, vicarious experiences, verbal persuasion, and psychological states (Bandura, 1977). Psychological states remain the least studied of the efficacy belief sources. A majority of studies that investigate psychological states and self-efficacy use self-efficacy as a predictor, rather than an outcome (Samson & Solomon, 2011). Therefore, this final research question sought to determine the influence of psychological states prior to a strength training session on daily task-specific self-efficacy for the workout session.

An athlete's self-efficacy for a whole strength training session was higher than for individual tasks within a strength training session. For both the overall workout and individual strength training tasks, when athletes had higher perceived recovery they displayed higher daily self-efficacy, while when athletes had lower recovery states they displayed lower self-efficacy for these tasks. These findings show that an athlete's perceptions of recovery can contribute to their beliefs in their abilities to perform a task. These findings are important because athletes are active agents that can self-regulate recovery processes. Athletes can use self-regulation strategies that promote recovery or that promote perseverance of stress, and individual differences in these resources are essential to recovery (Beckmann & Kellmann, 2004). Developing self-regulation strategies that promote recovery can also benefit an athlete's long-term health, well-being, and performance (Balk & Englert, 2020). Coaches can help athletes develop recovery self-regulation in several ways. First, coaches can help athletes become more aware of their physical and psychological states (Balk & Englert, 2020). This can be achieved by tracking these states in a journal and encouraging reflection on these states. Another way in which coaches can develop recovery self-regulation in athletes is creating behavioral habits in their daily training routines (Balk & Englert, 2020). Athletes are more likely to initiate recovery practices when the practices are part of their daily habits. In addition, creating implementation plans for situations that may arise can help athletes cope with these situations when they occur (Balk & Englert, 2020). In addition to helping athletes develop recovery self-regulation in practice, coaches can promote athlete self-regulation within the coaching climate they create. Goffena and Horn (2021) showed that autonomy-supportive coaching is related to self-regulated learning in sport. Mageau and Vallerand (2003) defined seven characteristics of autonomy-supportive coaching practices, which includes: providing athletes with choices within specific rules and limits, providing athletes with a rationale for tasks and limits, acknowledging athlete feelings and perspectives, providing athletes with opportunities to take initiative and complete independent work, providing athletes with competence feedback, avoiding controlling behaviors, and preventing ego-involvement in athletes. Like Goeffena and Horn (2021), coaches could use these autonomy-supportive coaching techniques to promote and develop self-regulated recovery practices. Specific to recovery, this could be accomplished by a coach providing athletes with a list of recovery protocols to choose from after practice and allowing them to do so independently.

Kellmann's (2002) scissors model defines the relationship between stress states and recovery demands in athletes. In this theoretical model, as stress increases an athlete's demand for recovery also increases. High levels of stress require high levels of recovery, and when an athlete's recovery status is not sufficient to meet an athlete's stress levels, negative consequences can occur. This relationship was tested in our model with an interaction between perceived stress and recovery, in which the relationship between recovery and self-efficacy depended on an athlete's stress level. Findings from our models supported the relationships posited in Kellman's (2002) scissors model. The relationship between recovery state and self-efficacy depends on an individual's perceived stress level for an overall workout, bench press task, and Olympic lift task. For an athlete displaying average or high perceived stress, low recovery levels related to lower self-efficacy levels while high recovery levels related to higher self-efficacy. Athletes with high stress required higher recovery levels to enhance self-efficacy. An equal increase in perceived recovery was more impactful to efficacy beliefs when perceived stress levels were higher, indicating that recovery practices are particularly beneficial for athletes in high-stress states. When stress levels were low, increases in recovery did not contribute to efficacy beliefs. This may be because the current levels of recovery in low-stress states are sufficient to meet the demands of the experienced stress. As the demand is already met an increase in recovery may not contribute to an alleviation of stress in this scenario, whereas with higher stress states the additional recovery may be necessary to meet this demand. Literature surrounding acute stress and recovery states shows a negative impact of a recovery-stress imbalance on performance measures (Coutts et al., 2007). However, the impact of this imbalance on psychological states is not well-documented. Our study adds to existing literature on recovery and stress states in athletes by providing support that the interaction of these states can impact an athlete’s belief in their capabilities to succeed in their training sessions.

In contrast to the other tasks, the relationship between perceived recovery and squat self-efficacy did not depend on perceived stress, meaning the relationship between recovery and self-efficacy is constant regardless of an athlete’s perceived stress level. This could mean that unlike the bench press and Olympic lift tasks, perceived recovery is equally important for the squat regardless of stress level. Even in low-stress states, those that are higher in recovery show more belief in their squat abilities, and the relationship between recovery and efficacy beliefs is similar regardless of experienced stress. It is possible that observed differences in this relationship between the squat and Olympic lifts are due to differences in task complexity and perceived task difficulty of the two tasks discussed earlier. For a task that is perceived as less complex, stress level may not exert an influence on the benefits of increased recovery for self-efficacy. In contrast, a task that is perceived as more complex or difficult could allow for high stress to impact the recovery-self-efficacy relationship, in which low recovery in a high stress state results in lower self-efficacy.

Limitations

The niche sample of strength and power track and field NCAA Division 1 athletes can be seen as a limitation in generalizing the findings of this study to other populations, however this specific sample selection may strengthen the conclusions that can be drawn specific to this population. Another limitation of this study is that it is a short-term training study, which provides a small snapshot of the entire training process and development of an athlete. Future research could seek to expand this research over a longer training period.

Another limitation of this study is that the volunteers were asked to remember on their own to complete each survey before and after each strength training session, without reminders from the researchers. This likely limited the number of data points that were collected, resulting in a smaller number of daily data points per individual. In addition, it is likely that the individuals who were recruited for this study but only completed one day of data collection could have been retained if a researcher was present to remind volunteers about the electronic surveys. This could have improved the level 2 sample size.

While Bandura recommends that self-efficacy constructs are measured on a 0-100% scale, our study measured self-efficacy and related constructs on a 0-10 Likert scale. This was due to a limitation in the electronic survey software employed to collect data collection. This discrepancy could impact statistical findings from our analysis, and a more precise analysis could have been conducted if the 100-point scale were used.

Importance

This study contributes to the understanding of athlete psychological responses to a strength training session in the weight room environment, with specific emphasis on how these responses relate to self-efficacy and achievement goal theory (Bandura, 1977; Elliott et al., 2011). This study specifically analyzed cognitive contributions (motivations, beliefs, and goals) to the subjective exercise experiences of positive well-being, psychological distress, and an athlete's perceptions of their performance. Findings from this study can help professionals create a training environment that fosters positive psychological responses to a training session by developing cognitive factors that impact athlete's experiences in this environment.

Our findings document the influence of two psychological states – perceived stress and perceived recovery – on an athlete's self-efficacy prior to their strength training workout. Psychological contributions are one of the four sources of efficacy information, suggesting that psychological states can influence an individual's beliefs. Findings from our study support the influence that acute sport-specific psychological states can exert on an athlete's beliefs about their capabilities in the training environment. Specifically, that high perceptions of recovery can positively influence an individual's self-efficacy, and this is particularly important in states of high perceived stress.

Our findings also verify that self-efficacy is an important contributor to psychological responses to a strength training session, at both the between-person and within-person level. Findings at the within-person level of analysis document the impact that an individual's fluctuations in self-efficacy can have on their training session outcomes. When an athlete's self-efficacy is average or below average, increases in perceptions of effort and performance can reduce negative psychological responses to the training session. As effort and perceived performance can be manipulated in the training environment, our findings provide direction for coaches to enhance positive psychological responses to a training session. In addition, we found that an athlete's definition of success using the 3 x 2 achievement goal orientation model can impact the relationship between effort and perceptions of their performance. For the squat exercise, athletes with mastery-approach orientations realized the largest benefits in perceptions of performance with increased efforts. Consideration of an athlete’s goal orientation can guide a coach’s approach to motivating athletes during training sessions.

Our findings document that perceptions of recovery, effort, and performance are important to a positive psychological experience for athletes in the strength training environment. In exercise, positive psychological responses are related to exercise adherence. This is likely to carry over to sport settings. Therefore, enhancing positive psychological responses to strength training sessions can improve athlete adherence to these sessions. In addition, positive psychological responses to a session can enhance efficacy beliefs for future training sessions and can guide future behavior in the environment. Developing better adherence, promoting higher efforts, and better performance in the strength training environment can therefore lead to improved performance in sport.

Conclusion

In conclusion, findings from this study have important implications for athletes engaging in a strength training session, and for the coaches responsible for these athletes during the sessions. At the daily level, our findings showed that athletes with average and high perceived stress levels that also have low recovery states will show lower self-efficacy at the beginning of a strength training workout. These lower levels of daily self-efficacy are particularly important to consider because they can impact the negative dimension of psychological responses to a strength training session. Athletes entering their strength training sessions with average or below-average self-efficacy levels may realize a reduction in psychological distress following the workout when they give higher efforts or sense higher perceptions of their performance. Athletes with high trait self-efficacy show more positive psychological responses to strength training sessions, and therefore use of strategies to promote self-efficacy in the strength training environment may benefit athlete psychological responses to strength training sessions. Finally, achievement goal orientations may be important in understanding how athletes perceive their performance for lower body strength exercises. In athletes that show mastery approach orientations, giving more effort leads to higher self-evaluations of performance. However, athletes with mastery avoidance or performance-based orientations towards strength training may not realize the same effect with an increase in effort.

Appendix A. IRB Approval Document

Office of Research Integrity and Assurance

Research Hall, 4400 University Drive, MS 6D5, Fairfax, Virginia 22030
Phone: 703-993-5445; Fax: 703-993-9590

DATE:	October 8, 2021
TO:	Debra Stroiney, PhD
FROM:	George Mason University IRB
Project Title:	[1811486-1] Contribution of state and trait variables to athlete choice behavior in the weight room environment
SUBMISSION TYPE:	New Project
ACTION:	APPROVED
APPROVAL DATE:	October 8, 2021
REVIEW TYPE:	Expedited Review
REVIEW TYPE:	Expedited review category # *5&7*

Thank you for your submission of New Project materials for this project. The George Mason University IRB has APPROVED your submission. This submission has received Expedited Review based on applicable federal regulations.

You are required to follow the George Mason University Covid-19 research continuity of operations guidance. You may not begin or resume any face-to-face interactions with human subjects until (i) Mason has generally authorized the types of activities you will conduct, or (ii) you have received advance written authorization to do so from Mason's Research Review Committee. In all cases, all safeguards for face-to-face contact that are required by Mason's COVID policies and procedures must be followed.

Please remember that all research must be conducted as described in the submitted materials.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding followed by a signed consent form unless the IRB has waived the requirement for a signature on the consent form or has waived the requirement for a consent process. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require that each participant receives a copy of the consent document.

Please note that any revision to previously approved materials must be approved by the IRB prior to initiation. Please use the appropriate revision forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others and SERIOUS and UNEXPECTED adverse events must be reported promptly to the IRB office. Please use the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed (if applicable).

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to the IRB.

This study does not have an expiration date but you will receive an annual reminder regarding future requirements.

Please note that all research records must be retained for a minimum of five years, or as described in your submission, after the completion of the project.

Please note that department or other approvals may be required to conduct your research in addition to IRB approval.

If you have any questions, please contact Michelle Wallerstedt at (703) 993-9628 or mwallers@gmu.edu. Please include your project title and reference number in all correspondence with this committee.

GMU IRB Standard Operating Procedures can be found here: https://oria.gmu.edu/topics-of-interest/human-subjects/

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within George Mason University IRB's records.

Appendix B. Demographic Questionnaire

Years of sport participation: _______________ years

Years of Resistance training experience: ________________ years

Gender: Male | Female

Age: ________ years

Year in School: Freshman | Sophomore | Junior | Senior | Graduate

Primary Competitive Event: _______________

Secondary Competitive Event: ________________

How much do you currently value giving high effort in strength training sessions for attaining your personal goals in sport?

(no value) 1 2 3 4 5 6 7 8 9 10 (high value)

How much do you currently value the benefits of strength training sessions for attaining your personal goals in sport?

(no value) 1 2 3 4 5 6 7 8 9 10 (high value)

How much do you currently value performing well in strength training sessions for attaining your personal goals in sport?

(no value) 1 2 3 4 5 6 7 8 9 10 (high value)

Appendix C. Sport Motivation Scale II

Why Do You Practice Strength Training?

Using the scale below, please indicate to what extent each of the following items corresponds to one of the reasons for which you are presently practicing strength training.

	Does not correspond at all			Corresponds moderately			Corresponds exactly
1. Because it gives me pleasure to learn more about strength training	1	2	3	4	5	6	7
2. Because it is very interesting to learn how I can improve	1	2	3	4	5	6	7
3. Because I find it enjoyable to discover new performance strategies	1	2	3	4	5	6	7
4. Because practicing strength training reflects the essence of whom I am	1	2	3	4	5	6	7
5. Because through strength training, I am living in line with my deepest principles	1	2	3	4	5	6	7
6. Because participating in strength training is an integral part of my life	1	2	3	4	5	6	7
7. Because it is one of the best ways I have chosen to develop other aspects of myself	1	2	3	4	5	6	7
8. Because I have chosen strength training as a way to develop myself	1	2	3	4	5	6	7
9. Because I found it is a good way to develop aspects of myself that I value	1	2	3	4	5	6	7
10. Because I would feel bad about myself if I did not take the time to do it	1	2	3	4	5	6	7
11. Because I feel better about myself when I do	1	2	3	4	5	6	7

12. Because I would not feel worthwhile if I did not	1	2	3	4	5	6	7
13. Because people I care about would be upset with me if I did not	1	2	3	4	5	6	7
14. Because people around me reward me when I do	1	2	3	4	5	6	7
15. Because I think others would disapprove of me if I did not	1	2	3	4	5	6	7
16. I used to have good reasons for strength training, but now I am asking myself if I should continue	1	2	3	4	5	6	7
17. I don't know anymore; I have the impression that I am incapable of succeeding in strength training	1	2	3	4	5	6	7
18. It is not clear to me anymore; I don't really think my place is in strength training	1	2	3	4	5	6	7

Appendix D. 3 x 2 Achievement Goal Questionnaire in Sport

The following statements represent types of goals that you may or may not have when you strength train. For each item, put a mark on the scale from 1 (strongly disagree) to 7 (strongly agree) to indicate your level of agreement with the statement.

In the weight room, my goal is:

	Strongly disagree			Strongly agree			
1. To perform well	1	2	3	4	5	6	7
2. To do better than what I usually do	1	2	3	4	5	6	7
3. To do better than others	1	2	3	4	5	6	7
4. To avoid performing badly	1	2	3	4	5	6	7
5. To avoid having worse results than I had previously	1	2	3	4	5	6	7
6. To avoid doing worse than others	1	2	3	4	5	6	7
7. To obtain good results	1	2	3	4	5	6	7
8. To have better results than I had in the past	1	2	3	4	5	6	7
9. To be more effective than others	1	2	3	4	5	6	7
10. To avoid bad results	1	2	3	4	5	6	7
11. To avoid doing worse than I usually do	1	2	3	4	5	6	7
12. To avoid worse results than others	1	2	3	4	5	6	7
13. To be effective	1	2	3	4	5	6	7
14. To be more effective than before	1	2	3	4	5	6	7
15. To have better results than others	1	2	3	4	5	6	7
16. To avoid being ineffective	1	2	3	4	5	6	7

17. To avoid being less effective compared to my usual level of performance	1	2	3	4	5	6	7
18. To avoid being less effective than others	1	2	3	4	5	6	7

Appendix E. Short Recovery Stress Scale

Below you find a list of expressions that describe different aspects of your current state of recovery. Rate how you feel **right now** in relation to your best ever recovery state.

Short Recovery Scale	**does not apply at all**						**fully applies**
Physical Performance Capability *e.g. strong, physically capable, energetic, full of power*	0	1	2	3	4	5	6
Mental Performance Capability *e.g. attentive, receptive, mentally alert, concentrated*	0	1	2	3	4	5	6
Emotional Balance *e.g. pleased, stable, in a good mood, having everything under control*	0	1	2	3	4	5	6
Overall Recovery *e.g. recovered, rested, muscle relaxation, physically relaxed*	0	1	2	3	4	5	6

Short Stress Scale	**does not apply at all**						**fully applies**
Muscular Stress *e.g. muscle exhaustion, muscle fatigue, muscle soreness, muscle stiffness*	0	1	2	3	4	5	6
Lack of Activation *e.g. unmotivated, sluggish, unenthusiastic, lacking energy*	0	1	2	3	4	5	6
Negative Emotional State *e.g. feeling down, stressed, annoyed, short-tempered*	0	1	2	3	4	5	6
Overall Stress *e.g. tired, worn-out, overloaded, physically exhausted*	0	1	2	3	4	5	6

Appendix F. Task-Specific Self-efficacy

How confident are you at this moment that you will be able to successfully complete your exercise prescription today?

0 1 2 3 4 5 6 7 8 9 10

How confident are you at this moment that you will be able to successfully complete your squat exercise prescription today?

0 1 2 3 4 5 6 7 8 9 10

How confident are you at this moment that you will be able to successfully complete your bench press exercise prescription today?

0 1 2 3 4 5 6 7 8 9 10

How confident are you at this moment that you will be able to successfully complete your clean/snatch exercise prescription today?

0 1 2 3 4 5 6 7 8 9 10

Appendix G. Perceived Effort

How much effort do you feel you gave in today’s strength training session overall?

0 1 2 3 4 5 6 7 8 9 10

How much effort do you feel you gave in today’s squat exercise?

0 1 2 3 4 5 6 7 8 9 10

How much effort do you feel you gave in today’s bench press exercise?

0 1 2 3 4 5 6 7 8 9 10

How much effort do you feel you gave in today’s clean/snatch exercise?

0 1 2 3 4 5 6 7 8 9 10

Appendix H. Perceived Performance

How did you feel your performance was during today's training session overall?

0 1 2 3 4 5 6 7 8 9 10

How did you feel your performance was during today's strength training session in the squat?

0 1 2 3 4 5 6 7 8 9 10

How did you feel your performance was during today's strength training session in the bench press?

0 1 2 3 4 5 6 7 8 9 10

How did you feel your performance was during today's strength training session in the clean/snatch?

0 1 2 3 4 5 6 7 8 9 10

Appendix I. Subjective Exercise Experiences Scale

How Do You Feel? This inventory contains a number of items designed to reflect how you feel at this particular moment in time (i.e., Right Now). Please circle the number on each item that indicates **HOW YOU FEEL RIGHT NOW.**

I FEEL:

	not at all			**moderately**			**very much so**
1. Great	1	2	3	4	5	6	7
2. Awful	1	2	3	4	5	6	7
3. Drained	1	2	3	4	5	6	7
4. Positive	1	2	3	4	5	6	7
5. Crummy	1	2	3	4	5	6	7
6. Exhausted	1	2	3	4	5	6	7
7. Strong	1	2	3	4	5	6	7
8. Discouraged	1	2	3	4	5	6	7
9. Fatigued	1	2	3	4	5	6	7
10. Terrific	1	2	3	4	5	6	7
11. Miserable	1	2	3	4	5	6	7
12. Tired	1	2	3	4	5	6	7

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Biography

Lauren Biscardi graduated from Shoreham Wading River High School in 2005. She received her Bachelor's degree in Business Management with a specialization in Marketing and a minor in Philosophy from Stony Brook University in 2009. She received her Master's degree in Business Management with a concentration in Information Technology Management in 2011. She received her Master's degree in Sport Science with a concentration in Strength and Conditioning, with distinction, from Hofstra University in 2016. She was employed as an Instructor at Suffolk County Community College for seven years teaching computer science coursework. She was employed as an Assitant Professor at Hofstra University for a year and a half teaching in the Health Professions department. She holds her Certified Strength and Conditioning Specialist with Distinction certificaiton from the National Strength and Conditioning Association. She holds her Certified Sport Nutritionist certification from the International Society of Sport Nutrition. She is employed as an Assistant Track and Field Coach at George Mason University.