ABSTRACT

THE EFFECTS OF PETTLEP IMAGERY ON STRENGTH TRAINING PERFORMANCE

by Morgan Rae Eckenrod

There has been a plethora of imagery research examining imagery and performance. Recent imagery research has examined the effects of PETTLEP imagery on golf bunker shots and bicep curl performance. Although there has been a study conducted that examined the effects of PETTLEP imagery on bicep curl performance of novice participants there has been no research to date that has examined the effects of PETTLEP imagery on barbell bench press performance of individuals with strength training experience. Thus, the purpose of this study was to examine the effects of imagery training on the barbell bench press performance of individuals with strength training experience. To examine these effects the researcher had the participants perform a 1 repetition maximum and repetitions at 80% of their pre-test 1 repetition maximum on the barbell bench press. After the completion of the four-week intervention the participants performed the 1 repetition maximum and repetitions at 80% of their pre-test 1 repetition maximum on the barbell bench press. The results indicated that participants in all three groups improved their 1 repetition maximum and repetitions at 80% of their pre-test 1 repetition maximum from pre-test to post-test. However, there were no differences based on the intervention across time.
THE EFFECTS OF PETTLEP IMAGERY ON STRENGTH TRAINING PERFORMANCE

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Chapter 1

Introduction

Strength training is more than just lifting weights for those who participate in athletics. Rather, it is for anyone who is interested in living a long and healthy life. Research has shown that those who participate in resistance training programs experience increased strength, fat-free mass, decreased body fat, and improved physical performance in either a sporting activity or daily life activities (Fleck & Kraemer, 2014). Over the years, research has predominantly focused on cardiovascular exercise and fitness, viewing strength training as something only “athletes” participated in. Now that research has shown how strength training can be beneficial to one’s health, many have started incorporating it into weekly exercise routines. It is important to understand the overall health benefits of strength training and the definition of strength training.

Strength training or resistance training has become a popular form of exercise that enhances one’s fitness as well as conditions athletes (Fleck & Kraemer, 2014). Strength training, resistance training, and weight training all typically refer to a type of exercise that requires the body’s musculature to move or attempt to move against an opposing force, usually presented by some type of equipment (Fleck & Kraemer, 2014).

Like all types of performance, strength training has a mental component. Mental training has been used to enhance performance in sport, including strength performance. Of particular interest in this study is the use of imagery as a mental training tool to enhance strength performance. Imagery has become an important mental skill for individuals improving physical performance. Lindsey Vonn, one of the top American skiers, used imagery as part of her mental training plan and by implementing imagery into her routine enabled her to win the 2010 Olympic Downhill and four World Cup overall championships (Vealey & Forlenza, 2015).

Research has shown that imagery can enhance physical performance as well as psychological characteristics such as confidence and coping with anxiety (Weinberg & Gould, 2015). Jones and Stuth (1997) defined mental imagery as the process of imagining the performance of a skill with no related overt actions. When individuals engage in vivid imagery, their brains interpret these images as identical to the actual situation (Holmes & Collins, 2001; Jeannerod, 1994). This is termed functional equivalence and certain types of imagery protocols have been developed to induce functional equivalence in the brain to enhance performance. One such imagery protocol is PETTLEP imagery, an acronym that stands
for physical, environment, task, timing, learning, emotion, and perspective (Holmes & Collins, 2001). The PETTLEP imagery protocol is of particular interest in this study.

There has been a plethora of imagery research conducted over the years that examined imagery and performance. Although the effects of imagery training on sport performance has been widely studied, only one study has examined the effects of imagery on strength training performance (Wright & Smith, 2009). The study used novice participants and had them perform a bicep curl on a bicep curl machine. The results of the study found that participants increased their strength performance through PETTLEP imagery training, a combination of PETTLEP imagery training and physical practice, and just through physical practice. The findings indicated that visualizing a bicep curl in the mind enabled participants to increase their bicep curl performance. This was an important study to begin examining the influence of imagery on strength performance.

However, additional research is needed to continue this important line of inquiry into the effectiveness of imagery training on strength performance. Wright and Smith (2009) used novice participants in their study, meaning that the participants had no prior strength training experience. Therefore, the imagery training may have enhanced performance in the early phase of actually “learning” the motor movement of a bicep curl. Additional research is needed to examine the influence of imagery training on participants who have strength training experience. Will the imagery training still enhance strength performance when used with experienced individuals practicing a well-learned movement? This study will use participants with strength training experience to ascertain if imagery training can enhance their performance on a previously learned strength training movement.

In addition, it seems important to examine the effectiveness of imagery training on larger muscle group performance. Wright and Smith (2009) isolated the small upper arm biceps as the target of imagery training in their study. This study will examine the influence of imagery training on the barbell bench press, a different and larger muscle group. It is significant that the bench press performed in this study uses the barbell, as opposed to using a weight machine as Wright and Smith (2009) did in their study. The use of free weights as opposed to weight machines requires additional focus due to the importance of technique and such factors as balance and stability. The purpose of this study was to examine the effects of imagery training on the barbell bench press performance of individuals with strength training experience.

Chapter 2
Review of Literature
In this chapter, relevant research related to this study is reviewed. First, imagery as a mental training tool is defined and explained. Next, imagery as a polysensory experience is discussed. Also, different imagery perspectives (internal and external), which are described. After imagery perspectives the next area of discussion is imagery ability. The last topic of imagery discussed is participation and years of experience, knowledge of the experience with imagery, and imagery amount and duration.

**Imagery and Sport Performance Enhancement**

Mental imagery is defined as the process of imagining the performance of a skill with no related overt actions; it is the most prevalent form of mental rehearsal used in athletics (Jones & Stuth, 1997). Vealey and Forlenza (2015) define imagery as using one’s senses to re-create or create an experience in the mind. Imagery has been shown to enhance sport performance, learning, and emotions in athletes that are critical to their performance, and research shows that successful athletes use imagery more extensively and systematically than less successful athletes (Vealey & Forlenza, 2015).

The term “mental practice” is used to describe using imagery to perform a specific sport skill repetitively in the mind (Vealey & Forlenza, 2015). Research has shown that mental practice enhances performance and is better than no practice at all (Martin, Moritz, & Hall, 1999), and mental practice has been shown to show improvement across a wide range of sports skills (Vealey & Forlenza, 2015). It is important to note that mental practice does not take the place of physical practice for improving or refining a sport skill, but mental practice complements physical practice and is better than no practice at all (Vealey & Forlenza, 2015). Mental practice is important because it allows the athlete to fine-tune their sport skills without having to physically perform the skill. The next section will discuss preparatory imagery and it’s relation to enhancing sport performance and learning.

**Preparatory Imagery**

Preparatory imagery is an important part of performance routines and research has shown that using imagery right before competition or performance can help an athlete perform better (Vealey & Forlenza, 2015). When imagery is used right before competition, it is usually to pump the athlete up, calm them down, or to help them focus on relevant aspects of the task (Vealey & Forlenza, 2015). Preparatory strategies used before a performance have shown to improve performance on muscular endurance tasks (Gould, Weinberg, & Jackson, 1980; Lee, 1990), strength tasks (Shelton & Mahoney, 1978; Tynes & McFatter, 1987), and golf putting performance (Murphy & Woolfolk, 1987; Woolfolk, Parrish & Murphy, 1985). Using imagery prior to performance in a pre-performance routine in a planned systematic order of thoughts and behaviors lead to automatic performance execution (Lidor & Singer,
Another area related to enhancing sport performance is enhancing competition related thoughts and emotions, which is discussed in the next section.

**Competition Thought Enhancement**

In the previous sections, mental imagery was discussed in relation to how it enhances sport performance and learning. However, imagery can also enhance competition related thoughts and emotions. Research has shown that imagery enhances self-confidence (Callow, Hardy, & Hall, 2001; Mamassis & Doganis, 2004) motivation (Martin & Hall, 1995), and attentional control (Calmels, Berthoumieux & d’Arripe-Longueville, 2004). Not only can it enhance imagery performance, it can also change athlete’s anxiety perceptions that are harmful and negative to positive and facilitative. Mental imagery can also decrease or control precompetitive anxiety when combined with other mental training methods such as relaxation and stress inoculation training (Kerr & Lith, 1993; Ryska, 1998).

**Imagery as Polysensory**

Imagery is creating or re-creating an experience in the mind, and involves recalling pieces of information from memory about experiences and taking these pieces and putting them into meaningful images (Weinberg & Gould, 2015). When engaging in imagery, individuals interpret these images as identical to the actual situation (Vealey & Forlenza, 2015). Though imagery is referred to as visualization, it can and should be polysensory. This means that multiple senses can and should be used to enhance the vividness of the image. Kinesthetic sense is defined as being able to feel the body move in different ways and positions. Auditory sense is being able to hear the sounds that are around you when performing the skill. An example of this would be hearing a basketball bounce on a wood floor. Visual sense is being able to see what is going on in the situation. An example of this would be when a wide receiver in football sees the ball being thrown to him. The tactile sense is when you are able to touch and feel the object. An example of this would be how a hockey player feels the hockey stick in his hands (Weinberg & Gould, 2015). Gustatory refers to taste and an example of this would an athlete tasting sweat when performing (Vealey & Forlenza, 2015). Lastly, the olfactory sense is being able to smell the certain smells when performing the skill (Weinberg & Gould, 2015). An example of the olfactory sense is a swimmer smelling the chlorine. All of the senses play an important role when performing imagery by helping to create or recreate the actual experience in one’s mind. Not only are multiple senses used when performing imagery, but there are also different imagery perspectives.

**Imagery Perspective**
There are two different types of imagery perspectives: internal and external. External imagery perspective is seeing the image from outside of the body from either the front, behind, or sides. It is like watching yourself on videotape. Internal imagery perspective is seeing the image from inside the body. Mahoney and Avener (1977) define internal imagery as when a person images being inside their body and experiences the same sensations that they would if they were physically performing the skill. Gymnasts who successfully qualified for the U.S Olympic team used internal imagery more than those who were unsuccessful (Mahoney & Avener, 1977). Research has shown that using both internal and external perspectives can be effective. Imagery involves using multiple senses and can be experienced in two different perspectives.

**Imagery Ability**

The most well-acknowledged individual difference variable in imagery studies is a person’s ability to image (Murphy, Nordin, & Cumming, 2008). Individual differences in imagery ability are likely due to the combination of genetic variability and experience (Paivio, 1986). There are some variations in imagery ability that relate to brain differences. This is saying that some athletes have more ability than other athletes to imagine visual, kinesthetic, auditory, or other aspects of imagery, but athletes can be taught how to improve the quality of their imagery experience (Murphy, Nordin, & Cumming, 2008). Some ways in which athletes differ in imagery ability relate to age, gender, level of participation and years of experience. Though we know there are differences related to level of participation and years of experience, the reason behind these differences is not yet known (Murphy, Nordin, & Cumming, 2008). Hall (2001) has suggested that people who spend more time in sport and exercise ultimately spend more time thinking about sport or exercise.

**Theories About How Imagery Enhances Performance**

There are five conceptual theories that will be explored in this section. It is important to discuss the conceptual imagery theories since these provide an explanation for the effects of imagery on performance. The first theory to be discussed is psychoneuromuscular theory.

**Psychoneuromuscular theory.** The psychoneuromuscular theory states that imagery assists with the learning of motor skills because neuromuscular patterns are activated while imaging (Jacobson, 1931). The imaged event activates the muscle similar to if the individual was physically practicing the movement. Hall (2001) showed that motor imagery is seen as suppressing physical activity and impulses fire to the muscles and it builds memory for the movement. A study conducted by Sunin (1972) with skiers found muscle activity in the legs when they were imagining a downhill run. The patterns in the
muscle were the same patterns that were expected when a skier was skiing a downhill run. Though there have been studies to support this theory, researchers are not convinced that the research done using this theory is accurate because it lacks experimental control and that EMG measure have only been restricted to amplitude measures. Though research supports that vivid imagery can produce low-level innervation of muscles, research has not shown that this slight muscle innervation produced by imagery actually facilitated performance (Slade, Landers, & Martin, 2002; Smith, Collins, & Holmes, 2003). To allow researchers to support this theory, frequency and duration need to be examined (Hale, 1994).

**Symbolic learning theory.** The second conceptual explanation for the effects of imagery on performance is symbolic learning theory. Symbolic learning theory was developed by Sackett (1934) and the theory states that imagery can function as a system that codes functions to help an individual understand and acquire movement patterns. The actions are coded and serve as a “mental blueprint,” and by using imagery, the blueprint is developed and strengthened, which makes the actions more familiar (Hall, 2001). If an individual learns a skill and has an understanding of what is required to perform that skill, then the skill can be performed successfully. Once the individual develops a motor program in the central nervous system, a mental blueprint is formed in the mind for completing the movement being performed successfully (Weinberg & Gould, 2015).

It has been said that this theory is restricted for tasks that are cognitive or symbolic (Murphy et al., 2008). Studies that have used symbolic learning theory have shown imagery is more successful for predominantly cognitive tasks. An example of a cognitive task would be a karate routine. A karate routine requires one to remember all the movements of a routine to be able to successfully perform the routine whereas a motor task would be squatting the bar. Sackett (1934) used imagery to see if it could improve cognitive task performance of a finger maze. In this study he found that the task could be easily coded into memory using imagery (Sackett, 1934). Though there has been research to support the symbolic learning theory, it does have some limitations. One limitation of this theory specifically is that it cannot explain how athletes with experience in their sport that have already learned the movements can improve their performance (Hall, 2001).

**Triple-code model.** Another theory that explains the effects of imagery on performance is the triple code model, which Ahsen (1984) proposed that imagery has three components that can affect performance. The components include the image, the somatic response, and the meaning of the image.

The image itself represents that objects and the senses that enable and allow for the individual to interact with the image. The second component is the somatic response, which states that the image
results in psychophysiological changes in the body. The last component, which is unique to the triple code theory, is the meaning of the image, which is defined as the meaning of the image to the person performing the imagery. The triple code model states that the individual performing the imagery should seek to understand and find the meanings of the images (Weinberg & Gould, 2015).

**Bioinformational theory.** The bioinformational theory is explaining the influence of imagery on performance has been discussed extensively in the sport psychology literature. Bioinformational theory is an image that is an organized set of propositions or characteristics, stored in the brain’s long-term memory (Lang, 1977, 1979). When using imagery, stimulus characteristics are activated that describe the images content and response characteristics and these describe what the responses to that stimulus are (Lang, 1977, 1979). Bioinformational theory states that for sport performance to be facilitated through imagery, response characteristics have to be activated so the responses can be modified, strengthened, and improved. Athletes’ performances have been improved through imagery using stimulus and response characteristics (Smith & Collins, 2004; Smith, Holmes, Whitemore, Collins, & Devenport, 2001).

**Theory of functional equivalence.** The theory of functional equivalence explains that imagery causes the brain to activate the same areas and processes as if the imaged movement is actually being performed. Using imagery to stimulate a movement recruits and uses the same parts in the brain as the actual physical performance (Holmes & Collins, 2001; Jeannerod, 1994). Research has shown that functional equivalent imagery has had more of a positive effect on youth and adult sport performance than less functionally equivalent imagery (Smith, Wright, Allsopp, & Westhead, 2007). For imagery to be more functionally equivalent, it should include senses and feelings associated with competing, practiced in a similar posture to performance posture, wearing competition clothing, being in an environment similar to the environment where the performance takes place, it is done at the same speed as the skill, and uses an internal imagery perspective (Vealey & Forlenza, 2015).

**Imagery and Strength Performance**

There has been a plethora of definitions, theories, and examples given to describe the components and theories of imagery. Due to the focus of this study, it is important to discuss the research that examines imagery and its influence on strength performance.

A study done by Yue and Cole (1992) examined the effects of imagery on the abductor muscle of the fifth finger and the elbow flexor. Thirty right-handed participants were recruited and randomly assigned in this study that was determining if mental training induced strength gains without actually
performing the physical movement in the fifth finger abductors and elbow flexor muscles. The mental training sessions lasted for fifteen minutes per day and were over the course of twelve weeks. There were four groups used in this study and the first group was trained to perform mental contractions of abducting the fifth finger. The second group was trained to perform mental contractions of elbow flexion, the third group was not trained but participated in the measurements. Finally, the last group just performed maximal finger abductions. During each session participants were given their instructions and performed the mental contractions or physical contractions depending on what group they were in. The participants were given a two-minute rest after the first 25 trials and then the participants completed the last 25 trials for the day. The results showed the abduction group increased their fifth finger abduction strength by 35% and the elbow flexion group increased their elbow strength by 13.5%. The control group, the non-trained group showed no significant changes in strength in fifth finger abduction or elbow flexion (Yue & Cole, 1992).

**PETTLEP Imagery and Vividness**

There has been recent research that examined the effects of applying elements of the PETTLEP model to assist vividness and ease of imagining movements (Anuar, Cumming, & Williams, 2015). One of the most important components of imagery is one’s ability to image. Imagery ability is a key factor in determining the effectiveness of achieving desired outcomes. The ability to image is multidimensional and two of the main dimensions are: ease and vividness. The purpose of this study was to extensively compare the effects of PETTLEP imagery against traditional imagery on the ease and vividness of external visual imagery, internal visual imagery, and kinesthetic imagery. Forty participants were recruited for the study where they completed the Vividness of Movement Imagery Questionnaire-2 (VMIQ-2), the imagery evaluation form, which asked if the participants understood the imagery instructions, different modalities, and visual perspectives. The last form the participants completed was the PETTLEP evaluation form, which included five items: imagining while adopting the physical positions, performing the imagery in the environment reflective of where the movements would physically be performed, imagining the movements of standard reflective of the movement capabilities, imaging the movement in real time, and incorporating the relevant feelings and emotions into the imagery. All the ratings for the evaluation forms were on a seven point Likert scale (Anuar, Cumming, & Williams, 2015).

The researchers found a strong positive relationship between ease and vividness ratings for each of the VMIQ-2 subscales and found significant differences between PETTLEP imagery and traditional
imagery for vividness. Incorporating more PETTLEP elements resulted in greater ease and vividness of internal imagery and kinesthetic imagery compared to traditional imagery but it did not lead to significantly higher ease or vividness of external visual imagery over traditional imagery (Anuar, Cumming, & Williams, 2015).

**The Effect of PETTLEP Imagery on Performance**

There has been recent research examining PETTLEP imagery and its effect on performance. Holmes and Collins (2001) developed the PETTLEP model to help practitioners maximize functional equivalence. It is vital to have an understanding of the PETTLEP model but also the research examining this model.

Smith, Wright, and Cantwell (2008) examined the effects of PETTLEP imagery on golf bunker shot performance. The purpose of the study was to identify and compare the effects of PETTLEP imagery on golf bunker shot performance. The acronym PETTLEP stands for: physical (physical response), environment (the place where the imagery takes place), task (matching the task being imagined to the actual task), timing (similar timing to an event), learning (imagery content will change over time as one learns), emotion (the response and meaning of the situation), and perspective, which is the way it is viewed (Smith, Wright, & Cantwell 2008). PETTLEP imagery was used to help maximize functional equivalence, which is defined as imagery activating similar neurons to when one is actually performing. The participants were randomly assigned to one of the four groups and the Movement Imagery questionnaire was given to each participant prior to the study. The participants completed 15 bunker shots during the pre and post-test and participants were then interviewed after the pre-test. The results of this study found that the PETTLEP + physical practice group improved significantly from pre to post-test. This group improved more than the PETTLEP only imagery group and the physical practice group. There was also no significant difference between the PETTLEP and physical practice group (Smith, Wright, & Cantwell, 2008). The results of the study conclude that PETTLEP + physical practice leads to the greatest improvement in golf bunker shots.

Wright and Smith (2009) examined the effect of PETTLEP imagery on strength training performance. Fifty participants were placed into five groups: PETTLEP imagery, traditional imagery, physical practice, PETTLEP + physical practice, and a control group. The participants selected for the study were novices, meaning none of the participants in the study had any strength training experience. The strength training exercise used to test the participant’s strength was a bicep curl machine. The PETTLEP group imaged themselves using the bicep curl machine but when the participants were
imaging they were sitting at the bicep curl machine. The traditional imagery group was put in a separate quiet room where they imaged using the bicep curl machine. The physical practice group performed the bicep curl on the machine. The PETTLEP + physical practice sat at the bicep curl machine and imaged themselves performing the exercise and they also performed physical repetitions on the bicep curl machine. Lastly, the control group did not use imagery nor did they perform any repetitions on the bicep curl machine.

The participants took part in their assigned group and either performed physical repetitions, imagery, or both twice a week for six weeks. The post-test revealed that the PETTLEP, physical practice, and the PETTLEP + physical practice group improved their strength on the bicep curl machine whereas the traditional imagery and control group did not significantly improve.

The purpose of this study was to examine the effects of PETTLEP imagery on strength performance. Specifically, this study looked to see if one’s barbell bench performance improved. The first hypothesis for this study was that the PETTLEP imagery group, physical practice group, and the PETTLEP/physical practice combination group would all improve their 1 repetition maximum and 80% of their pre-test 1 repetition maximum from pre to post-test. The second hypothesis for this study was that the participants in the PETTLEP/physical practice combination group would see the greatest improvement in their 1 repetition maximum and 80% of their pre-test 1 repetition maximum from pre to post-test. In this next section the participants and measures that were used in the study will be discussed.

**Method**

**Participants**

Eighteen students, seven male and 11 female between the ages of 19 and 27 served as participants for the study. The participants had no prior imagery training, but the participants participated in consistent and regular strength training routines. All the participants were provided an informed consent form and they completed the Movement Imagery Questionnaire-3 (MIQ-3) before the testing period began. The participants were randomly assigned to one of three groups: PETTLEP imagery group, physical practice group, or PETTLEP/physical practice combination group.

**Measures**

**Movement Imagery Questionnaire-3 (MIQ-3; Williams, Cumming, Ntoumanis, Nordin-Bates, Ramsey, & Hall, 2012).** The Movement Imagery Questionnaire-Revised assesses an individual’s visual and kinesthetic imagery ability and is comprised of eight items (Wright & Smith, 2009). The MIQ-R was used to assess novice participants imaging ability in a study conducted by Wright and Smith.
(2009) that examined the effects of PETTLEP imagery and strength training performance. Since this study the MIQ-R has been revised and is now called the Movement Imagery Questionnaire-3.

The Movement Imagery Questionnaire-3 assesses one’s visual and kinesthetic imaging ability. The MIQ-3 was developed because researchers argued that the MIQ-R was unable to distinguish the different visual perspectives (Williams et al., 2012). The MIQ-3 is comprised of twelve items and contains three subscales: kinesthetic subscale, internal imagery subscale, and external imagery subscale. This differs from the MIQ-R where the questionnaire is comprised of eight items and two subscales: kinesthetic subscale and visual subscale, which contained both internal and external imagery (Williams et al., 2012).

The participants had to complete many different movements before the participants were asked to stand still and attempt to “see” or “feel” themselves completing the movement. After this process is complete, the participants then had to answer on a scale of 1, which is “very difficult to see or feel” to 7, which is “very easy to see or feel” (Wright & Smith, 2009). After the participants answered the questions their internal imagery, external imagery, and kinesthetic subscales were calculated. The MIQ-3 has cronbach alpha values for the kinesthetic imagery subscale, internal imagery subscale, and external imagery subscale of .85, .79, and .83 (Williams et al., 2012). The MIQ-3 scoring is similar to the MIQ-R, where the highest one can score on any subscale is 28 and the lowest one can score is 7. The participants for this study had to score a 16 or higher on all subscales in order to be included in the research. A score of 16 is considered moderate imagery ability (Wright & Smith, 2009). This score was set based on previous imagery research (Smith & Collins, 2004; Smith et al., 2003).

**Procedure**

**Barbell Bench Press.** A barbell bench press is defined as an individual lying supine on a bench, holding the barbell over the chest with the arms extended, lowers the weight to the chest, and then raises it again. The equipment needed to perform the barbell bench press includes the following: barbell, a bench in the rack or attached to the rack, which is lying flat, and a rack where the bar is stationed. The gym where the study took place was located in a university building. Participants for the study received demonstration of proper barbell bench press technique. It is important to note that the participants involved in this study strength trained regularly.

The task for the study was to perform a barbell bench press as many times as possible. Prior to the intervention, a pre-test was conducted. The participants in this study were individuals who regularly strength train. A demonstration of the correct technique for a barbell bench press was done, but there
was no training videos shown since all participants regularly strength train and have experience performing the barbell bench press.

The pre-test that was conducted had each participant perform multiple warm-up sets, where they gradually increased their weight over the sets. Since all participants had an idea of the weight they should start at for their warm-up it was not necessary for the researcher to choose a weight for them. After the warm-up, the participants built up to their 1 repetition maximum. After the participants completed their 1 repetition maximum they were given three to four minutes rest and their 1 repetition maximum was recorded. During this rest period the researcher calculated 80% of the participants 1 repetition maximum (1 RM) on the barbell bench press. After the rest period the participants performed as many repetitions as possible at 80% of their 1 repetition maximum. After the participants performed as many repetitions as possible their score was recorded. While the participants were performing the barbell bench press, they had someone spotting them at all times to ensure their safety.

**Intervention**

After the completion of the pre-test, which included the MIQ-3, the barbell bench press 1RM test, and the participants performing as many repetitions as possible (80% of 1RM), the participants were randomly assigned to either the PETTLEP imagery, physical practice, or the PETTLEP/physical practice combination group. At the second meeting, the participants were told of their assignment and the interventions were introduced to the participants.

The intervention took place over the course of four weeks. Participants were in a supine position on the bench underneath the barbell where the bar was racked above them. This ensured the environmental factors of the PETTLEP imagery model were accounted for along with the visual, sounds and smell of the gym that were the exact same as those the participants experienced (Wright & Smith, 2009). The participants were also encouraged to place their hands on the bar where their hands would be if they were actually going to perform a barbell bench press.

After the 1 RM was completed during the pre-test and the participants moved to perform as many repetitions as possible at 80% of their 1 RM, they were also recorded with an IPAD. The researcher positioned the IPAD underneath the barbell to film the participants performing at many repetitions as possible at 80% of their 1 RM. By positioning the IPAD underneath the barbell it allowed the researcher to film the participant bench-pressing from an internal perspective. The video was shown to the participants on an IPAD before and while they completed their imagery. Factors that make up the PETTLEP model such as perspective and timing were considered, as the video was showing the
participants exact movement they completed during the set (Wright & Smith, 2009). Along with perspective and timing, the participants were encouraged by the researcher to include any emotions they experienced during the pre-test. (Wright & Smith, 2009). The participants then imaged themselves performing repetitions at 80% of their 1 RM on the barbell bench press. (Wright & Smith, 2009).

The physical practice group met with the researcher at the gym and completed the barbell bench press exercise. The participants assigned to this group performed as many repetitions as possible at 80% of their 1 RM for two sets. They performed the barbell bench press exercise twice a week for the four-week intervention. The combination group that included PETTLEP imagery/physical practice performed one set of 80% of their 1 RM on the barbell bench press, and during the second set performed the PETTLEP imagery technique described previously (Wright & Smith, 2009). The physical practice and the PETTLEP imagery/physical practice combination group performed their sets twice a week for four weeks.

The three groups used in the intervention performed their imagery, physical practice, or a combination of PETTLEP imagery and physical practice twice a week across the four-week intervention. The participants’ performing the PETTLEP imagery, physical practice, or a combination of PETTLEP imagery and physical practice were monitored by the researcher at each session in the gym.

After the four-week intervention concluded, the participants completed the post-test. Prior to the post-test, all participants performed multiple warm-up sets, where they gradually increased their weight over the sets. Since all participants had an idea of the weight they should start at for their warm-up, it was not necessary for the researcher to choose a weight for them. After the warm-up, the participants completed a 1 repetition maximum (1 RM) on the barbell bench press. This 1 RM was used as part of their post-test score. After the participants completed the 1RM, the participants performed 80% of their pre-test 1 RM. After the participants performed as many repetitions as possible their score was recorded. It is important to note that while the participants were performing the barbell bench press, they had someone spotting them at all times to ensure their safety.

**Manipulation Check**

The participants involved in the study that were randomly assigned to the PETTLEP imagery or the PETTLEP/physical practice combination group were asked a series of questions after each session. The participants in these groups for the first two weeks were asked three questions. The first question asked was if the participant was able to see themselves internally, the second question asked if the
participant felt their timing of imagery was close to the video, and lastly the participants were asked if they had any difficulties imagining themselves.

After the first two weeks the participants were still asked the first and third question as stated above but the last question asked was if they felt confident in their imagining abilities. During the third week of the intervention the researcher asked the PETTLEP group if they had been performing any strength training exercises that isolated and engaged the chest muscles. The participants that were randomly assigned to the PETTLEP imagery group were instructed prior to the start of the intervention not to perform any chest strength training exercises such as the barbell bench press and dumbbell flys because it could affect the data collected from pre-test to post-test. The physical practice group was not asked any questions during the intervention.

Chapter 4
Results

Cronbach’s alpha coefficients were calculated for each of the three subscales of the MIQ-3. The alpha coefficients for the MIQ-3 subscales were .19 (kinesthetic imagery subscale), .38 (internal imagery subscale), and .16 (external imagery subscale). These alpha coefficients were not similar to the ones found by Williams and colleagues (2012) likely due to the low number of participants in this study. The means and standard deviations of each subscale are listed in Table 1.

One-way ANOVAs were performed on the MIQ-3 data. The results revealed there were no significant between group differences on the kinesthetic imagery, internal imagery and external imagery subscales.

A mixed ANOVA examined the treatment group differences between the PETTLEP imagery, physical practice, and the PETTLEP imagery/physical practice combination groups across the pre-test and post-test for the 1 repetition maximum. The main effect for the repeated measures independent variable was significant, $F(1, 15) = 16.71, p = .001, \eta^2_p = .53$ and indicates that participants improved their 1 repetition maximum across the four-weeks of the study. There was no interaction based on the intervention, $F(2, 15) = .83, p = .46, \eta^2_p = .10$.

A second mixed ANOVA examined the treatment group differences between the PETTLEP imagery, physical practice, and the PETTLEP imagery/physical practice combination groups across the pre-test and post-test for repetitions at 80% of the pre-test 1 repetition maximum. The main effect for the repeated measures independent variable was significant, $F(1, 15) = 36.43, p = .000, \eta^2_p = .71$ and
indicates that participants improved their repetitions at 80% of their pre-test 1 repetition maximum across the four-weeks of the study. There was no interaction based on the intervention, $F(2, 15) = 1.86$, $p = .19$, $\eta^2_p = .20$.

An independent t-test was performed to determine if there were gender differences. There were gender differences in the 1 repetition maximum at the pre-test (Male $M = 222.14$, $SD = 59.15$; Female $M = 99.09$, $SD = 22.67$), $t(16) = 6.30$, $p < .001$. There were also gender differences in the 1 repetition maximum at the post-test (Male $M = 234.29$, $SD = 62.54$; Female $M = 104.09$, $SD = 20.47$), $t(16) = 6.48$, $p < .001$.

A second independent t-test was performed to determine if there were gender differences. There were no gender differences in repetitions at 80% of the pre-test 1 repetition maximum at the pre-test (Male $M = 8.86$, $SD = 3.39$; Female $M = 10.18$, $SD = 2.71$), $t(16) = .92$, $p > .37$. There were also no gender differences in repetitions at 80% of the pre-test 1 repetition maximum at the post-test (Male $M = 11.57$, $SD = 3.55$; Female $M = 12.81$, $SD = 3.03$), $t(16) = -.80$, $p > .44$. The participant’s gender was not the main variable of focus nor was discussed in the literature review but was something that peaked the interest of the researcher to explore after the data collection was complete.

Throughout the four-week intervention the participants in the PETTLEP imagery group and the PETTLEP imagery/physical practice combination group were asked questions pertaining to their imagery session. Participants were asked a series of questions during the four week intervention that looked to see if the participants were able to see themselves internally, if they were close in their timing of their video recording, if they had any difficulties imagining themselves, if they felt confident in their imagining ability, and those participants in the PETTLEP imagery group were asked if they were engaging and exercising their chest muscles during the intervention.

The participants in the PETTLEP imagery and the PETTLEP imagery/physical practice combination group were asked during the four week intervention if they were able to see themselves internally. Within these two groups, 87% of participants across the four weeks said they were able to see themselves internally. Participants in both the PETTLEP imagery and PETTLEP imagery/physical practice combination group were asked over the course of the first two weeks of the intervention if they felt their timing was close to the video taken of them at the pre-test and 79% stated their timing was either close or exactly timed with the video. Over the course of four weeks the participants were also asked if they had any other difficulties performing imagery and all of the participants stated they had no other difficulties.
During the last two weeks of the intervention the participants were asked if they felt confident in their imagining ability and all 12 participants across the last two weeks stated that they felt either semi-confident or confident in their imagining abilities. Lastly, the participants in the PETTLEP imagery group were asked during week three of the intervention if they had been engaging and exercising their chest muscles, which they were told not to do prior to the intervention. Out of seven participants in the PETTLEP imagery group, six participants said they did not engage or exercise their chest muscle during the intervention. These results can be seen in Table 3.

Though there was no interaction based on the intervention across time participants in all three groups improved from pre-test to post-test on their 1 repetition maximum and repetitions at 80% of their pre-test 1 repetition maximum.

Chapter 5
Discussion

The results of this study supported the first hypothesis that the PETTLEP imagery group, physical practice group, and the PETTLEP imagery/physical practice combination group would show improvements from pre-test to post-test on the 1 repetition maximum and the repetitions performed at 80% of the pre-test 1 repetition maximum. Though there were improvements in all groups from pre-test to post-test, there was no interaction based on the intervention across time. Thus, the second hypothesis, which stated the participants in the PETTLEP imagery/physical practice combination group would see the greatest improvement in their 1 repetition maximum and repetitions at 80% of their pre-test to post-test was not supported. There were also significant differences between males and females on the 1 repetition maximum at the pre-test and the post-test but there were no differences in repetitions performed at 80% of the pre-test 1 repetition maximum between males and females at the pre-test and post-test.

The second hypothesis was not supported since there was no interaction based on the intervention across time, but interestingly enough, the PETTLEP imagery, physical practice group, and the PETTLEP imagery/physical practice combination group all improved over time. This shows for this study, if the participants performed PETTLEP imagery, physical practice, or PETTLEP imagery/physical practice, they all improved relatively the same. This finding shows that one can only perform PETTLEP imagery on a strength training exercise and still see similar improvement in their 1 repetition maximum and repetitions at 80% of their pre-test 1 repetition maximum as those who performed just physical practice and a combination of PETTLEP imagery and physical practice.
The acronym PETTLEP stands for: physical (physical response), environment (the place where the imagery takes place), task (matching the task being imagined to the actual task), timing (similar to the timing to an event), learning (imagery content will change over time as one learns), emotion (the response and meaning of the situation), and the perspective, which is the way it is viewed (Smith, Wright, & Cantwell, 2008). PETTLEP imagery improves functional equivalence, which explains how imagery causes the brain to activate the same areas and processes as if they movement was actually being performed (Holmes & Collins, 2001; Jeannerod, 1994). For imagery to be more functionally equivalent it should include senses and feelings associated with the activity, practiced in a similar performance posture, wearing the clothing one would wear if they were performing the activity, being in an environment similar to where the task would be performed, done at the same speed as the skill, and uses an internal perspective (Vealey & Forlenza, 2015). The criteria listed above is the exact description of PETTLEP imagery. For imagery to be more functionally equivalent it should include all of the criteria PETTLEP imagery uses.

There has been recent research examining the effects of PETTLEP imagery and performance. A study conducted by Smith, Wright, and Cantwell (2008) examined the effects of the PETTLEP imagery on golf bunker performance. Smith, Wright, and Cantwell (2008) found that there was no difference between the PETTLEP imagery and physical practice group on their golf bunker shot performance. These results support the findings from this study, which found no differences between the PETTLEP imagery and physical practice group on the 1 repetition maximum and repetitions at 80% of the pre-test 1 repetition maximum across the four-week intervention.

The purpose of this study was to examine the effects of imagery training on the barbell bench press performance of individuals with strength training experience. Prior to this study there had only been one study conducted that examined the effects of PETTLEP imagery and strength training performance. The participants in the study had no strength training experience and exercised a smaller muscle group. Wright and Smith (2009) found that the PETTLEP imagery physical practice, and the PETTLEP + physical practice group all improved their strength on the bicep curl from pre-test to post-test. In this study the researcher found that the PETTLEP imagery, physical practice, and the PETTLEP imagery/physical practice combination group improved their performance on the 1 repetition maximum and repetitions at 80% of the pre-test 1 repetition maximum from pre-test to post-test. These findings support the findings of Wright and Smith (2009).
Throughout the intervention, participants in the PETTLEP imagery group and the PETTLEP imagery/physical practice group were asked a series of open-ended questions that asked about their imagining capabilities, difficulties, and confidence in imagining. Though this was a useful way to understand each participant’s capabilities, difficulties, and confidence, future research should change the manipulation check from open-ended questions to having participants rank themselves on a Likert scale to better understand their capabilities, difficulties, and confidence throughout the intervention.

One limitation of this study was the low number of participants. There were only 18 participants involved in this research. The low number of participants affected the amount of statistical power and effect size in the research. There was also no placebo control group in this research. In the study conducted by Wright and Smith (2009) the researchers had five groups: PETTLEP imagery, physical practice, PETTLEP + physical practice, traditional imagery, and the control group. In this study the traditional imagery and control group were eliminated since the participants in Wright and Smith (2009) had minimal improvement on their bicep curl performance from pre-test to post-test. Excluding a control group is another limitation in this study.

The time of day when the participants performed PETTLEP imagery, physical practice, or a combination of PETTLEP imagery and physical practice was a limitation in this study. The participants did not consistently perform the intervention at the same time every time they met the researcher. Participants that strength train regularly are likely in a routine where they strength train around the same time everyday. Specifically, in this research if a participant in the physical practice group regularly lifted early in the morning but for the research had to perform their physical practice in the evening this could affect how many repetitions they bench pressed. This off set of time and an unfamiliar routine may have affected their repetitions at 80% of their 1 repetition maximum. The majority of this data collection took place over the last two months of the semester.

During this time of year students are unable to meet at the same time for every intervention session due to other commitments and coursework but also these students had more stress and coursework at the time. Not only did the participants have more coursework and stress they also did not all have the same strength training experience coming into the research. The participants for the research had to be strength training 2-3 days per week for at least 6 weeks to be included in the study. Some participants had been strength training for two years where other participants had only been strength training three months. Another limitation was the low alpha coefficients for the Movement Imagery Questionnaire-3. Though these alpha levels were low it’s important to note that the Movement Imagery
Questionnaire-3 was only used as a screening tool not as a dependent variable and did not invalidate the results.

Future directions for research should expand on this study and increase the number of participants and also change the inclusion criteria to increase the amount of time one must spend strength training. Another future direction would be to expand the intervention timeline from four weeks to six weeks as it was done in Wright and Smith (2009). By extending the intervention from four to six weeks may allow for more strength improvements.

The results as previously stated found that those in the PETTLEP imagery, physical practice, and PETTLEP imagery/physical practice combination group all significantly improved their 1 repetition maximum and repetitions at 80% of their pre-test 1 repetition maximum from pre-test to post-test on the barbell bench press. Though the results revealed that there was no interaction based on the intervention across time there were still improvements across all groups from pre-test to post-test. These results illustrate the effect PETTLEP imagery has on individual’s strength training performance on the 1 repetition maximum and repetitions at 80% of their pre-test 1 repetition maximum. Research from this study and other PETTLEP imagery research suggests that a more functionally equivalent approach may provide even stronger results (Wright & Smith, 2009).
References


Hardy, L., & Callow, N. (1999). Efficacy of external and internal visual imagery perspectives for the enhancement of performance on tasks in which form is important. *Journal of Sport & Exercise Psychology, 21*, 95-112.


Table 1. MIQ-3 subscale means and standard deviations.

<table>
<thead>
<tr>
<th></th>
<th>MIQ-3 Kinesthetic Subscale</th>
<th>MIQ-3 Internal Subscale</th>
<th>MIQ-3 External Subscale</th>
</tr>
</thead>
<tbody>
<tr>
<td>PETTLEP</td>
<td>24.71 (SD 3.15)</td>
<td>24.86 (SD 2.04)</td>
<td>22.86 (SD 4.34)</td>
</tr>
<tr>
<td>PP</td>
<td>24.83 (SD 1.72)</td>
<td>24 (SD 2.76)</td>
<td>23.67 (SD 1.86)</td>
</tr>
<tr>
<td>Comb</td>
<td>26 (SD 3.46)</td>
<td>27.40 (SD 1.34)</td>
<td>25.20 (SD 3.90)</td>
</tr>
<tr>
<td></td>
<td>Pre-Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>----------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td></td>
<td>Pettlep</td>
<td>PP</td>
<td>Comb</td>
</tr>
<tr>
<td>1RM</td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td></td>
<td>121.42</td>
<td>44.78</td>
<td>169.16</td>
</tr>
<tr>
<td>80%</td>
<td>10.28</td>
<td>2.75</td>
<td>8.33</td>
</tr>
</tbody>
</table>
**Table 3.** Manipulation check responses for the PETTLEP imagery and PETTLEP imagery/physical practice combination group across time.

<table>
<thead>
<tr>
<th></th>
<th>Were you able to see yourself internally?</th>
<th>Did you feel your timing was close to the video?</th>
<th>Any other difficulties?</th>
<th>Do you feel confident in your imagining abilities?</th>
<th>Have you been performing chest strength exercises? (PETTLEP only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wk1Day1</td>
<td>11 of 12 yes</td>
<td>7 of 12 close or right on</td>
<td>12 of 12 no</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wk1Day2</td>
<td>10 of 12 yes</td>
<td>7 of 12 close or right on</td>
<td>12 of 12 no</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wk2Day1</td>
<td>12 of 12 yes</td>
<td>12 of 12 close or right on</td>
<td>12 of 12 no</td>
<td>12 of 12 confident or semi-confident</td>
<td></td>
</tr>
<tr>
<td>Wk2Day2</td>
<td>12 of 12 yes</td>
<td>12 of 12 close or right on</td>
<td>12 of 12 no</td>
<td>12 of 12 confident or semi-confident</td>
<td></td>
</tr>
<tr>
<td>Wk3Day1</td>
<td>12 of 12 yes</td>
<td>12 of 12 no</td>
<td></td>
<td>12 of 12 confident</td>
<td></td>
</tr>
<tr>
<td>Wk3Day2</td>
<td>12 of 12 yes</td>
<td>12 of 12 no</td>
<td></td>
<td>12 of 12 confident</td>
<td>6 of 7 no chest work during intervention; 1 of 7 said yes did chest work a few times</td>
</tr>
<tr>
<td>Wk4Day1</td>
<td>12 of 12 yes</td>
<td>12 of 12 no</td>
<td></td>
<td>12 of 12 confident</td>
<td></td>
</tr>
<tr>
<td>Wk4Day2</td>
<td>12 of 12 yes</td>
<td>12 of 12 no</td>
<td></td>
<td>12 of 12 confident</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>97% 79% 100% 100% 86%</td>
</tr>
</tbody>
</table>

26
Classroom Recruitment Script

Hello!

My name is Morgan Eckenrod and I am currently a graduate student here at Miami University. I am conducting research for my master’s thesis project and because of my interest in sport psychology and strength training, I have chosen PETTLEP imagery and strength training performance, specifically barbell bench press performance as my thesis topic.

There has only been one study conducted that examined the effects of PETTLEP imagery and strength training performance. This study recruited participants who had no strength training experience and had them perform a bicep curl on a bicep curl machine. The study concluded that those who used PETTLEP imagery, physical practice, and a combination of the two (PETTLEP + physical practice) significantly increased their bicep curl performance.

The purpose of my research is to extend the literature and examine the effects of PETTLEP imagery training on barbell bench press performance of individuals with strength training experience.

The inclusion criterion includes young healthy adults in the age range of 18-30. The participants must also have strength training experience. To be eligible for the study one must be strength training 2-3 times per week for at least 6 weeks.

If you would like to be involved in this study please feel free to email me at eckenrmr@miamioh.edu.

If you have any further questions I can be reached at eckenrmr@miamioh.edu. You can also contact either of my advisors, Dr. Vealey (vealeyrs@miamioh.edu) or Dr. Ward (wardrm1@miamioh.edu), who are faculty within the Kinesiology and Health Department.

Thank you for considering to participate in my research.

Have a great day!
Hello!

My name is Morgan Eckenrod and I am currently a graduate student here at Miami University. I am conducting research for my master’s thesis project and because of my interest in sport psychology and strength training, I have chosen PETTLEP imagery and strength training performance, specifically barbell bench press performance as my thesis topic.

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The purpose of my research is to extend the literature and examine the effects of PETTLEP imagery training on barbell bench press performance of individuals with strength training experience.

I am emailing you to request permission to come into your classroom and seek your student’s participation in my study. If you agree, I would schedule a time to come into your classroom to talk with your students about participating in an intervention with me that is examining the effects of PETTLEP imagery on barbell bench press performance. Specifically, I am looking for students between the ages of 18-30 who strength training 2 to 3 days a week and have been doing so for at least 6 weeks.

Is this something you think you could help me with? If, so please reply back to this email and we can decide on a time for me to come into your classroom that is convenient for you.

Please feel free to contact me (eckenrmr@miamioh.edu) or either of my thesis advisors Dr. Vealey (vealeys@miamioh.edu) and Dr. Ward (wardrm1@miamioh.edu) with any questions.

Thank you for your time.

Have a great day!

Sincerely,

Morgan
Dear Participant:

You have been asked to take part in the research project described below. If you have any questions, please feel free to contact Morgan Eckenrod (eckenrmr@miamioh.edu), Dr. Robin Vealey (vealeyrs@miamioh.edu) or Dr. Rose Marie Ward (wardrm1@miamioh.edu).

WHY ARE YOU BEING INVITED TO TAKE PART IN THIS RESEARCH?
You are being invited to take part in a research study that examines imagery and strength training performance. You are being invited because you are a student or faculty member on Miami University’s Oxford campus. If you volunteer to take part in this study, you will be one of about 50 people to do so.

WHO IS CONDUCTING THE STUDY?
The individuals in charge of this study are Morgan Eckenrod a master’s student in the Kinesiology and Health Department at Miami University (eckenrmr@miamioh.edu), Dr. Robin Vealey, Professor in the Kinesiology and Health Department at Miami University (vealeyrs@miamioh.edu), and Dr. Rose Marie Ward, Professor in Kinesiology and Health at Miami University (wardrm1@miamioh.edu). The results of this study, in summary form, will be disseminated through the principal investigator’s thesis and in university and peer-reviewed publication(s).

DESCRIPTION OF THE RESEARCH:
The purpose of the current study is to extend the literature by examining the effects of PETTLEP imagery training on the barbell bench press performance of individuals with strength training experience.

AGE:
You must be between the ages of 18 and 30 and strength train 2 to 3 days per week for at least 6 weeks to be in this research project.

RESEARCH PROCEDURES:
If you decide to take part in this study, your participation will involve participating in a four week intervention. The purpose of the current study is to extend the literature by examining the effects of PETTLEP imagery training on barbell bench press performance of individuals with strength training experience.

Each individual will be randomly assigned to one of the three groups that include: PETTLEP imagery, physical practice, or PETTLEP imagery + physical practice group. The participants will take the MIQ-3 to determine their imagery ability. The participants must score a 16 on the visual and kinesthetic subscales to be eligible to participate. The participants will then perform the pre-test, which requires them to perform a 1 repetition maximum on the barbell bench press. After completing the 1 repetition maximum the participant will take 3-4 minutes rest and then perform 80% of their 1 repetition maximum for as many repetitions as possible.

Once the intervention begins the participants will meet with the primary investigator twice a week for four weeks for 10-15 minutes per session where they will either perform PETTLEP imagery, physical
practice (80% of 1RM for as many repetitions as possible), or 1 set of physical practice (80% of 1RM for as many repetitions as possible) and 1 set of PETTLEP imagery.

At the end of the four week intervention the participants will perform a 1 repetition maximum on the barbell bench press. After completing the 1 repetition maximum the participant will take 3-4 minutes rest and then perform 80% of their original 1 repetition maximum (80% of pre-test 1 RM) for as many repetitions as possible.

TIME REQUIRED FOR PARTICIPATION:
The intervention will last four weeks. You will meet with the research 2 days a week for 15-20 minutes each time over the course of four weeks.

POTENTIAL RISKS:
The risks and discomforts to the participants are minimal throughout this study. The only inconvenience for the participants is that they have to come to the workout facility located in the Kinesiology and Health building twice a week for four weeks.

If an injury occurs Miami University will not be responsible. If injured, the participant will need to seek medical assistance after the initial first aid is complete at Phillips Hall.

*Barbell Bench Press Testing*: There is very little risk for the participant’s performing a barbell bench press. There is a possibility that the participants performing the barbell bench press may fail and will need assistance lifting the bar back up. Each participant will have a spotter. This is someone who is watching them perform the repetitions and will assist them if they cannot lift the barbell back up.

*Participants are being selected based on their familiarity with the exercise*: The participants will be familiar with the physical task and the gym environment. Given this familiarity, the risk to injury is lower.

POTENTIAL BENEFITS:
Participants will find their 1 repetition maximum on the barbell bench press at the pre-test and at the post-test. They will also find the number the repetitions they can perform at 80% of their 1 repetition maximum at the pre-test and at the post-test. In addition, answering the questions might help them reflect on their experiences.

CONFIDENTIALITY:
Your part in the study is confidential. You will be assigned a code and that is how you will be identified. Your name will not be used in this study.

VOLUNTARY PARTICIPATION:
The decision to participate in this research is up to you. You do not have to participate and can drop out from the intervention at any time.

COMPENSATION FOR INJURY:
Participation in this study is not expected to be harmful or injurious to you. However, if this study causes you any injury, you should write or call Morgan Eckenrod at eckenrmr@miamioh.edu or (814)-
341-1156, Dr. Robin Vealey at vealeyrs@miamioh.edu or Dr. Rose Marie Ward at wardrm1@miamioh.edu or (513) 529-9355.

CONTACT INFORMATION:
If you have questions about the study you can contact any of the investigators, Morgan Eckenrod, 814-341-1156 or eckenrmr@miamioh.edu; Dr. Robin Vealey, vealeyrs@miamioh.edu Dr. Rose Marie Ward, 513-529-9355 or wardrm1@miamioh.edu

If you have any questions or concerns about your rights as a subject, you may contact Miami University's Office for the Advancement of Research and Scholarship, (513) 529-3600 or humansubjects@miamioh.edu. A copy of your consent form will be emailed to you for your documentation.

You are at least 18 years old. You have read the consent form and your questions have been answered to your satisfaction. Your signing of this consent form implies your consent to participate in this study.

Thank you,
Morgan Eckenrod
Principal Investigator

Participant Signature:__________________________________
Participant Email Address:____________________________
Date:_____________
Emergency Procedure:

In the event of an emergency procedure the staff working in the Phillips Hall gym will be notified. If further medical attention is needed the primary researcher will contact the Oxford Emergency Medical Technician (EMTs), 911. Until the Emergency Medical Technicians arrive the primary researcher will wait and assist the participant in any way she can. Once the Emergency Medical Technician arrives the primary researcher will give the participant time with medical staff and wait to make sure the participant is ok.
Intake Questionnaire:

1. Are you between the ages of 18 and 30?
   a. Yes  
   b. No

2. Do you strength train?
   a. Yes  
   b. No

3. Do you strength train 2 to 3 days per week?
   a. Yes  
   b. No

4. Have you been strength training at least 6 weeks up to the date of this questionnaire?
   a. Yes  
   b. No

5. Have you performed the barbell bench press in the last six weeks?
   a. Yes  
   b. No
Movement Imagery Questionnaire-3

Full Questionnaire with Instructions

Instructions

This questionnaire concerns two ways of mentally performing movements which are used by some people more than by others, and are more applicable to some types of movements than others. The first is attempting to form a visual image or picture of a movement in your mind. The second is attempting to feel what performing a movement is like without actually doing the movement. You are requested to do both of these mental tasks for a variety of movements in this questionnaire, and then rate how easy/difficult you found the tasks to be. The ratings that you give are not designed to assess the goodness or badness of the way you perform these mental tasks. They are attempts to discover the capacity individuals’ show for performing these tasks for different movements. There are no right or wrong ratings or some ratings that are better than others.

Each of the following statements describes a particular action or movement. Read each statement carefully and then actually perform the movement as described. Only perform the movement a single time. Return to the starting position for the movement just as if you were going to perform the action a second time. Then depending on which of the following you are asked to do, either (1) form as clear and vivid a visual image as possible of the movement just performed from an internal perspective (i.e., from a 1st person perspective, as if you are actually inside yourself performing and seeing the action through your own eyes), (2) form as clear and vivid a visual image as possible of the movement just performed from an external perspective (i.e., from a 3rd person perspective, as if watching yourself on DVD), or (3) attempt to feel yourself making the movement just performed without actually doing it.

After you have completed the mental task required, rate the ease/difficulty with which you were able to do the task. Take your rating from the following scale. Be as accurate as possible and take as long as you feel necessary to arrive at the proper rating for each movement. You may choose the same rating for any number of movements “seen” or “felt” and it is not necessary to utilize the entire length of the scale.

RATING SCALES

Visual Imagery Scale

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Very hard to see</td>
<td>Hard to see</td>
<td>Somewhat hard to see</td>
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Kinesthetic Imagery Scale

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</table>
1. **STARTING POSITION:** Stand with your feet and legs together and your arms at your sides.

**ACTION:** Raise your right knee as high as possible so that you are starting on your left leg with your right leg flexed (bent) at the knee. Now lower your right leg so you are once again standing on two feet. The action is performed **slowly**.

**MENTAL TASK:** Assume the starting position. Attempt to **feel** yourself making the movement just observed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

Rating: __________

2. **STARTING POSITION:** Stand with your feet and legs together and your arms at your sides.

**ACTION:** Bend down low and then jump straight up in the air as high as possible with both arms extended above your head. Land with both feet apart and lower your arms to your sides.

**MENTAL TASK:** Assume the starting position. Attempt to **see** yourself making the movement just observed from an **internal perspective**. Now rate the ease/difficulty with which you were able to do this mental task.

Rating: __________

3. **STARTING POSITION:** Extend the arm of your non-dominant hand straight out to your side so that it is parallel to the ground, palm down.

**ACTION:** Move your arm forward until it is directly in front of your body (still parallel to the ground). Keep your arm extended during the movement, and make the movement **slowly**.

**MENTAL TASK:** Assume the starting position. Attempt to **see** yourself making the movement just observed from an **external perspective**. Now rate the ease/difficulty with which you were able to do this mental task and the angle the image was observed from (see additional sheet provided for full list of different angles)

Rating: __________

4. **STARTING POSITION:** Stand with your feet slightly apart and your arms fully extended above your head.
ACTION: Slowly bend forward at the waist and try and touch your toes with your fingertips (or, if possible, touch the floor with your fingertips or your hands). Now return to the starting position, standing erect with your arms extended above your head.

MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just observed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

Rating: __________

5. STARTING POSITION: Stand with your feet and legs together and your arms at your sides.

ACTION: Raise your right knee as high as possible so that you are starting on your left leg with your right leg flexed (bent) at the knee. Now lower your right leg so you are once again standing on two feet. The action is performed slowly.

MENTAL TASK: Assume the starting position. Attempt to see yourself making the movement just observed from an internal perspective. Now rate the ease/difficulty with which you were able to do this mental task.

Rating: __________

6. STARTING POSITION: Stand with your feet and legs together and your arms at your sides.

ACTION: Bend down low and then jump straight up in the air as high as possible with both arms extended above your head. Land with both feet apart and lower your arms to your sides.

MENTAL TASK: Assume the starting position. Attempt to see yourself making the movement just observed from an external perspective. Now rate the ease/difficulty with which you were able to do this mental task and the angle the image was observed from (see additional sheet provided for full list of different angles)

Rating: __________

7. STARTING POSITION: Extend the arm of your non-dominant hand straight out to your side so that it is parallel to the ground, palm down.

ACTION: Move your arm forward until it is directly in front of your body (still parallel to the ground). Keep your arm extended during the movement, and make the movement slowly.

Rating: __________
MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

Rating: __________

8. STARTING POSITION: Stand with your feet slightly apart and your arms fully extended above your head.

ACTION:: Slowly bend forward at the waist and try and touch your toes with your fingertips (or, if possible, touch the floor with your fingertips or your hands). Now return to the starting position, standing erect with your arms extended above your head.

MENTAL TASK: Assume the starting position. Attempt to see yourself making the movement just observed from an internal perspective. Now rate the ease/difficulty with which you were able to do this mental task.

Rating: __________

9. STARTING POSITION: Stand with your feet and legs together and your arms at your sides.

ACTION: Raise your right knee as high as possible so that you are starting on your left leg with your right leg flexed (bent) at the knee. Now lower your right leg so you are once again standing on two feet. The action is performed slowly.

MENTAL TASK: Assume the starting position. Attempt to see yourself making the movement just observed from an external perspective. Now rate the ease/difficulty with which you were able to do this mental task and the angle the image was observed from (see additional sheet provided for full list of different angles)

Rating: __________
10. STARTING POSITION: Stand with your feet and legs together and your arms at your sides.

ACTION: Bend down low and then jump straight up in the air as high as possible with both arms extended above your head. Land with both feet apart and lower your arms to your sides.

MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.
Rating: __________

11. STARTING POSITION: Extend the arm of your non-dominant hand straight out to your side so that it is parallel to the ground, palm down.

ACTION: Move your arm forward until it is directly in front of your body (still parallel to the ground). Keep your arm extended during the movement, and make the movement slowly.

MENTAL TASK: Assume the starting position. Attempt to see yourself making the movement just observed from an internal perspective. Now rate the ease/difficulty with which you were able to do this mental task.
Rating: __________

12. STARTING POSITION: Stand with your feet slightly apart and your arms fully extended above your head.

ACTION: Slowly bend forward at the waist and try and touch your toes with your fingertips (or, if possible, touch the floor with your fingertips or your hands). Now return to the starting position, standing erect with your arms extended above your head.

MENTAL TASK: Assume the starting position. Attempt to see yourself making the movement just observed from an external perspective. Now rate the ease/difficulty with which you were able to do this mental task and the angle the image was observed from (see additional sheet provided for full list of different angles)
Rating: __________
After you have completed the mental task required, rate the ease/difficulty with which you were able to do the task in the space provided below. Take your rating from the provided scale. Be as accurate as possible and take as long as you feel necessary to arrive at the proper rating for each movement. You may choose the same rating for any number of movements “seen” or “felt” and it is not necessary to utilise the entire length of the scale.

### RATING SCALES

#### Visual Imagery Scale

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<tr>
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#### Kinesthetic Imagery Scale

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1) Knee lift Rating: ____
2) Jump Rating: ____
3) Arm movement Rating: ____
4) Waist Bend Rating: ____
5) Knee lift Rating: ____
6) Jump Rating: ____
7) Arm movement Rating: ____
8) Waist Bend Rating: ____
9) Knee lift Rating: ____
10) Jump Rating: ____
11) Arm movement Rating: ____
12) Waist Bend Rating: ____
## Movement Imagery Questionnaire-3

### Instructions for Scoring

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<tr>
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<tr>
<td>Internal Visual Imagery</td>
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<tr>
<td>External Visual Imagery</td>
<td>Item 3 + Item 6 + Item 9 + Item 12/4</td>
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<tr>
<td>Kinesthetic Imagery</td>
<td>Item 1 + Item 4 + Item 7 + Item 10/4</td>
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