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The effects of guided imagery as mental practice during the learning of a novel psychomotor skill

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Justine Mary Revermann

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Project title: The effects of guided imagery as mental practice during the learning of a novel psychomotor skill

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Abstract

Previous research has shown that mental imagery is beneficial for individuals in improving performance, increasing confidence, and decreasing anxiety, among many other benefits. The purpose of my research study was to test if mental imagery is successful in creating these benefits for college students while learning a new psychomotor skill. Participants were first introduced to an athletic taping skill by viewing a two-minute video. After the video, they completed five minutes of physical practice of the skill, took an anxiety and confidence inventory, and completed a pre-test of the skill during which they were timed and scored. They were then randomly assigned to one of two groups: one group listened to a guided imagery audio that guided them through the steps of the athletic taping skill, while the second group viewed a PowerPoint presentation that listed the steps of the athletic taping skill. Next, participants from both groups took the anxiety and confidence inventory again and completed a post test of the elbow taping skill during which they were timed and scored. I predicted that participants in the imagery group would have both greater decreases in anxiety scores and greater decreases in time to complete the skill than those in the PowerPoint group. I also predicted that those in the imagery group would have greater increases in self-confidence and performance scores than the Power Point group. The results of my study did not provide support for my original hypotheses. However, significant differences were found for cognitive anxiety levels between the genders.

The effects of guided imagery as mental practice during the learning of a novel psychomotor skill

Imagery is one of the most widely-studied topics in psychology, particularly in the field of sport and exercise psychology (Anton, Bean, Hammonds, & Stefanidis, 2017). Imagery can be defined as using all of one's senses to create a mental image of an experience (Cox, 2012). Imagery is often mistaken for visualization. However, it is more than visualization; it has the ability to involve all of the senses, rather than vision alone (Burton & Raedeke, 2008). People using imagery imagine what an experience looks like, smells like, sounds like, feels like, and even tastes like (Jeannerod & Frank, 1999). Imagery can be described as similar to a video or image that is created in one's mind without any actual external stimuli (Jeannerod & Frank, 1999). One astonishing aspect of imagery is that the brain cannot tell between an experience imagined in one's mind or an actual event that is physically experienced (Sobierajewicz, Szarkiewicz, Przekoracka-Krawczyk, Jaśkowski, & van der Lubbe, 2016).

Imagery can also be described as a way of mentally practicing. In fact, mental practice is a term that is nearly synonymous to imagery (Burton & Raedeke, 2008). However, mental practice is slightly more specific; it occurs when a person is attempting to learn a skill and uses imagery in addition to physical practice of the skill (Hird, et al., 1991). Therefore, imagery can be used to provide extra practice repetitions as mental practice without the individual physically practicing the skill. It allows individuals the opportunity to prepare before the execution of a skill or to improve on and practice skills (White & Hardy, 1998).

While imagery allows for individuals to incorporate all senses into their mental experience, the visual and kinesthetic senses are most often used and are the primary focus of the imagery experience (Schuster et al., 2011). The kinesthetic element of imagery is commonly

defined as feeling the movement when one is carrying out a skill, while the visual element is connected to the visualization of the skill processes (Schuster et al., 2011). These two elements have typically been found to be the most important in the imagery of psychomotor skills (Schuster et al., 2011). Additionally, the understanding of the kinesthetic and visual elements is important for individuals to grasp in order for them to successfully carry out and practice imagery (Anuar, Cumming, & Williams, 2016).

Past Research

Sackett (1934, 1935) and Perry (1939) conducted a few of the first studies on imagery (Driskell, Copper, & Moran, 1994). Sackett (1934, 1935) looked at how mental rehearsal of a maze pattern was helpful to participants in the solving of the maze. Perry (1939) observed the efficiency of both actual and imagined practice for five different psychomotor tasks. These initial studies paved the way for hundreds of other studies to see how imagery affects various individuals and processes.

Most of the research in the past has looked at imagery's use in the realm of sport psychology (Ay, Halaweh, & Al-Taieb, 2013). There are hundreds of studies that have been done on how it can affect, help, and influence athletes and coaches (Burton & Raedeke, 2008; Cumming & Hall, 2002). For example, imagery has been used to help athletes increase their free-throw percentage (Savoy & Beitel, 1996), improve batting averages (She & Morris, 1997), and improve tennis serving percentages (Noel, 1980). In addition to increasing performance measures, imagery has been used in sport to decrease anxiety, increase confidence, increase self-efficacy, and increase motivation in various sports (Orlick & Partington, 1988).

Most research studies have looked at imagery's effect on sports and sport performance (She & Morris, 2011). Imagery is the most widely and popularly used method to improve

performance in athletes and coaches (Cumming & Hall, 2002). In addition, it has been found that athletes with higher skill levels and who have experienced more athletic success are more likely to use imagery than those who have less success (Burton & Raedeke, 2008; Cumming & Hall, 2002). In addition, over 90% of Olympians from Canada and the United States report they use imagery (Burton & Raedeke, 2008; Murphy, Jowdy, & Durtschi, 1990; Orlick & Partington, 1988).

Benefits of using Imagery

The fact that so many successful individuals use imagery indicates there must be reasons as to why they do so. Imagery has been shown to be used for a number of reasons, such as performance improvement, skill development, and preparation, and many benefits come with its use (Anton et al., 2017; Driskell et al., 1994). One of the most research-supported advantages is the different ways in which performance has improved, such as faster times, better accuracy, fewer mistakes, and overall more success (Driskell et al., 1994; Schuster et al., 2011). The other primary benefits of imagery are an increased self-confidence, higher motivation, increased attentional control, and lower anxiety (Cox, 2012; Vealey & Greenleaf, 2010). Furthermore, studies have found that imagery has led to higher self-efficacy, a greater feeling of control, lower stress, better emotion management, better energy management, and increased relaxation (Driskell et al., 1994; Schuster et al., 2011).

Components of Imagery

There are many reasons imagery is used, including learning a skill, practicing a skill, developing strategies, solving problems, preparation for competition or performance, improving psychological skills, and coping with injury, among several others (Cumming & Hall, 2002). In order to learn a new skill and practice that skill, a person is most likely to use cognitive-specific

imagery (Anuar et al., 2016). In cognitive-specific imagery, people are able to gather a blueprint for the skill and use imagery to gain experience with the various steps and imagine themselves properly performing a specific skill (Green & Iler, 2017; Morris et al., 2005). In fact, in novice learners, it has been shown that imagery is more effective for cognitive tasks rather than tasks that are purely physical (Driskell, et al., 1994). In other words, those learning new tasks that require a combination of cognitive functioning and physical movements have been shown to increase their performance at a higher rate by using imagery than those learning a new skill that is only physical and does not require cognitive skills.

Cognitive-specific imagery is part of the cognitive component of imagery, while the other overarching component is motivational imagery (Paivio, 1985). The motivational purpose of imagery can be broken down into motivational specific, motivational general-mastery, and motivational general-arousal (Paivio, 1985). On the other hand, the cognitive component of imagery is divided into cognitive specific and cognitive general (Paivio, 1985).

Imagery's Effect on Confidence and Anxiety

Imagery has also been studied for its effects on motivational elements, such as anxiety and confidence. Studies have looked at how imagery use has the ability to lead to higher confidence in individuals. Several of these studies have found that individuals who use imagery have both higher trait and state self-confidence (Williams & Cumming, 2012). Studies have suggested that the imagining of a successful completion of a skill allows the individual to believe that they are truly able to complete that task (Martin & Hall, 1995; Williams & Cumming, 2012). Increased confidence was found, both in games and practice, in athletes from various sports who used cognitive-specific imagery (Hall et al., 2009).

Anxiety is an emotional response that is often prevalent in individuals either performing or learning a skill. Speck (1990) studied how imagery can decrease nursing students' anxiety when administering an injection. Another study by Colin, Nieuwenhuys, Visser, & Oudejans (2014) found that the use of imagery was effective in reducing anxiety in police officers prior to their performance on a shooting task during which they were under pressure. A study by George and Abraham (2017) found that guided imagery was successful in reducing anxiety in college students.

A study by Vadocz, Hall, & Moritz (1997) used various measures, such as heart rate and self-reports on the Cognitive State Anxiety Inventory-2 (CSAI-2), to measure anxiety in roller skaters. This study showed that imagery was an effective strategy to decrease anxiety in before competition (Vadocz et al., 1997). A study by Jing, Wu, Liu, Wu, & Miao (2011), studied guided imagery and its effect on pilots as a means of decreasing anxiety before and after flight training. They found that guided imagery was able to decrease anxiety in these individuals as measured by heart rates (Jing et al., 2011).

Using Imagery for Novel Skills

While using cognitive-specific imagery, an individual is learning or practicing newly acquired skills. Many studies have looked at imagery's influence on the acquisition of novel skills and found that imagery is beneficial for individuals attempting to learn these new skills (Allami, Paulignan, Brovelli, & Boussaoud, 2008; Anton et al., 2017). One study showed that college students majoring in physical education benefited from the practice of imagery when learning a new volleyball skill. It is important to note that in this study, none of the students had previous experience with the sport of volleyball (Ay, Halaweh, & Al-Taieb, 2013). Brouziyne & Molinaro (2005) studied how imagery can benefit golf novices in improving their shot

performance. Hall & Hardy (1991) found that imagery was able to increase participant's performance in a beginner's pistol shooting course. Lastly, Allami et al. (2008) used a novel reach-to-grasp task during which the participants were required to grab a plastic object and precisely place it in a certain area as fast as possible, while balancing a marble, to test imagery's effectiveness. They were able to show that imagery was successful in increasing their participants' performances and for participants to learn and execute a motor task (Allami et al., 2008).

Combined Practice

A particularly useful strategy for increasing the effectiveness of imagery is to use a combination of physical and mental practice (Schuster et al., 2011). This is partially due to the fact that imagery alone typically does not show greater performance than physical practice (Allami et al., 2008; Burton & Raedeke, 2008; Cox, 2012). Similarly, research has shown that the most effective use of imagery is when it is used is in conjunction with physical practice, rather than as a total replacement (Burton & Raedeke, 2008; Hird, Landers, Thomas, & Horan, 1991). For these reasons, it is important and more beneficial for learners to use both physical practice and imagery when attempting to learn a new skill (Allami et al., 2008). The idea of both physical practice and imagery as mental practice is commonly referred to as combined practice (Ay et al., 2013; Gentili, Han, Schweighofer, & Papaxanthis, 2010)

When looking at how to best combine physical and mental practice, research has been done to see what fraction of practice should be mental, and how much should be physical (Allami et al., 2008; Gentilli et al., 2010; Malouin, Richards, Durand, & Doyon, 2009). Malouin et al. (2009) found that stroke patients who used over 90% of mental practice with the rest being physical practice were able to perform as well as those who completed all physical practice for a

rising and sitting skill. In this study, the amount of physical practice time was kept consistent, but when mental practice was used for 90% of the overall practice time, the participants saw the greatest increases in performance (Malouin et al., 2009). Allami et al. (2008) found that participants could reach their peak performance on a task during which they grasped an object with their eyes closed and placed it in a slot as precisely and quickly as they could when using a combination of 75% mental practice paired with 25% physical practice. Additionally, Gentili et al., (2010) found that combined practice with at least 25% of mental practice was better for the individuals than when they used physical practice alone on a task that required participants to remember and carry out a specific path while performing a pointing task with their hand.

Theories of Imagery

There are a few primary theories that aim to answer the question of why imagery works. Among these, some of the most popular and widely studied are the psychoneuromuscular theory, symbolic learning theory, and functional equivalence hypothesis (Ay et al., 2013; Jeannerod, 1995; Jowdy & Harris, 1990; Roosink & Zijdewind, 2010; Vealey & Greenleaf, 1998). The psychoneuromuscular theory claims that the subliminal neuromuscular patterns that occur during imagery are the same that occur when a person physically executes the movement (Jowdy & Harris, 1990). The symbolic learning theory proposes that imagery works because the individual participating in imagery is able to plan their actions before they have to actually execute them (Ay et al., 2013; Roosink & Zijdewind, 2010; Vealey & Greenleaf, 1998). Lastly, the functional equivalence hypothesis states that both imagery and physical practice utilize the same neurophysiological processes (Jeannerod, 1995). However, it is essential to understand that none of these theories have been accepted as the overarching theory behind why imagery works, rather most researchers conclude that imagery works because of the use of similar neuromuscular

patterns as physical practice in imagery, planning techniques, and use of the same brain and body processes in imagery and physical execution.

Numerous studies have looked into how imagery allows individuals to increase performance. One finding that is consistent in much of this literature is that the imagining of a motor task and the physical execution of a motor task share similar neural pathways and operations. This concept is similar to the functional equivalence hypothesis (Gentili et al., 2010; Papaxanthis et al., 2002).

Gentili et al. (2010) found that physical practice and imagery follow similar brain patterns in individuals while learning a new psychomotor skill. The skill in this study was made up of participants being timed for how long it took them to complete a certain pattern of finger pointing. This study revealed that individuals can learn the pattern for finger pointing while using mental imagery and yield similar or superior results to those who used only physical practice (Gentili et al., 2010; Jowdy & Harris, 1990). The results and concepts from this study are similar to the psychoneuromuscular theory and provide support for it because it shows how similar neuromuscular patterns are utilized in imagery and physical practice during the practice of a finger pointing task (Gentili et al., 2010; Jowdy & Harris, 1990)

Strategies and Best Practices for Imagery Use

In order to increase its effectiveness and to best practice imagery, there are certain strategies and steps that can be taken. One of the most studied methods for carrying out imagery is called PETTLEP (Holmes & Collins, 2001). This acronym stands for the physical, environmental, task, timing, learning, emotional, and perspective components of imagery (Holmes & Collins, 2001). Each element of PETTLEP is important for an imagery experience.

For the physical and environment component, a person should imagine all of the *physical* sensations that will be encountered during the real experience and should do so in the *environment* that they will be physically performing in (Anural et al., 2006; Smith et al., 2008). Additionally, for the *task* and *timing* parts, the task of the imagined experience should also involve the same thoughts, feelings, and actions and the imagined performance should be completed at the same speed and pace as the physical task (Smith et al., 2008). Individuals should use imagery in a way that corresponds to their level of learning at the time and must imagine actions that are appropriate to their abilities at the time to incorporate the *learning* element (Smith et al., 2008) To create an *emotional* similarity, the person should imagine the emotions that they will be feeling during the physical execution of a task. Lastly, the person should incorporate either an internal or external *perspective* while using imagery when imagining the completion of a skill, depending on the situation (Smith et al., 2008). An internal perspective is used when a person imagines the experience as if they are in their own body and imagines the experience using their own senses and eyes. An external perspective is when a person imagines the experience from a perspective outside of their body and sees the experience similar to a video that is playing, rather than from their own eyes (Smith et al., 2008).

A study by Smith, Wright, and Cantwell (2008) found that a PETTLEP imagery approach was successful in increasing performance for golfers performing a bunker shot. The best results for this study occurred when PETTLEP imagery was paired with physical practice (Smith et al., 2008). Another study found that participants had a higher ease of imagery and increased vividness when using PETTLEP imagery for internal visual and kinesthetic imagery, as compared to more traditional imagery processes (Anuar et al., 2016). The ease of imagery is how well and easily an individual can accurately create and control an imagery experience (Anuar et

al., 2016). Additionally, this study found that the participants self-reported that incorporating the physical elements of the PETTLEP approach, such as holding the props and being in the same clothes as one would during the performance, was the most beneficial of the PETTLEP elements in aiding the vividness of their imagery (Anuar et al., 2016). This study showed that the physical and environmental elements were reported as the most helpful in the "ease of imagery" among the PETTLEP elements (Anuar et al., 2016).

While carrying out imagery, it is important for the environmental conditions to be appropriate to obtain the best results. One important factor is for the space to be quiet with limited distraction and for the individual to feel comfortable. Participants are typically encouraged to sit still and close their eyes as well (Anuar et al., 2016). Additionally, individuals should focus on the successful completion of the skill and imagine themselves completing it in an ideal fashion (Anuar et al., 2016). Individuals can also be provided with cues or triggers to aid the learning process (Anuar et al., 2016). While imaging, individuals can also use partial movements that correspond to the skill they are imagining in order to aid their learning process (Anuar et al., 2016)

As far as imagery duration goes, most research points to the fact that short sessions are typically the most effective. A study by Etnier and Landers (1996) suggests one to three minute blocks of time for imagery. Similarly, Driskell et al. (1994) recommends an overall exposure to imagery time of 20 minutes for a single session. In these 20 minutes, the same skill can be mentally practiced several times for a few minutes each time, but with breaks in between each mental rehearsal of the skill to end up at a total of 20 minutes (Driskell et al., 1994). Schuster et al. (2011) conclude that overall sessions of around ten minutes are typically the most effective. Furthermore, for each imagined repetition of a skill, there should be a relaxation and

rest period before the next imagination of the skill (Morris et al., 2005; Suinn, 1984). In other words, individuals often complete shorter sessions of imagery repeatedly a few times a week for several weeks in order to gain imagery experience. For example, a participant could follow an imagery script that takes two minutes a total of three times to complete six total minutes of imagery. This sequence can be repeated over the course of several weeks, in only a single day, or as long as the participant wishes.

In summary, most imagery literature comes to the conclusion that short sessions anywhere from one to five minutes, adding up to a total of ten to twenty minutes, are the most effective for individuals using imagery as mental practice.

Uses of Imagery

Imagery can be carried out in various ways. Individuals have many options, including using guided imagery during which another person brings them through the steps of the imagery session. Houvington & Brouwer (2010) used guided imagery in stroke patients and were able to show that guided imagery was helpful in allowing patients to activate affected muscles in order to guide recovery. Another study by Sanders et al. (2008) showed that guided imagery was more effective than textbook study in teaching surgical skills to students. Colin et al. (2014) used audio guided imagery in police officers to decrease their anxiety. These police officers used imagery before completing a shooting exercise during which they aimed at targets on a simulated opponent.

In recent years, there is increasing research looking into the use of imagery by nurses, surgeons, and doctors. A recent study by Anton et al. (2007), looked at how imagery can be used to help prepare surgeons for the execution of various surgeries. Imagery was found to be successful in aiding surgeons in acquiring skills necessary for surgery and also allowed surgeons

to have increased confidence in their performance (Anton et al., 2007). Similarly, another study showed that the imagery allowed surgeons to transfer newly learned skills to actual physical execution in real-life surgery (Sanders, Sadoski, van Walsum, Bramson, Wiprud, & Fossum, 2008).

Not only has imagery been useful for athletes and health professionals, but research indicates it can be helpful for students. Speck (1990) showed that imagery can be used for nursing students to decrease their anxiety while performing injections. This decreased anxiety led to higher performance in the students (Speck, 1990). Another study showed that mental imagery was as effective as yoga and aerobic exercise in decreasing stress in college students (Kumar, Bhanagari, Mohile, & Limaye, 2016). An additional study used college students to show the improvements in reaction times of a psychomotor skill after using mental imagery. In this study, the participants performed a timed table tennis swing simulation while reacting to lights, and used imagery to gain mental practice of the skill (Post, Young, & Simpson, 2018).

As with most skills that can be learned, imagery is most effective when used consistently, practiced over time, and used in several sessions (Orlick & Parrington, 1988). However, there are also studies that show its use in single and brief sessions of only a short amount of time that result in improvement. This shows that imagery can be effective both in single sessions and when practiced over numerous sessions. Allami et al. (2008) was one such study that had participants use imagery for a single, brief session and the participants learned a hand movement task of grabbing an object and placing it in specific areas as fast as possible. This specific study consisted of only one practice session and showed that this short amount of combined physical practice and imagery was effective in improving performance in the participants (Allami et al., 2008). Another study looked at how a single session of imagery can affect police officers'

shooting performance and their anxiety levels (Colin et al., 2014). This single imagery intervention was found to be successful in increasing the officers' accuracy in shooting under threat and decreasing their anxiety levels (Colin et al., 2014).

Practical Benefits of Imagery

Beyond its benefits, there are also practical and logical reasons why people do and should use imagery. One of the main reasons that imagery is an effective strategy is its availability; an individual can use imagery at any time and in any environment. Additionally, imagery is free and can be done without using any resources. It has been shown to be an effective substitute for physical practice during the acquisition of skills in athletes and in the general population. For this reason, mental practice can be used in situations when physical practice is not possible, is dangerous, or is expensive. For example, surgeons often use imagery when preparing for unusual or atypical surgeries (Anton et al., 2017). Similarly, surgeons can utilize imagery as opposed to additional physical practice to save on resource costs (Anton et al., 2017).

The Current Research

Previous research has shown that imagery has had strong effects on many aspects of human functioning, such as confidence, anxiety, and performance. In numerous studies, imagery has helped many individuals learn skills, including novel skills. In particular, cognitive-specific imagery has been shown to increase confidence, learning, and performance. Furthermore, guided imagery has been used as an effective approach for individuals to gain mental practice and reap its benefits. Additionally, imagery has been used as a successful method to impact the performance of college students. Lastly, imagery as mental practice is often used as a part of combined practice to yield optimal results and performance in many situations.

Based on previous research, the current researcher hopes to study the effectiveness of combined physical practice and imagery on improving performance, increasing confidence, and decreasing anxiety. Specifically, this study will look into the effectiveness of a short bout of physical practice followed by imagery. Additionally, the current study hopes to find a positive relationship between imagery use and self-confidence in being able to perform a specific psychomotor task. This study will also look into the effects imagery has on the amount of time it takes to complete a task.

The current study will research elements of imagery that previous studies have neglected. The current study will research how imagery can be used in the undergraduate educational setting, to advance students' skills and the learning of a new skill. Imagery use is a strategy that has not been studied extensively in the general undergraduate college population and the results have the potential to benefit students of a variety of majors, such as engineering, athletic training, and chemistry, in the future. Imagery is not a skill that is typically taught or practiced in the college environment, but it has been shown to be beneficial to the learners of many psychomotor skills.

Additionally, the study will look at how imagery can influence confidence, anxiety, and performance, all of which are essential components of students' successes in the educational setting. This study will also incorporate a combined practice approach of both imagery and physical practice in the learning of a novel skill. The current study will assess self-reported anxiety which will add to the literature on imagery's effect on anxiety. While combined practice has shown to be superior to physical practice or imagery alone, specifically in regard to performance, there is limited research on its influence on factors such as confidence and anxiety, especially in environments outside of sport. The current study hopes to dive into these previously

untouched subjects, specifically to find the benefits imagery can have on the learning of skills that are non-sports related in undergraduate college students.

For the current study, the following hypotheses are proposed:

Hypothesis 1: Participants in the experimental group (imagery) will have larger decreases in the amount of time it takes to perform the skill from pre- to post-test compared to the control group.

Hypothesis 2: Participants in the experimental group (imagery) will have a better-quality performance and will increase their performance to a higher degree from pre- to post-test compared to those in the control group.

Hypothesis 3: Participants in the experimental group (imagery) will have higher increases on the confidence portion of the Cognitive Trait Anxiety Inventory-2 (CTAI-2) from pre- to post-test compared to those in the control group.

Hypothesis 4: Participants in the experimental (imagery) group will have higher decreases on the cognitive anxiety portion of the Cognitive Trait Anxiety Inventory-2 (CTAI-2) from pre- to post-test compared to those in the control group.

Hypothesis 5: Participants in the experimental (imagery) group will have higher decreases on the somatic anxiety portion of the Cognitive Trait Anxiety Inventory-2 (CTAI-2) from pre- to post-test compared to those in the control group.

Method

Participants

Participants included 40 college students enrolled in a small, Catholic, liberal arts institution in the Midwest. The total sample (N = 40) consisted of 28 females (n = 28) and 12 males (n = 12). These individuals ranged from ages 18-22. Participants were recruited through Introductory Psychology courses and received partial course credit for participation. Additionally, the sample included first-years (n = 23), sophomores (n = 13), and juniors (n = 4).

Design

Participants were randomly assigned into one of two groups: imagery group (n = 23) or the PowerPoint control group (n = 17). The participants were randomly assigned into these groups by the flipping of a coin, which was conducted by the research assistant. The group the participant was assigned to was blind to the researcher throughout the study. The control group was an active control group who engaged in five minutes of physical practice during which the participant practiced the designated skill (athletic taping) once, followed by five minutes of reviewing the steps of the athletic taping skill through the viewing of a PowerPoint presentation that was played twice for two minutes each for a total exposure of four minutes for the presentation. The second group was the experimental imagery group who completed the same five minutes of physical practice, but then participated in a guided imagery session for four minutes, during which they were guided through the successful completion of the elbow taping skill processes through an audio recording. The participants completed the athletic taping skill on one of two research assistants who was present throughout the duration of each research session.

Measures

Confidence and Anxiety. Confidence and anxiety were measured using the Competitive Trait Anxiety Inventory (CTAI-2; Martens, Vealey, & Burton, 1990). This inventory was a 27-item questionnaire. It evaluated how cognitively anxious, somatically anxious, and self-confident individuals felt prior to being evaluated on their ability to complete elbow taping skill. Participants rated on 4-point Likert type scale ranging from 1 (not at all) to 4 (very much so) how much they were experiencing each of the twenty-seven items before performing the elbow taping skill. Nine of the questions were designated to measure self-confidence, with nine dedicated to

measuring cognitive anxiety, and the remaining nine measuring somatic anxiety. The CTAI-2 was administered online for this study.

Performance Evaluation Form. Skill performance for both the pre- and post-tests was measured using an elbow-taping checklist and scoring form created for this study. This evaluation form was created as an on-line form for this study. At the top, there was a spot for the researcher to type the participant's identification number and for the researcher to indicate whether it was a pre- or post-test. The rest of the form was a checklist. The participants were assessed for the completion of twenty-six different steps and correct procedures of the elbow taping process. The completion of these tasks was scored out of twenty-six points and this total was the score for the participant's performance. The following are examples of the items on the checklist: "Tapes the first tape strip from distal to proximal (forearm to bicep)," and "Uses two anchor strips that overlap by about a half of a tape width." There was also a spot on the form to indicate how long it took the participants to complete the elbow taping skill.

Manipulation checks. Participants in the experimental imagery group completed a manipulation check to ensure that they were able to perform the imagery as instructed. In this manipulation check, the participants were asked if they had any problems during the imagery sessions. They were also be asked to state any problems that did arise for them in their ability to use imagery.

Procedure

The experiment was run in sessions of one participant at a time. Upon arrival, participants first completed a consent form and verified their identification number in order to receive PRIA credit for their participation. From there, they were told that the purpose of the study was to test

the effects of different types of practice on learning a new skill and were told that they would be learning the skill of athletic taping of an elbow.

At this point, they were introduced to the elbow taping skill with a short introduction to the skill and why it is used, followed by an instructional video that was played on a screen for the participants to view. The instructional video was played once for the participants and the video lasted approximately two minutes. Following the instructional video, participants were given five minutes to practice the skill and read over the steps of the process. The steps of the elbow-taping process were printed for all participants to read over as they physically practiced the skill. It was expected that the participants would be able to complete one practice run through of the elbow taping process. After the five practice minutes, the participants completed the Competitive Trait Anxiety Inventory-2 regarding their self-confidence and anxiety in their ability to complete the elbow taping skill. The CTAI-2 was available for the participants to complete on a computer in the form of an online survey. The participants were informed that their responses were anonymous. Next, participants completed a pre-test of their ability to tape an elbow. The participants had a maximum time limit of five minutes to complete the elbow taping skill.

Athletic taping, specifically of the elbow, is a psychomotor skill. It required individuals to incorporate intellectual processes with physical movements. Additionally, taping required a large amount of cognitive processing in order for participants to complete the physical task because of the large number of steps of the process and complexity of the taping patterns used while completing the skill. The literature suggests that the learning of a novel skill, specifically one that is mostly cognitive, can be facilitated through the use of imagery. Therefore, elbow taping was concluded to be a fitting skill to learn through the use of imagery as mental practice.

The participants were timed on how long it took them to complete the task. Additionally, they were evaluated on their ability to complete all of the steps of the elbow taping process using an elbow-taping checklist and scoring form. The participants were given a score out of twenty-six for their pre-test. The evaluation form was completed by the researcher as they assessed the participant's performance of the elbow taping skill on one of the research assistants.

Following the pre-test, the researcher left the room and the research assistant initiated either the playing of the PowerPoint slides or the playing of the guided imagery audio for the participant depending on the group to which they were randomly assigned. This allowed the researcher to be blind to the condition to which each participant was exposed.

The control group viewed a PowerPoint reviewing the 22 steps of the elbow taping process. The PowerPoint contained 22 slides, one for each of the steps of the process, matching up with the steps on the elbow taping evaluation form. The PowerPoint was played and controlled by the research assistant and was played twice, each for two minutes, totaling four minutes of exposure to the PowerPoints.

The experimental imagery group was first introduced to the topic of imagery from the research assistant and given information that describes its general definition. The definition and background information used in this description came from previous research studies (White & Hardy, 1998, p. 389; Anuar et al., 2016). The research assistant was in charge of introducing the participants to imagery and gave them information about imagery by stating,

> *"To help you learn the steps of the elbow taping skill. We are going to play a guided imagery audio for you. Imagery is the process of using all of you senses to create a mental image of an experience. It is more than just visualization because it has the ability*

to involve all of the senses, rather than vision. Imagery can be described as similar to a video or image that is created in one's mind without any actual external. One astonishing aspect of imagery is that the brain cannot tell between an experience imagined in one's mind or an actual event that is physically experienced. For this exercise, imagine yourself as if you are going through the steps of the elbow taping skill you have learned today as the guided imagery audio is played. It will last for about 4 minutes and I will play it once for you."

Following the reading of the imagery information, the participants were informed of the different perspectives imagery can have (internal or external), as well as the other elements of the PETTLEP approach. They were guided through strategies to incorporate PETTLEP elements into the imaging of their completion of the elbow taping skill, such as imagining them completing the skill in real time, rather than fast or slow motion. The participants were informed to close their eyes for the imagery and to incorporate a first-person perspective. Additionally, the participants performed the imagery in the same room that they completed the pre- and post-tests for the taping skill and were told to attempt to imagine themselves in the same room.

Next, the audio was played for the participants as they were seated in a dark room. The research assistant sat in the room with the participant while going through the guided imagery audio. Participants were given tape and pre-wrap to use as props throughout the imagery session, if they chose to use it to help them in the imagery process. The guided imagery audio was played once for the participants and the audio lasted four minutes.

Following the viewing of the PowerPoint or the playing of the guided imagery audio, all participants completed a second Competitive Trait Anxiety Inventory-2 to rate their confidence

and anxiety in their ability to tape an elbow. While the participants were completing the second Competitive Trait Anxiety Inventory-2, the researcher came back to the research room. Next, participants completed a post-test of their ability to tape an elbow and were again evaluated on how long it took them to complete the task and were assessed using the elbow-taping checklist and scoring evaluation. They again had a time limit of five minutes to complete the skill and were informed of this time limit prior to being evaluated. The participant completed the elbow taping skill on the research assistant while the researcher observed, timed, and scored the completion of the skill.

Following the post-test, only participants in the imagery (experimental) group completed a manipulation check that asked the participants to state if they were able to complete the imagery successfully and if they had any troubles. They were also asked if they were able to complete the imagery as instructed and to state any problems that they had in completing the imagery. Those in the PowerPoint group did not complete the manipulation check and went immediately to the debriefing portion of the study.

The last element of this experiment for all participants was the debriefing in which the participants were told the purpose of the study and they were asked not to reveal its purpose to other potential participants. They were also be thanked for their participation in the study, told they would receive PRIA credit, and then they were allowed to leave.

Results

The dependent variables in this study were the time to complete the taping skill, performance scores for the skill, cognitive anxiety scores on the CTAI-2, somatic anxiety scores on the CTAI-2, and self-confidence scores on the CTAI-2. These dependent variables were measured using difference scores from the pre-test score and post-test score. For each variable,

difference scores were calculated by subtracting the pre-test score from the post-test score. Positive difference scores would indicate higher scores on the post-test than on the pre-test, whereas negative difference scores would indicate lower scores on the post-test than on the pre-test. The difference scores for these five dependent variables were then compared between the PowerPoint (control) group and the imagery (experimental) group using an independent-samples *t*-test (with an alpha level of 0.05) to determine statistical significance difference.

It was expected that there would be a statistically significant increase in self-confidence from pre-test to post-test in the experimental group as compared to the control group as measured by the confidence portion of the CTAI-2 scores. There was not a significant increased difference in the mean level of confidence for people in the imagery and PowerPoint groups, t (38) = 1.373, p = 0.178, d = 0.43.

For anxiety, it was expected that the experimental group would have larger decreases in anxiety than the control group as measured by the two anxiety portions of the CTAI-2, cognitive anxiety and somatic anxiety. There was not a significant increased difference in the mean level of cognitive anxiety for people in the imagery and PowerPoint groups, t (38) = -0.596, p = 0.555, d = 0.19. Additionally, there was not a significant increased difference in the mean level of somatic anxiety for people in the imagery and PowerPoint groups, t (38) = 0.294, p = 0.771, d = 0.10.

Additionally, for the taping skill, it was expected that there would be a larger increase in performance scores for the experimental group than the control group from pre-test to post-test scores as measured on the taping performance evaluation form. There was not a significant increased difference in the mean level of performance scores for people in the imagery and PowerPoint groups, t (38) = 1.373, p = 0.178, d = 0.43.

Lastly, it was expected that for the time taken to complete the athletic taping skill, there would be a larger decrease in the experimental group than the control group. There was not a significant increased difference in the mean level of time taken to complete the athletic taping skill for people in the imagery and PowerPoint groups, t (36) = - 0.670, p = 0.507, d = 0.22. Means difference scores and standard deviations for the two groups can be seen in Table 1.

Although there were no predictions about gender differences, there was a statistically significant difference between men and women in both groups for cognitive anxiety scores, t (38) = -3.01, p = .005, d = 1.07. The women had greater decreases in cognitive anxiety scores than men. To look further at the reason for this significant difference in difference scores for cognitive anxiety between the genders, pre-test scores for cognitive anxiety, on a scale from nine to 36, were tested for significant differences. There was a statistically significant difference between men and women for their mean pre-test cognitive anxiety score, t (38) = 2.60, p = 0.013, d = 0.901. The women had significantly higher cognitive anxiety scores during the pre-test administration of the CTAI-2 than men.

However, at the post-test there was not a statistically significant difference between men and women, t (38) = 1.24, p = 0.221, d = 0.426. The women did not have significantly higher cognitive anxiety scores during the post-test administration of the CTAI-2 than men. Thus, throughout the study, women had a much larger decrease in their average cognitive anxiety scores than men which contributed to the statistically significant difference in cognitive anxiety difference scores between the two genders. The average cognitive anxiety score of women in the study became much closer to the average cognitive anxiety score of men in the study during the post-test administration of the CTAI-2. Mean difference scores for the two groups can be seen in Table 2.

Discussion

The results did not support the hypotheses. Those in the experimental (imagery) group did not have greater increases from pre- to post-test in performance scores and self-confidence than those in the control group. Additionally, those in the experimental (imagery) group did not have significantly greater decreases in their anxiety, nor did it take significantly less time to complete the elbow-taping skill as compared to the control group from pre-test to post-test.

These results do not cohere with the findings of previous research on imagery. In various settings, including educational and learning settings, the use of imagery has been successfully shown to decrease anxiety, while increasing confidence. However, the results of the current study did not line up with these previous findings.

There are many factors that need to be considered that may help explain these results. One possibility is that the task itself of elbow taping was not an adequate skill for assessing these variables. Perhaps the skill was not complex enough for the participants to benefit from the imagery, or the skill did not have enough steps to require a process of visualization. Perhaps, a different, or more cognitively challenging task may have showed more significant results, especially for differences in performances scores and performance times.

One such example would be the athletic training skill of ankle taping, which would have required more visualization because it includes more, and more complex steps, such as the taping of heel locks, which is a multi-step process. Additionally, the scores for post-test performance in the current study ranged from 13-26 with an average of 22.23. This shows that in general, the scores were high. With a more difficult task, there could be greater range of scores. With a more complex task like ankle taping, visualization might help with such complexity.

Similarly, there was a possibility of a ceiling effect with these performance scores. With a limited range of scores, there is a possibility that there was a ceiling effect, or near ceiling effect, which may have affected the ability to discern differences between the groups and the results of the study. While most participants did not receive a perfect score, most were only a few points away from a perfect score during their post-test. Additionally, for many participants, they received a high score on their pre-test, so they did not have the ability to see large improvements from pre-test to post-test because they already had a high score for the elbow taping skill on their pre-test score.

In addition, it is possible that the elbow taping evaluation form was not an adequate measure of performance of the elbow taping skill. While the form measured the performance of the participants, it is possible that the form did not accurately measure the quality of the performance of the elbow taping skill. Perhaps the evaluation should have included a measure to rate the quality of the elbow taping in addition to the checklist of the 26 items.

For anxiety, while much of the research has found that imagery is successful in decreasing overall anxiety, cognitive anxiety, and somatic anxiety, including a study by Colin et. al (2014) showing decreased anxiety in police officers through the use of imagery, the current study did not yield the same results. One possibility is that the stakes were not high enough for the participants in the current study to evoke enough anxiety that might be moderated by imagery. The participants came into the study knowing that their performance did not affect their grade or standing with the institution, nor was it a task for which success would likely be associated with high status among college students, as opposed to athletic skills or musical ability. Therefore, the participants may not have had high motivation to put forth their full efforts, or anxiety levels may not have been affected by the task because of the low stakes.

In addition, some of the participants were familiar with either the research assistant or the researcher, and this familiarity may have had an effect on their anxiety levels during the study. Familiarity with the researcher may have led to lower anxiety levels because of the participant's comfort level in the research environment.

Because of the gender differences found in levels of cognitive anxiety, another factor to be considered is the gender of the researcher and research assistants. The researcher and the research assistants were female. It is possible that the male participants felt more comfortable, less anxious, and less intimidated by the two females conducting the research, as compared to the female participants. Female participants may have felt as though they were dealing with social comparison with the other females in the room. On the other hand, the men may have felt at ease being in a room of all females, not felt the burden of social comparison, and were less physically and socially intimidated in the presence of the female researchers. Traditional gender roles and stereotypes suggest men are typically expected to be the more powerful gender, which could have led to differences in comfort levels that affected anxiety levels in the participants.

Furthermore, there were some individuals who were not invited to participate in the study based on their responses to two screening questions. This is a potential issue because participants who may have benefitted from the imagery were not included in the study based on these two questions. Additionally, the two screening questions limited the available participants for the study. The two pre-screening questions were, "How often have you used mental imagery to practice skills?" and "Do you have experience wrapping or taping injured body parts, such as elbows or ankles?" The inclusion of these pre-screening questions could have influenced the overall makeup of the participants in the study. Perhaps it would have been appropriate to include individuals who did have experience with athletic taping. It is possible that the use of

imagery would have been useful for those with experience in athletic taping because they would be able to better visualize the skill and know the kinesthetic movements, which would lead to a more realistic mental image. A more realistic and vivid mental image of the elbow taping experience may have helped the participants to decrease anxiety, improve performance, and increase confidence because the imagery may have been more similar to the actual physical performance of the skill.

For self-confidence, participants may have felt that they gained confidence throughout the study by simply being exposed to the task more throughout the learning of the skill. Therefore, this may have led to increases in the self-confidence levels of both groups, and in fact, the results indicated consistent increases in self-confidence for both groups throughout the study.

The results indicated that gender was related to the cognitive anxiety levels of participants throughout the study. There was a significant difference during the pre-test administration of the CTAI-2 between male and female participants in their cognitive anxiety levels, with females having higher levels of self-reported cognitive anxiety than men. However, during the post-test administration of the CTAI-2, the women's cognitive anxiety scores were not significantly different from the men. The average cognitive anxiety levels of men and women were similar to each other during the post-test. This difference shows that the women's scores became closer to the men's average cognitive anxiety scores throughout the study. The women's average cognitive anxiety went down at a high rate, whereas the men's cognitive anxiety scores only went down slightly during the study.

There are many possible explanations for this finding. It may suggest that at the beginning of the study women were more honest about their levels of cognitive anxiety, whereas men underestimated their cognitive anxiety levels. This may have been because women felt more

comfortable sharing their feelings about being nervous and anxious. Men are taught that they should be emotionally strong, so they may have been more likely to say they were not nervous, even if they were. Another explanation is that both imagery and the PowerPoint were more successful in decreasing the cognitive anxiety in the female participants. Another possibility is that women have been shown to have higher anxiety levels in general, but those in the study realized over time that their anxiety was not necessary for this situation.

In sum, contrary to my predictions, the use of guided imagery as mental practice during the learning of a novel psychomotor skill did not serve to improve performance, increase confidence, and decrease anxiety. These results suggest it is necessary for there to be more research on the topic of imagery in other settings, with different populations, and using a variety of psychomotor skills to be learned.

Limitations

Like all studies, this one is not without its limitations. The sample size could have been larger in order have more participants in both the experimental and control groups and increase the statistical power of the analyses. Additionally, only students currently enrolled in the Introductory Psychology laboratory participated in this study, and nearly all lab students are first-years and sophomores. In addition, the sample consisted of traditional, college-aged students (18-22 years of age) at two religiously affiliated institutions of higher education. Thus, the sample was not representative of the average college population, let alone the broader population. Another limitation of the study was the inclusion of only one comparison group. This issue will be discussed further in the following section regarding future directions of imagery research.

Many researchers have found that females are more likely to participate in psychological research studies, and that was also true in this study, in which female participants were overrepresented, leading to a gender bias in the sample. There were a limited number of male participants, as only twelve of the 40 participants were male. A larger number of male participants, or a larger sample with a greater percentage of males, could have allowed for more powerful examination of gender differences on multiple variables. In addition, it might have provided the opportunity to examine the interactions between gender and group assignments. An example would be the interaction of imagery and gender. Perhaps one group, such as females using imagery, saw the greatest improvements in performance scores throughout the study. Additionally, with the differences found in levels of cognitive anxiety, the interaction of cognitive anxiety and gender could also be examined as it relates to performance. The inclusion of more male participants would provide the opportunity to look at how the group the participant is assigned to and their gender interacted to have an influence on their anxiety, confidence, and performance.

As discussed previously, the motivation levels of the participants are another limitation of the study. All of the students came into the study knowing they had nothing to lose by being in the study, and knew they only had to complete the process in order to receive their PRIA credit. If the motivation of the students were better able to be manipulated in the study, the research study could have been strengthened. To increase motivation, athletic training students could be used as the participants. These students would have higher motivation to do well on the skill because it would be a skill required for their success in the studies and future career.

Another limitation that this study presents is the possibility that the participants were not able to completely or accurately complete the imagery as they were instructed. In addition,

participants in the control group may have unconsciously participated in imagery despite only viewing the PowerPoint. However, the manipulation checks used in this study sought to cut down on this limitation by asking the participants about their experience and if they had any difficulties. Of the 23 participants in the imagery group, all 23 responded yes to the question, "Were you able to perform the imagery as instructed? Please describe your experience." There were two other questions on the manipulation check that asked the participants, "Did you have any problems during the imagery sessions? If so, what were they?" and, "Please state any problems that did arise for you in your ability to use imagery." Participants consistently reported that they did not have any problems with the imagery in their responses to these two questions.

Future Directions

Future research could take measures to assess whether participants in all groups used a form of imagery throughout the research study by using a manipulation check as opposed to only asking the imagery group to complete the check as done in the current study.

A future study could look at the effects varying combinations of time devoted to mental practice and time devoted to physical practice have on the participants. For example, there could be three groups that use either 25% imagery, 50% imagery, and 75% imagery, in regard to their overall practice time. If they use 25% imagery, then their remaining 75% of time in the study is devoted to physical practice of the skill. In this research study, the 25% imagery group would use mental practice for fifteen minutes and physical practice for 45 minutes of an hour-long study. On the other hand, the 50% group would spend equal time using mental practice and physical practice. If this method were incorporated into the current study, one group could physically practice the taping skill for four minutes and then mentally practice for the four minutes to represent the 50% imagery group. The researcher would be able to manipulate the amount of

time in the study the participants used mental imagery to see the proportions that yield the greatest results in improving performance.

As previously suggested, future studies could use more complex tasks than athletic taping, or multiple different tasks that involve the learning of a psychomotor skill in order to test its effect on performance, anxiety, and confidence. Possible examples could be patients imagining correct walking form during physical therapy, mechanics imagining themselves correctly changing the oil in vehicles, or occupational therapists imagining themselves teaching a patient to correctly put their shoes on with tools to aid them.

Additionally, tasks relevant to student training, such as nursing students inserting an IV into someone's arm, handling medications, or checking a patient's blood pressure, that are fairly difficult and would be important to the students, would also increase motivation to learn and perform well (see Speck's 1990, study of nursing students using imagery to learn how to give injections). For example, imagery could be taught to nursing students throughout the semester and their progress with the skill could be measured and assessed. In order to compare the results of the various groups and see how imagery best benefits these nursing students, researchers could look at their performance, confidence, and anxiety levels depending on the amount of imagery they use and how often they use it. For example, they could have groups who use imagery every day for ten minutes for a month (30 total 10-minute imagery sessions), one group that use imagery for ten minutes once a week during one month (four total 10-minute imagery session), and a group who only uses imagery for a single session of ten minutes. They could then assess the groups' performance on various, such as injecting an IV, checking blood pressure, or dealing with medications to compare the results of each group.

Future studies could also use physiological measures to test anxiety in the participants throughout the study. It would not only help to have another form of measuring anxiety, but it would also provide a more objective measure of anxiety, as opposed to the self-reporting of anxiety. Future studies could measure heart rate or skin conductance in order to measure anxiety levels throughout the study. This would be beneficial in looking at somatic anxiety levels of participants and assessing whether imagery is successful in affecting physiological processes. Physiological measures have the ability to measure the anxiety levels of participants even if the participants are not aware their own anxieties levels, or do not respond honestly on self-report measures of anxiety.

Future studies could use another type of comparison group other than the PowerPoint group. Examples of different comparison groups could be a group that completes a worksheet with information regarding the task they are learning or a group that creates flashcards for the task they are learning and is allowed time to study them. This would allow researchers to look at whether it is the exposure to the skill that was helpful in increasing the participants' performance or if the increase is due to the use of imagery. While the participants would complete flashcards or complete a worksheet, they would be cognitively engaged, and this would allow for them to be less likely to spontaneously engage in imagery. This may be a good option, because unlike the PowerPoint group, it requires movement and cognitive engagement with the materials. Additionally, it is representative of study techniques common in the educational environment. This would provide a helpful comparison of how imagery measures up against study techniques of students and would be of particular interest for the educational setting.

Changes in the procedure could be made for future studies. One change could be the length of the guided imagery audio and the number of times participants listen to it. Participants

may have experienced greater effects of the imagery with exposure longer than four minutes. Instead of only listening to the audio once, they could have listened to the audio two times. The audio also could have been increased in time itself in order to incorporate more description of the skill, so the participants could greater imagine the process. Similarly, the audio could have had more language describing the emotional and attentional elements of completing the task, which could have had a greater effect on the participant's anxiety and confidence levels.

Additionally, the participants could listen to the guided imagery audio and then view the instructional video of the elbow taping skill again to ensure they have the steps of the skill down correctly in their mind when they are imagining the skill. This would allow the participants to strengthen their visual image of the correct taping process and determine if there were any areas they needed to double check to make sure they are doing it correctly, or improve on steps they had completely forgotten how to do.

It may be advantageous for future studies to look at the use of imagery in students. Research in this area can help students to find strategies to decrease anxiety. Anxiety is one of the top concerns students present regarding their mental health, so any technique to decrease anxiety would be beneficial for students ("Anxiety in Teens and College Students," 2018). For example, decreased anxiety in nursing students would allow them to better perform the skills they are learning and likely lead to increased safety in their work.

With the benefits of increased performance, increased confidence, and decreased anxiety, imagery could also be an important tool for students. More specifically, engineering students can use it when working with circuit boards to visualize possible designs or when designing robot arms to perform specific tasks. In the case of the robot arm, engineers can employ a third-person perspective to imagine how movement would feel from the arm's perspective and can help the

engineer in creating plans and designs. Imagery could also be helpful for culinary students in preparing dishes with multiple steps and ingredients, or for skills such as the proper cutting techniques of certain foods like meats and vegetables. Imagery is a strategy that has great potential to be beneficial to many students in the educational setting.

More research is warranted to examine the ways imagery can be used to benefit learners and students of all ages, and anyone undergoing training for a skill. Imagery need not be confined to only sport, or even college environments, because it has the ability to benefit people of all ages and in a wide variety of ways. Despite the non-significant results of this study, more research is needed in order to examine imagery's effect on learning new skills.

References

Albrecht, R.R., & Feltz, D.L. (1987). Generality and specificity of attention related to competitive anxiety and sport performance. *Journal of Sport Psychology, 9,* 23-248.

Allami, N., Paulignan, Y., Brovelli, A., & Boussaoud, D. (2008). Visuo-motor learning with combination of different rates of motor imagery and physical practice. *Experimental Brain Research, 184*(1), 105-113. doi:10.1007/s00221-007-1086-x

Anton, N. E., Bean, E. A., Hammonds, S. C., & Stefanidis, D. (2017). Application of mental skills training in surgery: A review of its effectiveness and proposed next steps. *Journal of Laparoendoscopic & Advanced Surgical Techniques, 27*(5), 459-469. doi:10.1089/lap.2016.0656

Anuar, N., Cumming, J., & Williams, S. E. (2016). Effects of applying the PETTLEP model on vividness and ease of imaging movement. *Journal of Applied Sport Psychology, 28(*2), 185-198. doi:10.1080/10413200.2015.1099122

Anxiety in teens and college students. (2018). Retrieved April 20, 2019, from https://adaa.org/living-with-anxiety/college-students

Ay, K. M., Halaweh, R. S., & Al-Taieb, M. A. (2013). The effect of movement imagery training on learning forearm pass in volleyball. *Education, 134*(2), 227-239.

Brouziyne, M., & Molinaro, C. (2005). Mental imagery combined with physical practice of approach shots for golf beginners. *Perceptual & Motor Skills, 101*(1), 203–211.

Burton, D., & Raedeke, T. D. (2008). *Sport psychology for coaches*. Champaign, IL: Human Kinetics.

Colin, L., Nieuwenhuys, A., Visser, A., & Oudejans, R. D. (2014). Positive effects of imagery on police officers' shooting performance under threat. *Applied Cognitive Psychology, 28*(1), 115-121. doi:10.1002/acp.2972

Cox, R. H. (2012). *Sport psychology: Concepts and applications* (7th ed.). New York, NY: McGraw-Hill.

Cumming, J., & Hall, C. (2002). Deliberate imagery practice: the development of imagery skills in competitive athletes. *Journal of Sports Sciences, 20*(2), 137-145. doi:10.1080/026404102317200846

Driskell, J. E., Copper, C., & Moran, A. (1994). Does mental practice enhance performance? *Journal of Applied Psychology, 79*(4), 481-492.

Etnier, J. L., & Landers, D. M. (1996). The influence of procedural variables on the efficacy of mental practice. *Sport Psychologist, 10*(1), 48-57.

Gentili, R., Han, C. E., Schweighofer, N., & Papaxanthis, C. (2010). Motor learning without doing: Trial-by-trial improvement in motor performance during mental training. *Journal of Neurophysiology, 104*(2), 774-783. doi:10.1152/jn.00257.2010

George, S. A., & Abraham, A. T. (2017). Effectiveness of guided imagery technique in reducing stress and improving academic performance among college students. *International Journal of Therapies & Rehabilitation Research, 6*(1), 152-153.

Hall, E. G., & Hardy, C. J. (1991). Ready, aim, fire: Relaxation strategies for enhancing pistol marksmanship. *Perceptual & Motor Skills, 72*(3), 775–786.

Hall, C. R., Munroe-Chandler, K. J., Cumming, J., Law, B., Ramsey, R., & Murphy, L. (2009). Imagery and observational learning use and their relationship to sport confidence. *Journal of Sports Sciences, 27*(4), 327-337.

Hird, J. S., Landers, D. M., Thomas, J. R., & Horan, J. J. (1991). Physical practice is superior to mental practice in enhancing cognitive and motor task performance. *Journal of Sport & Exercise Psychology, 13*(3), 281-293.

Holmes, P., & Collins, D. (2001). The PETTLEP approach to motor imagery: a functional equivalence model for sport psychologists. *Journal of Applied Sport Psychology, 13*(1), 60-83.

Jeannerod, M., & Frank, V. (1999). Mental imaging of motor activity in humans. *Current Opinion in Neurobiology, 9*(6), 735-739. doi:10.1016/S0959-4388(99)00038-0

Jing, X., Wu, P., Liu, F., Wu, B., & Miao, D. (2011). Guided imagery, anxiety, heart rate, and heart rate variability during centrifuge training. *Aviation, Space, and Environmental Medicine, 82*(2), 92-96. doi:10.3357/ASEM.2822.2011

Jowdy, D. P., & Harris, D. V. (1990). Muscular responses during mental imagery as a function of motor skill level. Journal of Sport & Exercise Psychology, 12(2), 191-201.

Kumar, S., Bhanagari, A. H., Mohile, A. S., & Limaye, A. H. (2016). Effect of aerobic exercises, yoga and mental imagery on stress in college students - A comparative study. *Indian Journal of Physiotherapy & Occupational Therapy, 10*(3), 69-74. doi:10.5958/0973-5674.2016.00084.8

Malouin, F., Richards, C., Durand, A., & Doyon, J. (2009). Added value of mental practice combined with a small amount of physical practice on the relearning of rising and sitting post-stroke: a pilot study. *Journal of Neurologic Physical Therapy, 33*(4), 195-202. doi:10.1097/NPT.0b013e3181c2112b

Martin, K. A., & Hall, C.R. (1995). Using mental imagery to enhance intrinsic motivation. *Journal of Sport & Exercise Psychology, 17,* 54-59.

Martens, R., Burton. D., Vealey, R. S., Bump, L. A., & Smith, D. E. (1990). Development validation of the Competitive State Anxiety Inventory- 2. In R. Martens, R.S. Vealey & D. Burton (Eds.), *Competitive anxiety in sport* (pp 117-190). Champaign, IL: Human Kinetics.

Morris, T., Spittle, M., & Watt, A. P. (2005). *Imagery in sport*. Champaign, IL: Human Kinetics.

Murphy, S.M., Jowdy, D., & Durtschi, S. (1990). *Report on the U.S. Olympic Committee survey on imagery use in sport.* Colorado Springs: U.S. Olympic Training Center.

Noel, R.C. (1980). The effect of visuomotor behavior rehearsal on tennis performance. *Journal of Sport Psychology*, (2), 221-226.

Orlick, T., & Partington, J. (1988). Mental Links to Excellence. S*port Psychologist, 2*(2), 105-130.

Neil, R., Mellalieu, S.D., & Hanton, S. (2006). Psychological skills usage and the competitive anxiety response as a function of skill level in rugby union. *Journal of Sports Science and Medicine*, (5), 415-423.

Paivio, A. (1985). Cognitive and motivational functions of imagery in human performance. *Canadian Journal of Applied Sport Sciences, 10*(4), 22S-28s.

Perry, H. M. (1939). The relative efficiency of actual and 'imaginary' practice in five selected tasks. *Archives of Psychology* (Columbia University), *243*,76.

Roosink, M., & Zijdewind, I. (2010). Corticospinal excitability during observation and imagery of simple and complex hand tasks: Implications for motor rehabilitation. *Behavioral Brain Research, 213*(1), 35-41.

Sackett, R. S. (1934). The influence of symbolic rehearsal upon the retention of a maze habit. *Journal of General Psychology, 10*, 376-398. doi:10.1080/00221309.1934.9917742

Sackett, R. S. (1935). The relationship between amount of symbolic rehearsal and retention of a maze habit. *Journal of General Psychology, 13*, 113-130.

Sanders C.W., Sadoski M., van Walsum K., Bramson R., Wiprud R., & Fossum T.W. (2008). Learning basic surgical skills with mental imagery: using the simulation centre in the mind. *Medical Education*, 42(6), 607–612.

Savoy, C., & P. Beitel. (1996) Mental imagery for basketball. *International Journal of Sport Psychology, 27*, 454-462.

Schuster, C., Hilfiker, R., Amft, O., Scheidhauer, A., Andrews, B., Butler, J., & Ettlin, T. (2011). Best practice for motor imagery: a systematic literature review on motor imagery training elements in five different disciplines. *BMC Medicine, 9*(1), 75-109. doi:10.1186/1741-7015-9-75

She, W., & T. Morris. (1997). Imagery, self-confidence, and baseball hitting. In *Proceedings of the IX Word Congress of Sport Psychology*, ed. R. Lidor and M. Bar-Elli, 626-628. Netanya, Israel: ISSP

Smith, D., Wright, C. J., & Cantwell, C. (2008). Beating the bunker: The effect of PETTLEP imagery on golf bunker shot performance. *Research Quarterly for Exercise and Sport, 79*(3), 385-391.

Sobierajewicz, J., Szarkiewicz, S., Przekoracka-Krawczyk, A., Jaśkowski, W., & van der Lubbe, R. (2016). To what extent can motor imagery replace motor execution while learning a fine motor skill? *Advances in Cognitive Psychology, 12*(4), 178-191. doi:10.5709/acp-0197-1

Speck, B. (1990). The effect of guided imagery upon first semester nursing students performing their first injections. *Journal of Nursing Education, 29*(8), 346-350.

Suinn, R. M. (1984). Visual motor behavior rehearsal: The basic technique. *Scandinavian Journal of Behaviour Therapy, 13*(3), 131-142. doi:10.1080/16506078409455701

Vadocz, E. A., Hall, C. R., & Moritz, S. E. (1997). The relationship between competitive anxiety and imagery use. *Journal of Applied Sport Psychology, 9*(2), 241-253. doi:10.1080/10413209708406485

Vealey, R. S., & Greenleaf, C. A. (2010). Seeing is believing: Understanding and using imagery in sport. In J. M. Williams (Ed.), *Applied sport psychology: Personal growth to peak performance* (pp. 267-304). New York: McGraw-Hill publishers (p. 272, Fig 14.1).

White, A., & Hardy, L. (1998). An in-depth analysis of the uses of imagery by high-level slalom canoeists and artistic gymnasts. *Sport Psychologist, 12,* 387–403.

Williams, S. E., & Cumming, J. (2012). Sport imagery ability predicts trait confidence, and challenge and threat appraisal tendencies. *European Journal of Sport Science, 12*(6), 499-508.

Table 1

Mean Difference Scores	Imagery	PowerPoint
Time	-10.22 (23.16)	-4.73 (26.84)
Self-Confidence	5.83 (4.66)	4.53 (4.67)
Performance	4.09 (2.28)	2.94 (3.01)
Cognitive Anxiety	-4.96 (3.48)	-4.24 (4.16)
Somatic Anxiety	-4.26 (3.78)	-4.65 (4.33)

Table 2

Mean Difference Scores	Female	Male
Time	-10.63 (26.94)	-1.73 (16.3)
Self-Confidence	5.86 (5.20)	3.92 (2.71)
Performance	3.82 (2.29)	3.08 (3.37)
Cognitive Anxiety	-5.71 (3.56)	-2.17 (3.04)
Somatic Anxiety	-4.71 (4.26)	-3.75 (3.28)

Appendix A: Competitive Trait Anxiety Inventory-2

PRIA Number:

Number:

CTAI-2

Instructions: The following are several statements that performers use to describe their feelings before a performance or competition. Read each statement and circle the appropriate number to indicate how you feel right now—at this moment. There are no right or wrong answers. Do not spend too much time on any one statement.

1. I am concerned about this performance.
2. I feel nervous.
3. I feel at ease.
4. I have self-doubts.
5. I feel jittery.
6. I feel comfortable.
7. I am concerned I may not do as well in this performance as I could.
8. My body feels tense.
9. I feel self-confident.
10. I am concerned about losing or doing poorly.
11. I feel tense in my stomach.
12. I feel secure.
13. I am worried about performing well.
14. My body feels relaxed.
15. I'm confident I can meet this challenge.
16. I'm concerned about performing poorly.
17. My heart is racing.
18. I'm confident about performing well.
19. I'm worried about reaching my goal.
20. I feel my stomach sinking.
21. I feel mentally relaxed.
22. I'm concerned that others will be disappointed with my performance.
23. My hands are clammy.
24. I'm confident because I mentally picture myself reaching my goal.
25. I'm concerned I won't be able to focus.
26. My body feels tight.
27. I'm confident of coming through under pressure.

Scoring: Rate the following on a scale from 1-4: Not at all (1), somewhat (2), moderately (3), very much so (4)

This scale divides anxiety into three components: cognitive anxiety, somatic anxiety, and a related component—self-confidence. Self-confidence tends to be the opposite of cognitive anxiety and is another important factor in managing stress.

To score the CTAI-2, take the scores for each item at face value with the exception of item 14, where you "reverse" the score.

When totaling your rankings, you will arrive at the following three scores: _____ Cognitive Anxiety: (Sum of items 1, 4, 7, 10, 13, 16, 19, 22, & 25) _____ Somatic Anxiety: (Sum of items 2, 5, 8, 11, 14, 17, 20, 23, & 26) _____ Self-Confidence: (Sum of items 3, 6, 9, 12, 15, 18, 21, 24, & 27)

Your scores for each will range from 9 to 36: 9 indicating low anxiety and 36 indicated high anxiety.

Appendix B: Elbow Taping Scoring Evaluation and Checklist

PRIA Number

Pre or post test:

Taping Evaluation Form

- ☐ Has athlete make fist/flex at beginning
- ☐ Places pre-wrap on the arm
- ☐ Starts pre-wrap on the correct spot of mid forearm
- ☐ Ends on the correct spot of the bicep
- ☐ Starts on forearm and ends at bicep with prewrap (distal to proximal)
- ☐ Places white tape anchor on mid forearm
- ☐ Uses two anchor strips that overlap by about a half of a tape width
- ☐ Places white tape anchors on bicep
- ☐ Uses two anchors that overlap by about a half of a tape width
- ☐ Tape anchor strips first on forearm and then on bicep
- ☐ Places the first strip straight up
- ☐ Tapes the first strip of white tape from distal to proximal (forearm to bicep)
- ☐ Places the second strip at an angle that overlaps the first and goes diagonal
- ☐ Tapes the second strip from proximal to distal (bicep to forearm)
- ☐ Places the third strip at an angle the overlaps with the first two and makes an X with the second
- ☐ Tapes the third strip from proximal to distal (bicep to forearm)
- ☐ Places two anchor strips on forearm
- ☐ Use two anchors that overlap by about a half of a tape width on forearm
- ☐ Places two anchor strips on biceps
- ☐ Use two anchors that overlap by about a half of a tape width on biceps
- ☐ Tape anchor strips first on forearm and then bicep
- ☐ Encourages/asks participant to keep arm flexed the entirety of taping
- ☐ Fan has space between tape and elbow
- ☐ Fan crosses at elbow joint
- ☐ Taping begins at correct spot on forearm
- ☐ Taping ends at correct spot on bicep

Total number correct (out of 26):

Time to complete task:

Appendix C: Manipulation Check

PRIA Number:

Were you able to perform the imagery as instructed? Please describe your experience.

Did you have any problems during the imagery sessions? If so, what were they?

Please state any problems that did arise for you in your ability to use imagery:

Appendix D: Guided Imagery Script used for audio

"To begin the guided imagery, you should try to become very relaxed. Find a comfortable position in your seat. Allow yourself to find a position in which you can relax and focus for about five minutes. Let your eyes close and shift your attention inward. Notice the areas of tension in your body and allow them to relax. Release any tightness or tension you are feeling. Now concentrate on your breathing. Take three deep, slow breaths that will fill your lungs and chest with air, breathe in…….. and breathe out……. breathe in…….. breathe out……Good, your mind is relaxed, and ready to start our imagery session.

First, start to create a picture in your mind of the environment in which you will be performing the taping skill. Visualize the room you are in and the objects that are around you. See the tape and pre-wrap setting on the table. Imagine yourself preparing to tape someone's elbow. Imagine what the room and the various elements in the room smell like. Feel the emotions that you want to be experiencing as you perform this skill. You are confident and calm. Take a deep breath and release any anxieties you may be having.

Now visualize yourself beginning the elbow taping skill. To help, you may grab the tape or pre-wrap if you wish. While imagining yourself performing the elbow taping skill, do so as if you are performing the skill yourself on your own body and in real-time.

Begin by picturing yourself asking the person to make a fist and flex as you wrap pre-wrap on their arm, starting on their mid forearm and going up to the bicep. Next, pick up the white tape and feel its texture on your fingers as you place two anchor strips on their forearm, overlapping each by half of the width of the tape. You're wrapping the anchors at an angle that looks like a C that comes together at its ends. Then picture yourself putting the same two anchor strips on the person's bicep, again overlapping the tape by half. Now you have two anchor points, one at the mid forearm and one at the bicep, each with two pieces of tape.

Next, you will use the white tape again and begin by taping from their lower arm to their upper arm with a strip of tape straight up and down. This strip of tape will run from their mid-forearm to their bicep, where the anchors are placed and it will connect the two anchors. Now you tape another strip but this time at an angle, forming one side of an X. You will start at the bicep and attach it at the mid-forearm last. Grab the tape again and go again from the bicep to the mid forearm and tape the other side of the X. Now there are three strips of tape on their arm. One straight up and down and two that form an X with each other.

Now place the first set of closing anchor strips on the person's mid-forearm. Just as you did in the beginning, place two strips at an angle that overlap by about half of the width of the tape. Now move to the participant's bicep and place two anchor strips there as well, overlapping by about half again.

Lastly, imagine the emotions you are feeling as you have successfully completed this task. You have successfully finished the taping skill. Now take three deep breaths and relax. You can open your eyes whenever you feel comfortable."