January 2019

The Time Of Imagery Use And Its' Effect On Performance And Self-Efficacy In College Baseball Players: An Intervention Study

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THE TIME OF IMAGERY USE AND ITS' EFFECT ON PERFORMANCE AND SELF-EFFICACY IN COLLEGE BASEBALL PLAYERS: AN INTERVENTION STUDY

by

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A Thesis

Submitted to the Graduate Faculty

of the

University of North Dakota

in partial fulfillment of the requirements

for the degree of

Master of Science

Kinesiology

Grand Forks, North Dakota

May
2019

This thesis, submitted by Colton Haight in partial fulfillment of the requirements for the Degree of Master of Science Kinesiology from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done and is hereby approved.

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This thesis is being submitted by the appointed advisory committee as having met all of the requirements of the School of Graduate Studies at the University of North Dakota and is hereby approved.

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Title THE TIME OF IMAGERY USE AND ITS' EFFECT ON PERFORMANCE AND SELF-EFFICACY IN COLLEGE BASEBALL PLAYERS: AN INTERVENTION STUDY

Department Kinesiology

Degree Master of Science

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Colton Haight
4/29/2019

Table of Contents

LIST OF TABLES

TABLE

ACKNOWLEDGMENTS

I wish to express my sincere appreciation to the members of my advisory committee for their guidance and support during my time in the kinesiology master's program at the University of North Dakota.

To my mom Tami, my dad Jeff, and my girlfriend Jordan,

Thank you for your continued love and support.

I couldn’t have done this without you!

ABSTRACT

This thesis examined the interaction between the time of imagery use and performance and self-efficacy in college baseball players during a hitting task. Participants (n=24) were randomly assigned to one of 3 conditions: (a) before practice imagery group, (b) during practice imagery group, (c) after practice imagery group. A 3 (imagery group) × 2 (pretest and posttest) repeated measures ANOVA with performance and self-efficacy as the dependent variables was used. Results for performance main effects and interactions were not significant ($p > .05$); means were lower during posttest than pretest but weren't considered significant changes. For self-efficacy, there was a significant time by imagery group interaction ($F\ (2, 21) = 4.67$, $p < .05$). Although imagery has been known to have significant effects on performance and other variables, these findings suggest that imagery had a stronger psychological effect than physical effect in this study.

CHAPTER 1

INTRODUCTION

Imagery is widely used by coaches and athletes and can be defined as: “a psychological activity which evokes the physical characteristics of an object either permanently or temporarily absent from the perceptual field” (Garg, 2010). Over the past few decades, researchers have been striving to understand the use of imagery by athletes, with the ultimate goal being the development of more effective imagery training interventions (Cumming & Hall, 2002). Blair, Hall, and Leyshon (1993) examined the influence of including sport specific imagery with physical practice in novice and elite soccer players and found that participants in the imagery group significantly increased their performance on the field. There has been enough research on imagery to know that it works and has multiple uses. However, minimal to no research has been done on the most effective time to use imagery, or with baseball players.

Imagery is a psychological skill that is known for its’ performance enhancing effects on athletes of all ages and sports. It requires the use of all appropriate senses to create or re-create an image or experience in the mind (Wraga & Kosslyn, 2002). For example, a baseball hitter sees the ball being released by the pitcher (visual), feels the muscles in his upper arm as he begins the swing (kinesthetic), and hears the crack of the bat (auditory) (Weinberg, 2008). In sport, visual and kinesthetic imagery ability have been examined extensively. Not only do better imagers use imagery more effectively in sport but when athletes increase their use of imagery, their imagery ability improves (Rodgers, Hall, & Buckolz, 1991). In this section, five theories are outlined to provide some light on how imagery works and effects sport performance.

The psychoneuromuscular theory, or muscle memory, was developed by Carpenter in 1894. This theory proposes that imagining a movement produces nerve impulses from the brain to the muscles to achieve a movement identical to those in physical practice. For example, a baseball hitter might imagine himself swinging a bat, which would activate the muscles required to swing, such as the shoulders and forearms, although the nerve impulses aren't as strong as the physical performance of the skill. In other words, the psychoneuromuscular theory is centered on the activation of muscles during imagery and facilitates the performance and learning of the movement (Frank, Land, Popp, & Schack, 2014).

Another theory that helps to explain the effectiveness of imagery is the symbolic learning theory developed by Sackett in 1934. The symbolic learning theory is that imagery develops mental blueprints for a skill in the central nervous system. In other words, mental imagery works because a person can plan their actions in advance. The learning of a goal or a skill is considered cognitively before the need of a physical response. A study done by Feltz and Landers (1983) found that participants who used imagery performed consistently better on tasks that were primarily cognitive than those that were primarily revolved around motor skills.

Lawther (1968) developed the next theory, the gross framework theory, which states that athletes with previous experience in a task develop a mental framework of the movements involved in the task (Smith, 1987). In a study done by Clarke (1960), participants were 144 varsity, junior varsity, or novice performers. Imagery practice proved to be almost as effective as physical practice in the experienced performers but not the novice group. This result provides support for the gross framework theory. The more experience an athlete has, the more effective imagery training will be in helping to improve motor skills.

Another imagery theory, the bioinformational theory, is more cognitive driven. Developed by Lang in 1979, the bioinformational theory is that images should be viewed as part of the information processing abilities of the brain, as they contain stimulus and response propositions that elicit a physiological response. Williams, Cooley, and Cumming (2013) tested this theory in novice golf putters and found performance improvements. They also found an increase in imagery ability as the study went on.

The last theory, Ahsen's (1984) triple-code theory, focuses on the personal meaning of the content being imaged to the individual. Each image has a significant meaning to the individual and can have different effects on different people. The same image can be viewed by multiple people but can be interpreted very differently across athletes (Martin, Moritz, & Hall, 1999). For example, a baseball hitter might have greater self-confidence when he is up to bat with the bases loaded in the bottom of the 9th inning and down by one run. He might get excited about having the opportunity to win the game. However, a different hitter might view the same image as stressful and feel anxious.

To explain how imagery effects psychological constructs like efficacy and performance, Holmes and Collins (2001) developed the PETTLEP model, which aims to aid practitioners in producing functionally equivalent mental stimulation. PETTLEP is an acronym for seven important components to consider when conducting motor-based imagery interventions, these include: physical, environmental, task, timing, learning, emotion and perspective. The physical component relates to the athletes physical response in a situation. For example, a hitter visualizes himself at the plate during an at-bat while physically holding the bat in his hands. A baseball player performing imagery in the batter's box at the field he'll be playing at is also part of the physical component. The environment component refers to the environment in which imagery is performed. A baseball catcher might perform imagery while standing on dirt, or looking at a photograph of home plate to make the environment as game-like as possible. The task component needs to be closely related to the thoughts and feelings of the physical performance. For example, a baseball hitter needs to be able to create an at-bat in their head that closely mimics the thoughts and feelings of a plate appearance during competition. The next component, timing, is very important to consider during imagery sessions. As athletes get older, the speed of the game gets faster. Regardless of the skill that is being learned, athletes should try to perform the skill at similar speeds as they would in a game. The learning component refers to what stage of learning the athlete is at, distinguishing between cognitive or autonomous. For an athlete that is in the cognitive stage, they might focus more on imaging the mechanics of the movement; whereas an athlete who is in the autonomous stage might focus more on the feeling of the movement instead of technique because they don't have to think about the execution as much. The emotion component refers to an athlete incorporating all of the positive emotions that are associated with arousal into their imagery sessions. For example, providing a personalized, emotion driven imagery script can provide a more vivid experience for the user. The perspective component has to do with the way imagery is viewed, such as from an internal or external view. Internal, or 1st person imagery is viewed from the vantage point of the performer, external, or 3^{rd} person imagery, is viewed from the vantage point of a spectator (Smith, Wright, Allsopp, & Westhead, 2007). It might be more beneficial to use both perspectives when performing imagery, especially during one-shot imagery interventions.

A one-shot imagery intervention is when the individual only performs a single bout of imagery. From a research perspective, data collection occurs before and after the intervention. Intuitively, we would believe that for something to be effective, it generally takes time. Thus, some researchers have asked the question of whether one-shot imagery interventions really work? Results from a review by Cooley, Williams, Burns, and Cumming (2013) showed that they do. Seventeen out of the 20 imagery interventions had a significant effect on performance and various psychological variables (e.g., self-efficacy, motivation, mental toughness, etc.). However, the duration of the intervention also played a significant role. Results showed a major increase in performance the longer the intervention was.

The amount of time imagery was used ranged from 9 minutes to 12 hours and 50 minutes over the course the interventions, while data collection ranged from 3 to 16 weeks in length.

Imagery ability and imagery content (what is imaged) play a pivotal role in explaining imagery's effectiveness. Though performing imagery successfully is difficult for some individuals, everyone has the ability to image (Paivio, 1985). Williams and Cumming (2011) explained that imagery ability can be measured by any number of characteristics that represent someone's capacity to form, maintain, and transform images. It has become a common theme for researchers to evaluate imagery ability while performing imagery-based interventions as a screening tool. Numerous researchers have reported results demonstrating that individuals with better imagery ability experience more benefits (Cumming & Williams, 2013). Robin et al. (2007) showed that although all athletes in their study improved their tennis serve accuracy following imagery with physical practice, those who had higher imagery ability had greater improvements.

Every individual uses imagery in different ways. For that reason, it's important for athletes to understand the "where," "when," and "why" when it comes to imagery usage (Munroe-Chandler, Hall, Fishburne, & Strachan, 2007). Where athletes image depends on the person themselves; some people find using imagery at home or at work most effective, while others prefer to do it in the place they'll be performing. However, imagery can be used almost anywhere. When athletes use imagery (timing) is critical for maximizing its effect. Researchers (Munroe, Hall, Simms, & Weinberg, 1998) have shown that using imagery before practice or competition has a larger impact on performance, although positive effects have been shown from using imagery during and after competition as well. There are many reasons athletes might image. Most athletes use imagery for personal gain or their own achievements, depending on the desired outcome (Cumming & Williams, 2013). However, imagery has been known to be a primary cause for increased motivation and team accomplishments (Guillot & Collet, 2008). For example, athletes might use imagery to help relieve stress and improve motivation to accomplish a task. They might also perform imagery interventions to help their team win games or championships (Munroe-Chandler et al., 2007).

The conceptual framework proposed by Paivio (1985) classifies imagery as cognitive or motivational in nature, operating at specific or general levels. This 2 by 2 framework results in four types of imagery content: cognitive specific (CS), cognitive general (CG), motivational specific (MS), and motivational general (MG). MG imagery has been split into two sub-categories: motivational general-arousal (MG-A) and motivational general-mastery (MG-M) (Hall, Mack, Paivio, & Hausenblas, 1998). CS imagery is where an individual images the performance of a skill or a movement. CG Imagery involves an individual imaging strategies or routines needed to be successful in a given sport. MS imagery is the visualization of an individual's goals and achievements, while MG imagery involves images of achievements and mastery of a skill or sport. MG-A and MG-M are similar but have two distinct differences: MG-A is associated with managing stress and anxiety during competition, while MG-M focuses on confidence and success in competition and what you need to do to achieve it. A baseball pitcher might use MG-A imagery in the dugout before a start on game day to help them breath and calm the nerves. They might also use MG-M imagery before a game to help them feel confident about what they need to do to be successful, such as changing location and speed on their pitches. Applying the proper type of imagery to a task is critical in achieving the desired outcomes (Martin et al., 1999). For example, using CS imagery to learn basic baseball throwing mechanics is optimal for being able to throw the ball accurately to the target. Using CG imagery to improve throwing mechanics wouldn't be ideal, due to its' primary function being improving strategies and routines in a given sport, although crossover effects do occur (Short, Monsma, & Short, 2004). On the motivational side, an example would be using MG-M to achieve the feeling of confidence and being in control of your movements (Slimani, Chamari, Boudhiba, & Chéour, 2016).

Researchers have shown imagery to serve multiple functions, one being to increase levels of confidence/self-efficacy (Cumming & Williams, 2013). Bandura (1977) defined self-efficacy as "people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives" (p. 191). For example, pitchers in baseball need to believe in their abilities to get a hitter out. They need to have a firm belief that they can put any pitch where they want to at any time in any count. Interventions designed to improve confidence should also have desirable performance effects (Cresswell & Hodge, 2004) as self-efficacy has been known to be a strong predictor of performance in athletes (Feltz, Short, & Sullivan, 2008). For example, a hitter in baseball who has high levels of confidence (efficacy) before competition is more likely to perform better on the field. Confidence is the most important psychological state to affect performance in sport (Feltz et al., 2008). A study done by George (1994) examined the effect of self-efficacy, anxiety, and effort questionnaires on hitting performance in 53 high school and college baseball players. The high school players showed signs of greater anxiety than the college players which hindered their performance. Self-efficacy and effort scores reported much higher in the college players than the high school players, which translated to better performance. Self-efficacy has shown to be a good predictor of performance, however, little research has been done that includes imagery as a potential variable in baseball player studies.

Several studies have been conducted to assess the relationship between imagery and self-efficacy in other sports. Researchers have shown that imagery can increase self-efficacy, and there is a positive correlation between imagery use and self-efficacy (see a review of self-efficacy based interventions, Ross-Stewart & Short, 2009). For example, in a lab-based golf putting study (Short, 2002), researchers examined the interaction between CS and MG-M imagery and imagery direction on self-efficacy and performance; the results showed an increase in self-efficacy from pre-test to post-test.

Researchers have also demonstrated positive performance effects from pre-competition imagery use. Pain, Harwood, and Anderson (2011) used five soccer players during a 19-week competitive season. Personalized imagery and music scripts were given during the players' prematch warm-ups to examine its' effect on performance and self-efficacy. Performance was measured immediately after each match. Results showed that the music and MG-M imagery when combined had a significant effect on performance and flow in each athlete. Players' comments after the experiment supported these findings and suggested that interventions have positive effects on athletes when used before competition.

There's one major component of "when" athletes use imagery that is still unclear; what is the best time to perform imagery relative to practice (before, during, or after)? The purpose of this study was to examine if there is a difference in self-efficacy and performance of athletes depending on if they use imagery before, during, or after practice. Based on past research (Hall, Rodgers, & Barr, 1990; Munroe, Hall, Simms, & Weinberg, 1998), it was hypothesized that using imagery before practice or competition would have a larger effect on performance, compared to using it during or after competition.

CHAPTER 2

METHODS

2.1 Participants

Participants were 24 male intercollegiate baseball players from the University of Minnesota-Crookston. There was a 100% participation rate from eligible athletes. Meaning, all athletes that were invited to participate in the study did. Pitchers were excluded from the study due to the very low amount of at-bats they receive during games. The University of Minnesota-Crookston is a member of the Northern Sun Intercollegiate Conference (NSIC), a division II conference for baseball. The participants ranged in age from 18-22 years old ($M = 20.17$, $SD = 1.34$). Participants recorded their skill level on a 5-point Likert scale using a scale anchored by 1 (*pretty bad hitter*), 3 (*average hitter*), 5 (*pretty good hitter*). Fifteen out of the 24 hitters considered themselves to be very good hitters, while the remaining 9 hitters considered themselves to be average. Other background data that was collected included handedness (right or left handed) and frequency of hitting practice (how often a player comes in to hit). Fourteen participants were right-handed and 10 were left-handed. Every participant recorded a "yes" when asked if they come in every day for extra hitting practice.

2.2 Measures

2.2.1 *Sport efficacy questionnaire (SEQ).* The Self-Efficacy Questionnaire used in this study was based off the recommendations by Feltz et al. (2008). The SEQ was a 10-item questionnaire that included items relating to performance. Participants recorded the strength of their belief that they could hit 1 out of 10 balls hard (2 out of 10, 3 out of 10, etc.) on a 10-point Likert scale from 0 (*Not at all*), 1 (*Low confidence*), and 10 (*High confidence*). A hard ball was defined as any swing that resulted in an exit velocity equal to or greater than the average exit velocity from the first round of batting practice (described below). SEQ scores were computed by adding the item responses. Scores could range from a low of 0 to a maximum score of 100. A score of 50 or higher indicates an individual who has moderate to high levels of self-efficacy. The SEQ was found to be highly reliable with a Cronbach's Alpha (α) of .92.

2.2.2 ***Sport imagery ability questionnaire (SIAQ; Williams & Cumming, 2014).*** The SIAQ is a 15-item questionnaire designed to assess a person's cognitive and motivational imagery ability using sport specific images. Participants recorded how easy it was for them to generate images on a scale of 1 to 7 anchored by 1 (*very hard to image) and* 7 (*very easy to image*). The SIAQ consists of two subscales: emotion/mentality and performance. Scores can range from a low score of 15 to a maximum score of 105. Scores that range from 75-105 suggest that the participant has high imagery ability. Cronbach's Alpha was calculated and analyzed for each subscale. The emotion and mentality subscale consisted of 7 items (α=.74), and the performance subscale consisted of 8 items (α=.71). As a whole, the imagery ability questionnaire was found to be reliable (15 items; α=.79).

Additional questions were asked regarding the imagery intervention as a manipulation check. Participants were asked how accurately they were able to follow the imagery script on a 5-point Likert scale from 1 (*not very accurately*) to 5 (*very accurately*). Participants were also asked to assess how difficult or easy it was for them to see (visual) or feel (kinesthetic) the images in the script. Participants were also asked if they performed the imagery to the best of their ability) and if the imagery script was easy to follow. If they responded "No" to either of these questions, they were asked to explain their reasoning.

2.2.3 *Hitting performance.* Performance was measured by adding the number of each participant's hard-hit-ball total after each round of 10 swings. A radar gun was used to track exit velocity to determine the number of "hard hit balls" each participant had. The exit velocity used to determine whether a ball was hit hard differed for each individual, depending on their average exit velocity during their baseline performance test.

2.3 Procedure

Approval to conduct this study was granted by the Institutional Review Board of the University of North Dakota. Prior to participating in the baseball-hitting task, all participants completed an informed consent form explaining the purpose of the study and giving permission to participate. Similar to the procedure of Short et al. (2002), participants completed the SIAQ (Williams & Cumming, 2014) in their team classroom. Only the individuals with average imagery ability scores of at least 5 or higher (*somewhat easy to image*) were contacted after data was collected. No participants were excluded from the study, as they all averaged a 5 or higher on the SIAQ. Participants arrived at the turf room at a prearranged time. To protect confidentiality and remove potential bias, the procedure was explained by someone not involved with the team or the coaching staff.

First, each participant hit 10 balls as a baseline measure to calculate the average exit velocity, followed by another block of 10 balls at the same distance of 35 feet from the screen. Based upon the number of balls that were hit hard in the second round (number of balls above their average exit velocity), the distances that were used for the remainder of the study were assigned (i.e., 8 or more hard hit balls, assigned 25 feet from the screen; 6 hard hit balls, assigned 30 feet from the screen; 4 hard hit balls, assigned 35 feet from the screen; 2 or less hard hit balls, assigned 40 feet from the screen). This method of assigning distances was used to increase/decrease velocity to make the task harder/easier. Doing so assures some form of variability in self-efficacy and performance levels. The SEQ was then completed with the assigned distance in mind. Participants then completed in hitting trials, and the final SEQ was given after the third round of batting practice. Questions regarding the intervention were asked following the second SEQ.

Participants were randomly assigned to one of 3 groups; one group performing imagery before practice, one during practice, and one after practice. Every group used the following CS/MG-M+facilitative imagery script:

Begin to remember the best game you've ever played…where it was, your teammates, all of the sights and sounds of it. Feel the excitement you felt, the power, being in control of your movements, like no one could ever get *you out. Begin to think about yourself in the batters box…how the dirt felt beneath your cleats…digging your back cleat into the clay…the excitement and butterflies you had being up to bat with the game on the line. Begin to see yourself staring the pitcher in the eyes…thinking there's no way he going to beat you. Start to visualize the pitch you want…the location you want it in. Feel yourself get in a good hitting position as the pitcher gets ready to throw the ball...see the pitcher start his wind-up. Begin to feel your weight shift back…your hands separate…and take your short stride as the pitcher delivers the ball…he throws it in that exact spot. Feel the barrel of your bat stay above your hands as your start your swing…your hands staying inside the ball as you make contact...you feel yourself getting extension as you drive the ball over the left-center field wall. Hear the crowd cheer as you're rounding the bases…giving you all the confidence in the world. Feel yourself touch home plate…see your teammates come congratulate you and how it made you feel. Remember this feeling…remember what makes you successful…remind yourself that you're a good and confident hitter…believe in yourself and your ability…like no one will ever be able to get you out.*

Participants were instructed to use as many of the components from the PETTLEP model developed by Holmes and Collins (2001) as possible. For example, the athletes held a bat in their hand (physical), stood in the batter's box (environmental), used the imagery script for task-related images (task), performed at game speed (timing), focused on the feeling of the swing rather than the mechanics (learning), as well as the positive emotions associated with hitting a ball hard (emotion). They used whatever perspective they wanted to, although the script encouraged a 1st person point of view (perspective). The entire procedure is outlined in Table 1.

Table 1. Intervention Layout

Before Practice Group	**During Practice Group**	**After Practice Group**
Completion of SIAQ	Completion of SIAQ	Completion of SIAQ
Shown the distance they would hit from	Shown the distance they would hit from	Shown the distance they would hit from
Baseline performance for exit velocity	Baseline performance for exit velocity	Baseline performance for exit velocity
Complete the SIQ	Complete the SIQ	Complete the SIQ
Perform imagery	Complete 1st performance measure	Complete 1st performance measure
Complete 1st performance measure	**Perform imagery**	Complete 2nd performance measure
Complete 2nd performance measure	Complete 2nd performance measure	**Perform imagery**
Complete 2nd SEQ	Complete 2nd SEQ	Complete 2nd SEQ
Complete the follow-up imagery questions	Complete the follow-up imagery questions	Complete the follow-up imagery questions

CHAPTER 3

RESULTS

Descriptive data for self-efficacy and performance based on their imagery group can be found in Tables 2 and 3. Effect sizes were calculated for each group (pre- and post-test differences) using Cohen's *d*. Effect sizes .80, .50, and .20 can be considered as large, moderate, or small in size.

Table 2. Descriptive Statistics and Effect Sizes for Performance According to their Imagery Group

	Pretest Performance		Post-test Performance		Cohen's *d*
	Mean	SD	Mean	SD	
Before practice imagery	78.56	4.69	76.45	7.32	-.18
During practice imagery	76.65	4.85	72.33	7.20	-.35
After practice imagery	76.08	5.46	75.65	7.08	-.04
Total	77.10	4.91	74.81	7.12	-.20

Note. Cohen's *d* is negative if there was a decrease from pretest to post-test, and positive if there was an increase from pretest to post-test.

Table 3. Descriptive Statistics and Effect Sizes for Self-Efficacy according to their Imagery Group

	Pretest Self-Efficacy		Post-test Self-Efficacy		Cohen's d
	Mean	SD	Mean	SD	

Before practice imagery	7.69	1.60	7.05	2.15	-.33
During practice imagery	7.56	1.40	7.94	1.41	.27
After practice imagery	7.53	1.43	8.19	1.41	.46
Total	7.59	1.41	7.73	1.69	.09

Note. Cohen's *d* is negative if there was a decrease from pretest to post-test, and positive if there was an increase from pretest to post-test.

A 3 (imagery group) × 2 (pretest and posttest) repeated measures analysis of variance (ANOVA) examined the effect that time of imagery use had on performance in before, during, and after practice conditions. The results indicated that the time × imagery group interaction was not significant: F (2, 21) = 1.15, $p > .05$. The main effect for mean performance scores from pretest to posttest F (1, 21) = 4.73, $p < .05$ and the main effect for imagery group F (2, 21) = .57, $p > .05$ were not statistically significant. The total mean was higher during the baseline performance round than the posttest performance round which resulted in a negative Cohen's *d* (-.20).

A 3 (imagery group) × 2 (pretest and posttest) repeated measures analysis of variance (ANOVA) examined the effect that time of imagery use had on self-efficacy in before, during, and after practice conditions. The results indicated that the time × imagery group interaction was statistically significant ($F(2, 21) = 4.67$, $p < .05$). Imagery use increased self-efficacy scores from pre-test to post-test for the during and after practice imagery groups, but not for the before practice imagery group.

Qualitative data was collected following the intervention. The participants were asked how accurately they were able to follow the imagery script, how difficult or easy it was for them to see or feel the images in the script, and if they performed the imagery to the best of their ability. Each participant reported that they were able to accurately follow the imagery script and that it was very easy to perform. The participants also mentioned that they were easily able to feel and visualize the images mentioned throughout the script.

CHAPTER 4

DISCUSSION

This study examined the effects of imagery on self-efficacy and performance. Specifically, the time imagery was used during a practice was manipulated. The results showed that regardless of time used, imagery decreased the performance of baseball hitters, and that the time imagery was used differentially effected self-efficacy where using it during or after practice increased self-efficacy, compared to using it before practice.

The finding that imagery did not positively affect performance was surprising. However, some methodological issues may have caused this result. In this study, the maximum distance a player had to hit from was 40ft. In a game-like setting, the actual distance from the front of the pitching rubber to the point of home plate is 60ft 6in. In this situation, it may have been more beneficial for the player to image himself being successful in a BP (batting practice) setting, instead of a game like situation. It may also be that that they were only exposed to game-like imagery for a short period of time (1 minute and 30 seconds). It might be that one-shot imagery interventions of a short duration work better for enhancing self-efficacy than actual performance, after a warm-up session. Longer bouts of imagery exposure have shown to have more significant effects on performance, compared to shorter imagery scripts (Cooley et al., 2013)

A review by Cooley et al. (2013) showed that longer bouts of imagery had more significant effects on performance. In their results, the total duration that participants engaged in imagery within a single session ranged from approximately 1 min 40 s to 11 min, and a moderate, positive correlation was found between the total imagery use within a single session and intervention success. The intervention used in this study was very much on the short side in regards to imagery exposure, given that the imagery script was 1 min 30 s in length. The decreases in performance may also be a result of a radar gun error, or the fact that hitting a baseball is an open-skill, compared to a closed skill. Radar guns require a couple different variables to be present in order to achieve accurate measurements. First, pitch location and the accuracy of the barrel of the bat must be in the right location in order to hit the ball in the right trajectory. If a player hits the ball at an upward angle, the measurement will be less accurate than if the ball was hit on a line. Hitting a baseball is one of the hardest skills to master in sports, due to a constantly changing environment and minimal reaction time. Barrow, Weigland, Thomas, Hemmings, and Walley (2007) explained that athletes in open-skill sports such as baseball primarily use MG-A and MG-M imagery, compared to athletes in closed-skill sports who scored higher on CS and MS imagery scales. It could be that more complex tasks such as hitting a baseball require more extensive imagery use, instead of a one-shot imagery intervention.

Short et al. (2002) provided two additional explanations for the decrease in performance. In their study involving a golf putting task, they had the participants perform imagery before each putt, as well as focus on accuracy during the script (sinking the putt). In baseball, it's natural for hitters to perform imagery before every pitch. However, in this study, the participants only performed imagery once and it focused on strength (number of hard hit balls), not accuracy. There is limited research involving strength gains using imagery, which could suggest that physical fatigue may have set in during the final rounds of BP. Perhaps using an image of strength (making the participant feel strong) would have been more useful.

The results for self-efficacy showed that imagery use increased self-efficacy scores from pre- to post-test for the during and after groups, but not for the before group. First, this result is consistent with all other researchers who have found that using imagery can increase self-efficacy (Feltz et al., 2008), and further supports Bandura's theory (Bandura, 1998). The breakdown of when imagery was used showed interesting results. It raises the question as to whether a warm-up session is necessary prior to imagery use in a field setting, such as this one. A proper warm-up is necessary before physical participation in any task. One could conclude that a mental warm-up before performing imagery would have the same effect (breathing techniques, visualization, etc.). Despite the decrease in performance in this study, the increase in self-efficacy is encouraging. If a bad practice occurs, players can use imagery as a way to increase their confidence and well-being and still find a way to feel good about their performance.

There may be additional procedural limitations that can aid future researchers. As mentioned, the content of the imagery script was game-like, although the performance measure was a practice session. It might be helpful to investigate the effect of manipulating imagery content (someone imaging themselves hitting in a BP setting vs someone imaging themselves in a game setting), as well as perform imagery in between each swing. Also, using a pitching machine, instead of manually throwing balls for batting practice, would keep the performance task standardized. Pitching machines can be set at constant speeds and locations, which limit the variability of pitch velocity and human error. Recording the imagery script, such as in this study, is also an easy way to limit variability.

Given the numerous studies performed on imagery interventions, we know that imagery is a successful confidence and performance enhancement tool (e.g., Short et al, 2002; Blair, Hall, Leyshon, 1993; Mills, Munroe, Hall, 2000; Robin et al, 2007). Due to the lack of imagery research using baseball players, researchers should consider analyzing the psychological and performance results of players at different age levels using the previously suggested limitations of this study. Baseball is a physically, mentally taxing game, and coaches and players are always seeking innovative ways to gain an edge on the competition.

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