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NEGATIVE IMAGERY AND PERFORMANCE: SEARCHING FOR BIASING EFFECTS AND A COGNITIVE INTERVENTION STRATEGY

By

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ABSTRACT

NEGATIVE IMAGERY AND PERFORMANCE: SEARCHING FOR BIASING EFFECTS AND A COGNITIVE INTERVENTION STRATEGY

By

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The purpose of the present investigation was to examine the effects of negative imagery on putting performance, to search for systematic biasing effects, to determine the effectiveness of positive imagery as a cognitive intervention strategy, and to identify the influence of imagery ability. Sixty-four college students (45 males, 19 females) were blocked for imagery ability (high, low), then randomly assigned to one of four conditions prior to performing the pre-post putting task: negative imagery, positive followed by negative imagery, negative followed by positive imagery, or control. The results provided partial support for the use of positive imagery as a cognitive intervention strategy, as well as for the existence of systematic biasing effects of negative imagery on putting direction. Neither putting performance nor putting direction were influenced by imagery ability. Results and their implications are discussed, and future research directions are offered.

DEDICATION

To my mother, Eva Afremow

ACKNOWLEDGMENTS

I wish to thank my advisor, Dr. Lynnette Overby, for all her assistance and support for this project. I have greatly appreciated your guidance and generous availability. You have contributed much to my understanding of mental imagery.

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To my father, Arthur, and my sister, Nancy, thank you for everything. I love you both and would not have been able to finish my thesis and my master's degree at Michigan State without your support and encouragement.

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Finally, I thank all those I met here on my journey and who helped me, directly or indirectly, to cross this finish line. I want to particularly mention Anthony Kontos, and Mick and Lynn Collins for being such good friends.

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CHAPTER I

INTRODUCTION

Nature of the Problem

The use of mental imagery as a tool to enhance the learning and performance of motor and sport skills has been a topic of much interest to sport psychologists, coaches, and athletes. Imagery is routinely used by elite and non-elite athletes in both individual and team sports. Several investigations have documented and assessed the use of mental imagery by athletes competing in individual or team sports at varying competitive levels (e.g., Barr & Hall, 1992; Hall, Rodgers, & Barr, 1990; Orlick & Partington, 1988; Salmon, Hall, & Haslam, 1994).

Testimonials from many famous athletes on the important role imagery has played in helping them achieve their athletic success adds experiential or anecdotal evidence to the numerous empirical research findings supporting imagery use. For example, golf great Jack Nicklaus states that he never hits a shot without first using imagery (Neal, 1976). Meta-analyses of the mental practice literature (Driskell, Copper, & Moran, 1994; Feltz & Landers, 1983) have concluded that mental imagery is an effective means of enhancing performance. In addition, many variables that either mediate (e.g., imagery ability) or moderate (e.g., type of task) the relationship between imagery and performance have been identified (e.g., Feltz & Landers, 1983).

Image outcome is one factor that mediates the effectiveness of preperformance imagery rehearsal (Murphy & Jowdy, 1992). Specifically, image outcome refers to

whether the imagery rehearsal of a task includes a successful end result (positive imagery) or an unsuccessful end result (negative imagery). Thus, imagery can work in a negative way, just like it can in a positive way, and this outcome component of an image plays an important role in determining whether imagery enhances or degrades subsequent performance (Woolfolk, Murphy, Gottesfeld, & Aitken, 1985a; Woolfolk, Parish, & Murphy, 1985b). This finding is notable because studies that have examined imagery use have reported that athletes at times image themselves performing incorrectly and/or unsuccessfully in competition (e.g., Barr & Hall, 1992; Hall et al., 1990; Orlick & Partington, 1988). There is a need, therefore, to examine the effects of both positive and negative imagery on the performance of motor and sport skills. Unfortunately, there is a paucity of studies which have explored the effects of negative imagery.

Powell (1973) compared the effects of positive and negative imagery rehearsal using a dart throwing task. Results showed that subjects in the positive imagery group (imaging the dart landing near the center of the target) improved their performance, whereas subjects in the negative imagery group (imaging the dart landing near the edge of the board) showed a decrease in performance. Woolfolk et al. (1985b) investigated the effects of preperformance positive and negative imagery rehearsal using a golf putting task. The results were consistent with Powell's findings in that positive imagery (sinking the putt) enhanced performance, whereas negative imagery (missing the putt) inhibited performance. Woolfolk et al. (1985a) extended the Woolfolk et al. (1985b) study by investigating the influence of the performance versus outcome components of preperformance imagery, and possible interactions among these components, on golf

putting performance. Similar to the findings from the above studies, the negative imagery conditions (negative outcome with performance, negative outcome only) resulted in a deterioration in performance. However, in contrast, the positive imagery conditions (positive outcome with performance, positive outcome only), as well as the performance only condition, failed to enhance performance. These researchers suggested that perhaps negative imagery is more powerful in inhibiting performance than positive imagery is in facilitating it.

The results from the above studies clearly demonstrate that instructions to image an unsuccessful outcome are harmful to subsequent performance. However, other than a general deterioration in performance, any additional effects of the negative imagery manipulation on performance are unknown. Moreover, an adequate theory explaining how negative imagery might harm performance is lacking (Murphy, 1994).

Johnson (1982), using a linear positioning task, demonstrated that "incorrect" images can have systematic biasing effects (in both direction and magnitude) on the recall of a previously learned movement. For example, if subjects learned to move a slide 30 cm, but then imagined moving the slide 60 cm, they showed a systematic tendency towards longer movements in recall, and vice versa. This finding raises the very interesting question of whether negative imagery, in addition to a general deterioration in performance, also produces systematic biasing effects on performance in accordance with the particular nature of the outcome component. In other words, would imaging missing a golf putt to the left of the cup increase the tendency to miss the putt in this direction?

In an effort to increase our understanding of the precise effects of negative imagery and in turn, shed light on how negative imagery harms performance, the present study investigated this issue by controlling precisely, in contrast to Powell (1973) and Woolfolk et al. (1985b), how subjects in the negative imagery conditions are to image missing the target (to the left of the cup) and to record whether this results in a greater percentage of being missed to the left of the cup.

Given the consistent findings demonstrating the deleterious effects of negative imagery on motor skill performance, it is important to consider ways in which the harmful effects of these images can be prevented or reduced when they occur (Woolfolk et al., 1985a). One plausible strategy is to counterbalance the negative image by preceding or following it with a positive image prior to performance. If negative imagery is more powerful at inhibiting performance than positive imagery is at improving performance, as suggested by Woolfolk et al. (1985a), then this strategy may reduce rather than completely block damage to subsequent performance. The present study tested the success of this intervention by employing a negative imagery (N), a positive followed by negative imagery (P-N), a negative followed by positive imagery (N-P), and a control group (C).

Individual differences in imagery ability is perhaps one of the most critical factors influencing the effectiveness of imagery on motor skill performance (Hall, Buckolz, & Fishburne, 1992). Studies using various assessment instruments have found a positive relationship between imagery ability and motor skill performance (e.g., Issac, 1992; Goss, Hall, Buckolz, & Fishburne, 1986). However, these studies employed images that

were correct or successful and neglected to explore the role that imagery ability plays in performance when the images are incorrect or unsuccessful. If we assume that negative imagery effects performance along the same lines as positive imagery, it would follow that a negative relationship between imagery ability and motor skill performance would occur with negative images. If so, higher skilled imagers would experience a greater decline in performance than lower skilled imagers when exposed to negative images. This prediction was examined in the present study using the Movement Imagery Questionnaire-Revised (MIQ-R; Hall & Martin, 1997), a revision of the MIQ (Hall & Pongrac, 1983), to assess visual and kinesthetic movement imagery ability.

Statement of the Problem

The aim of this study was to advance negative imagery research in four ways. First, following the work of Woolfolk et al. (1985b), this study extended the examination of the effects of negative imagery on motor skill performance to a natural setting. Second, in this study we investigated for the presence of a systematic biasing effect of negative imagery on performance. Third, we investigated whether positive imagery can successfully prevent negative imagery from degrading subsequent performance. Finally, to determine the influence of imagery ability on performance when exposed to negative images.

Hypotheses

The following hypotheses were tested in this study:

1. Participants in the negative imagery group (N) will experience a significant decrease in putting performance from pre- to posttest.

2. Participants in the negative imagery group (N) will make significantly fewer putts from pre- to posttest in comparison to the positive followed by negative imagery (P-N), negative followed by positive imagery (N-P), and control groups (C).

3. Participants in the negative imagery group (N) will experience a significant increase in the number of missed putts to the left of the cup from pre- to posttest.

4. Participants in the negative imagery group (N) will miss significantly more putts to the left of the cup from pre- to posttest in comparison to the positive followed by negative imagery (P-N), negative followed by positive imagery (N-P), and control groups (C).

5. There will be a negative relationship between imagery ability and putting performance on the posttest for participants in the negative imagery group (N).

Delimitations

This study was limited to students at a large midwestern university. Although participants were enrolled in a beginning or intermediate golf class, they cannot be considered elite golfers. Thus, the results of this study may not generalize to elite or for that matter completely novice golfers. Moreover, given that only a relatively brief imagery training session was employed, a systematic imagery training program over an extended period of time may have produced different results. This study did not address

any possible differences between the effects of negative imagery on performance resulting from the spontaneous occurrence of negative imagery during actual performance, inadvertent negative imagery as the result of attempted positive imagery rehearsal, or intentional preperformance negative imagery of the type this study employed. Finally, it was assumed that participants would respond honestly to all items on the MIQ-R and post-experimental questionnaire.

Rationale for Putting Task

Golf putting provides an excellent vehicle to investigate the effects of outcome imagery on motor skill performance. Putting is a closed motor skill in that it is self-paced and performed in a relatively predictable and stable environment. Consequently, closed motor skills are generally easier to image in comparison to open motor skills which are less predictable and often require one to react to unanticipated events. Further, a putting task provides an ideal opportunity to explore systematic biasing effects and changes in performance. Participants in this study rehearsed negative images which involved imaging missing the putt to the left of the cup. Whether a putt was sunk or not, as well as the direction of a missed putt, was readily recorded.

Definitions

Mental Imagery

Mental imagery, in the field of exercise science, is the intentional use of the senses to mentally rehearse performing a particular sport skill or movement sequence in the absence of, or in combination with, overt physical movement (Afremow, Overby, & Vadocz, 1997).

Mental Practice

Mental practice refers to the rehearsal of a mental technique (e.g., self-talk) and may or may not involve mental imagery (Murphy & Jowdy, 1992).

Preperformance Imagery

Preperformance imagery refers to imagery rehearsed immediately prior to physical performance (Budney & Woolfolk, 1990).

Positive Imagery

Positive imagery refers to an image having a success outcome component (Murphy & Jowdy, 1992). For purposes of the present study, imaging the golf ball dropping into the cup is considered a positive image.

Negative Imagery

Negative imagery refers to an image having a failure outcome component (Murphy & Jowdy, 1992). For purposes of the present study, imaging the golf ball not dropping into the cup is considered a negative image.

Internal Imagery

Internal imagery refers to imagery that is experienced from the perspective of inside the performer's own body and simulates the sensations of actually performing (Mahoney & Avener, 1977).

External Imagery

External imagery refers to imagery that is experienced from the perspective of outside the performer's own body and is similar to watching a performance on TV (Mahoney & Avener, 1977).

Visual Imagery

Visual imagery involves recreating the sensation of sight in the absence of external stimuli (Vealey & Walter, 1993).

Kinesthetic Imagery

Kinesthetic imagery involves recreating the sensations associated with bodily movement in the absence of actual physical movement (Vealey & Walter, 1993).

Closed Motor Skill

A closed motor skill is self-paced and performed in a relatively predictable and stable environment (Singer, 1980). Putting a golf ball, the task used in the present study, is an example of a closed motor skill.

Open Motor Skill

An open motor skill involves reacting to events in a relatively unpredictable and unstable environment (Singer, 1980). A goalie attempting to block a shot on goal is an example of a open motor skill.

Performance

For purposes of the present study, performance was measured for both the pretest and posttest by the total number of putts made.

Systematic Biasing Effects

For purposes of the present study, systematic biasing effects were measured for both the pretest and posttest by the total number of putts missed to the left of the cup.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

Mental imagery is a primary form of cognition, and plays a central role in numerous human activities (Kosslyn, 1994). Sport is one such activity in which both the spontaneous and the intentional use of imagery (as a performance enhancement technique) has played an important role. With regard to sport and physical activity, mental imagery can be defined as the intentional use of the senses to mentally rehearse performing a particular sport skill or movement sequence in the absence of, or in combination with, overt physical movement. Other terms used in place of mental imagery, but referring to the same mental process, include symbolic rehearsal, visualization, cognitive rehearsal, imaginal practice, implicit practice, and ideomotor training (Murphy & Jowdy, 1992).

Mental Imagery and Mental Practice History

Mental imagery is by no means a new research topic. In their discussion of past research, Murphy and Jowdy (1992) briefly mention a study by Jastrow (1892) pertaining to an examination of "muscular activity during mental operations" (p. 224). The authors indicate that studies exploring the effects of mental imagery on performance began to appear during the 1930s (e.g., Perry, 1939).

An early study by Vandel, Davis, and Clugston (1943) examined the "function" of mental imagery in the acquisition of dart throwing and basketball free throw shooting skills. Three experimental groups were used in the study. Group 1 performed physical

practice on the first and last day of the study (day 1 and day 20), with no practice in between. Group 2 performed physical practice for 20 consecutive days. Finally, Group 3 (like group 1) performed physical practice on the first and last day of the study (day 1 and day 20), however during the interval they engaged in mental practice. Results of the study showed that mental practice was more effective than no practice, but not as effective as physical practice.

Research on Imagery and Mental Practice

Denis (1985) reviewed the basic paradigm for studying the effects of mental practice. Subjects are randomly assigned to either a mental practice group (MP), a physical practice group (PP), or a control/no-practice group (C). Each group is given a pretest, of the particular skill to be measured in the study (e.g., golf putting), prior to the experimental manipulations. Next, subjects in the MP and PP groups mentally and physically rehearse the motor skill, respectively. Finally, a posttest is performed to determine the effects of MP on performance. For example, if data indicate that the MP group showed significantly greater improvement (over initial performance) than the C group, but not the PP group, then mental practice will be explained as having a positive effect on performance, but to a lesser extent than physical practice.

Mental practice studies have examined the effects of imagery on a wide range of motor skills and tasks. For example, dart throwing (Arnold, 1965), badminton short serve (Beckow, 1967), pursuit rotor task (Kohl & Roenker, 1980), stabilometer (Ryan & Simons, 1981), golf putt (Woolfolk, Parrish, & Murphy, 1985), diving (Grouios, 1992a), baseball batting (Bagg, 1966), and many other sport skills and motor tasks have been

utilized to study the effects of imagery and mental practice. Moreover, the effects of imagery on cognitive (e.g., pegboard), motor (e.g., golf putt), and strength tasks (e.g., hand-grip) have been studied and compared to one another (e.g., Driskell et al., 1994).

Researchers have also sought to explore the effects of imagery on motor performance by manipulating the amount of mental practice prior to performance, or different combinations of mental and physical practice. For example, Hird, Landers, Thomas, and Horan (1991) compared differing proportions of physical and mental practice on cognitive and motor task performance. Results revealed that physical practice was superior to mental practice in enhancing performance, and the higher the ratio of physical to mental practice the greater the positive effect. Although physical practice was superior to mental practice, it is important to note that mental practice was superior to no practice (control group). Thus, the authors argue that mental practice should be used, not as a substitute for physical practice, but only when physical practice cannot be performed (while injured, before, or after practice, etc.). A second finding indicated that although mental practice leads to enhanced performance on both cognitive and motor tasks, greater effects were revealed for cognitive tasks.

Researchers have also combined other forms of mental practice and mental preparation along with mental imagery in their studies. For example, Meacci and Price (1985) combined relaxation, body rehearsal, and mental imagery as a successful intervention in golf putting acquisition. Noel (1980) also added a relaxation phase prior to visualization, utilizing the visuo-motor behavior technique (VMBR); however, no

significant differences between tennis players using VMBR or the control group were found.

Research on Imagery Use

Hall et al. (1990) surveyed Canadian athletes from a variety of sports and found that the higher the competitive level the more extensively imagery was used by the athletes. Orlick and Partington (1988) reported that "some 99%" of 160 Canadian 1984 Olympic athletes surveyed reported using mental imagery as a preparation strategy. McCaffrey and Orlick (1989) interviewed 14 top professional golfers regarding their mental readiness strategies and reported that all used imagery on a daily basis.

Additional support for imagery and mental practice can be found by looking at studies comparing successful and unsuccessful athletes (Murphy & Jowdy, 1992) and imagery use by elite vs. non-elite athletes. These studies typically utilize a questionnaire to determine imagery use, imagery perspective, etc. For example, Mahoney and Avener (1977) found a greater frequency of internal imagery use by those selected for the 1976 U.S. Olympic male gymnastics team, than those failing to qualify. Moreover, Murphy and Jowdy (1992) indicate that while some evidence indicates "clearer imagery" by successful over less successful athletes (e.g., Highlen & Bennett, 1983), other studies have failed to find similar results (e.g., Gould, Weiss, & Weinberg, 1981).

Barr and Hall (1992) administered the Imagery Use Questionnaire (IUQ) to rowers of varying achievement levels. Among other findings, results indicated that elite rowers used mental imagery in competition, before a race, and during breaks in the day to a significantly greater extent than novices. It should be noted, however, that these findings

do not indicate a causal relationship between imagery use and performance (Murphy & Jowdy, 1992). Further, imagery rehearsal is not always positive. Athletes at times image themselves performing incorrectly and failing (Hall et al., 1990; Orlick, 1986; Rodgers, Hall, & Buckolz, 1991).

Research on Outcome Imagery

Powell (1973) conducted the first study investigating the effects of positive versus negative imagery on motor skill performance. He divided subjects into either a positive or a negative imagery group and compared subsequent performance on a dart throwing task. Subjects were instructed to image both the performance (i.e., throwing the dart) and the outcome (i.e., where the dart landed) during their rehearsal. A positive image involved the dart landing near the center of the target, while a negative image involved the dart landing near the edge of the board. The procedure consisted of five blocks, with blocks 1, 3, and 5 involving throwing the darts at the target and with imagery rehearsal occurring during blocks 2 and 4. The results showed, comparing the first and last blocks, an improvement in performance by subjects in the positive imagery condition and a deterioration in performance by subjects in the negative imagery condition. However, as noted by Woolfolk et al. (1985b), the lack of a control group limits the conclusions that can be drawn from this study.

Woolfolk et al. (1985b) examined further the effects of preperformance positive versus negative imagery on motor skill performance. The task was putting a golf ball and each subject was initially blocked on putting ability, which then determined their subsequent putting distance. Next, performance on 10 putts was used as the baseline for

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each subject. Subjects were then randomly assigned either to a positive imagery, negative imagery, or control group. Subjects in the two imagery conditions were instructed to image both the performance (i.e., putting the golf ball) and the outcome (i.e., either sinking or missing the putt). Imagery subjects followed identical instructions except for the outcome component of the image. A positive image involved sinking the putt, while a negative image involved the golf ball just missing the cup. The procedure consisted of a testing session of 10 putts performed on six consecutive days. The results of the six trials revealed that subjects in the positive imagery condition significantly improved their putting performance (30.4%), while subjects in the negative imagery condition showed a significant decline in performance (21.2%) from baseline. The control group showed a slight improvement in their putting performance (9.9%). It was concluded that preperformance imagery can serve either to enhance or degrade subsequent motor skill performance depending on whether the outcome component is positive or negative.

Woolfolk et al. (1985a) extended the Woolfolk et al. (1985b) study by investigating the influence of the performance versus outcome components of preperformance imagery, and possible interactions among these components, on subsequent motor skill performance. As before, the task was putting a golf ball and each subject was initially blocked on putting ability which then determined their subsequent putting distance. Next, each subject performed a pretest which consisted of two blocks of 10 putts for a total of 20 putts. Subjects were then randomly assigned to one of five imagery groups (positive outcome with performance, negative outcome with performance, performance

only, positive outcome only, and negative outcome only) or to a control group. Subjects then performed the posttest, which was identical to the pretest except for the subjects in the imagery conditions who were instructed to rehearse their assigned image prior to each putt and for one minute before each block of 10 putts. The results revealed a main effect for outcome, with both negative imagery groups (negative outcome with performance, negative outcome only) exhibiting a deterioration in performance. However, contrary to the Woolfolk et al. (1985b) study, the positive imagery groups (positive outcome with performance, positive outcome only) did not show an improvement in performance. In addition, the performance only group also failed to show an improvement in performance. It was suggested by the authors that negative imagery is perhaps more potent in harming performance than positive imagery is in enhancing performance. Moreover, the outcome component of preperformance imagery has a greater impact on subsequent performance than the performance only component. The researchers further sought to investigate the mechanisms underlying the effect of imagery on performance, however, neither subjects' levels of tension or ratings of self-efficacy were able to explain performance.

Two unpublished studies (Blackshear, 1991; Schmidt, 1992) explored the effects of performance (correct versus incorrect) and outcome (positive versus negative) imagery on the learning and performance of sport skills. In contrast to the above studies the images were not rehearsed immediately prior to performance. Neither study found negative imagery to harm performance. As noted by Schmidt (1992), these results, when

compared to past findings, suggest that negative imagery is damaging only when immediately preceding performance.

Research on Imagery Biasing Effects

A review of the mental imagery literature reveals that imagery is functionally similar to physical practice and can produce biasing effects for motor learning and motor memory (Finke, 1979; Hall, Bernoties, & Schmidt, 1995; Johnson, 1982). Johnson, using a linear positioning task, demonstrated that images can systematically have biasing effects on performance. All subjects were provided with 15 acquisition trials in which they moved a slide along a track until reaching a stop, set at a specific distance by the experimenter. Subjects were then randomly assigned to an interpolated activity prior to having to recall this position on the track with the stop removed. One interpolated activity involved counting backwards and this control condition did not result in significant error at recall. A second interpolated activity required subjects to imagine moving the slide the same distance as physically performed during the acquisition period and this condition did not result in significant error at recall. In the two other conditions, the interpolated activity consisted of either imagining or physically moving the slide either half or twice the distance of the original movement. Results showed significant error in recall by subjects in both of these conditions. Moreover, both the "novel" imagery and the "novel" movements produced systematic biasing effects in both direction and magnitude on the movement to be recalled. This finding demonstrated that the effects of physical movements and imagery of movements are functionally equivalent.

In a second experiment, Johnson (1982) tested predictions from the symbolic learning theory and the psychoneuromuscular theory to account for mental imagery effects. Specifically, Johnson compared the effects of a visual interference task and a motor interference task on the systematic biasing effects produced by the interpolated activity of imaging an incorrect slide movement. The results revealed the biasing produced by imagery in the first experiment did not occur for imagery combined with visual interference, in the second experiment. In contrast, biasing from imagery resulted despite motor interference. The interfering effect on recall due to visual interference, not motor interference, was argued to provide support for the symbolic learning theory.

Research on Imagery Ability

Individual differences in imagery ability are perhaps one of the most critical factors influencing the effectiveness of imagery on motor skill performance (Hall et al., 1992). However, several studies considering imagery ability have produced inconsistent results. Woolfolk et al. (1985a) administered an imagery questionnaire to subjects in the imagery groups, but did not find either vividness or control to influence performance. Hall et al. (1985) argued that the use of inadequate instruments to measure imagery ability for movement have played a large role in the inconsistent findings. Consequently, the Movement Imagery Questionnaire (MIQ; Hall & Pongrac, 1983) was developed to measure movement imagery ability. Studies using the MIQ have found a positive relationship between imagery ability and motor skill performance (e.g., Goss et al., 1986). Moreover, in a study by Issac (1992) using both the Vividness of Visual Imagery questionnaire (VVIQ; Marks, 1973) and the Vividness of Movement Imagery

Questionnaire (VMIQ; Isaac, Marks, & Russell, 1986) to assess imagery ability, high skilled imagers improved significantly more on trampolining skills than low skilled imagers in the imagery training condition.

Theories of Imagery

A number of plausible theoretical explanations have been developed in an attempt to explain the effects of mental imagery in motor skill learning and performance. However, explanations receiving the most attention by researchers are the symbolic learning theory and the psychoneuromuscular theory. A relatively more recent theory by Paivio (1985), concerning the cognitive and motivational functions of imagery on performance, will also be discussed.

Symbolic Learning Theory. The symbolic learning theory, which evolved from the work of Sackett (1934), suggests that mental practice provides "the opportunity to rehearse the sequence of movements as symbolic components of the task" (Grouios, 1992b, p. 45). This additional preparation, in turn, leads to enhanced performance. Providing support for this theory are studies that have found mental practice to provide greater effects for tasks higher in cognitive than motor or strength components (e.g., Feltz & Landers, 1983). Further, researchers have found that mental practice is more effective in the early stages of learning, which is considered to be primarily cognitive (Murphy & Jowdy, 1992). Thus, operations within the central nervous system would account for mental imagery effects (Murphy & Jowdy, 1992). The symbolic learning theory would explain negative imagery's impact on performance as resulting from distortions in the internal representation of the task.

Psychoneuromuscular Theory. According to the psychoneuromuscular explanation, "mental practice causes minute innervations to occur in the muscles that are actually used in the physical performance of the skill being learned" (Driskell et al., 1994, p. 489). This innervation of the muscles and resulting kinesthetic feedback, strengthens the motor program for the particular task and eventually leads to enhanced performance (Murphy & Jowdy, 1992). Jacobson (1932) was one of the first to provide partial support for this theory by detecting muscle activity in areas of the body subjects imagined moving (Murphy & Jowdy, 1992). According to this theory, the involvement of the peripheral musculature accounts for mental imagery effects (Murphy & Jowdy, 1992). However, as discussed above, a number of studies have demonstrated superior mental practice effects for cognitive rather than physical tasks (e.g., Driskell et al., 1994). Further, Johnson (1982) found that visual, rather than motor, interference countered biasing effects of imagery. These findings conflict with what would be expected according to the psychoneuromuscular theory. The psychoneuromuscular theory would explain negative imagery's impact on performance as resulting from changes in the motor program of the task.

Cognitive and Motivational Theory. According to Paivio (1985), imagery can fulfill both a motivational and a cognitive role, at either a general or specific level, in mediating sport behavior. Specifically, motivation at the general level influences arousal and affect, and goal-oriented responses at the specific level. On the other hand, the cognitive function of imagery at the general level pertains to sport strategies, and for sport skills at the specific level. The cognitive and motivational theory would account for negative

imagery's impact on performance as a possible decrease in arousal and affect at the general level of motivation, and/or disruptive changes in skill execution at the cognitive specific level.

Conclusion

This review of the mental imagery literature reveals that, although imagery has been extensively researched, the area regarding the effects of negative imagery on performance has been largely neglected. It is evident from the literature review that athletes do experience negative images and that preperformance negative imagery rehearsal can result in a decrement in subsequent performance. However, a number of important questions need to be addressed. First, it is necessary for the finding regarding the deleterious effects of negative imagery to be replicated in a natural setting. It is possible that negative imagery effects found in the laboratory may not translate to the field, in which greater motivation to perform well would perhaps be expected. Second, effective strategies intended to counter negative images need to be developed. Third, it is important to consider whether negative images have systematic biasing effects on performance to better understand what the specific effects of these images are, as well as to perhaps throw light on the mechanism(s) underlying negative imagery effects. Theories including the symbolic learning theory, the psychoneuromuscular theory, and the cognitive and motivational theory, have been developed to explain mental imagery effects on performance. Presently, the symbolic learning theory has received the most empirical support. Finally, although imagery ability has been posited as a crucial

variable in imagery effects, it remains uncertain what the influence of imagery ability is on negative imagery effects.

CHAPTER III

METHOD

Participants

Sixty-four students (45 males, 19 females) from a large midwestern university were recruited to voluntarily participate in the experiment. All participants had either completed or were currently enrolled in a beginning or intermediate golf class, co-taught by the experimenter.

Questionnaires

Movement Imagery Questionnaire-Revised (MIQ-R). The MIQ-R (Hall & Martin, 1997; See Appendix B) was administered to assess visual and kinesthetic movement imagery ability. Participants physically performed a total of eight motor movements. Specifically, four separate motor movements were each performed twice in order to obtain both a visual and kinesthetic imagery score. After performing each movement, participants attempted to image "seeing" or "feeling" themselves performing the movement. Next, participants rated the ease/difficulty of imaging the movement using a 7-point Likert scale. Vadocz, Moritz, and Hall (1997) identified alpha coefficients for the visual and kinesthetic subscales of the MIQ-R as .82 and .83, respectively. Moreover, they reported test-retest reliability coefficients for the visual and kinesthetic subscales as .89 and .90, respectively.

Post-Experimental Questionnaire. A questionnaire (See Appendix C), tailored for each experimental group, was administered to each participant upon completion of the posttest. The questionnaire served as a manipulation check to assess the extent to which

participants in the imagery groups followed the procedure and rehearsed the image(s) according to their respective instructions (e.g., How often did you image missing the putt to the left of the cup prior to physically putting the ball?). Participants in the control group were asked whether they used visual or kinesthetic imagery prior to performance. Moreover, items were designed to assess the participants' perceptions of the effect the imagery rehearsal had on their performance and putting strategy (e.g., What effect do you think imaging yourself missing the putt had on your subsequent performance?).

Performance Task and Equipment

The task performed by each participant involved putting a golf ball from a specified distance across a public outdoor practice green into a standard size 4.25 in (10.80 cm) in diameter putting cup. Specifically, participants putted on both the pretest and posttest from an assigned distance based on their performance on 10 putts from a distance of 5.5 ft (1.68 m). This procedure was similar to Woolfolk et al. (1985b). All participants putted Top Flite regular trajectory golf balls supplied by the experimenter and used their own putter, with the restriction that they use the same putter on both the pretest and posttest.

Procedure

After signing the consent (See Appendix D), participants were administered the MIQ-R in a group setting. The experimenter began by reviewing the instructions with the participants. Prior to each of the four motor movements, the experimenter modeled the starting position. Next, each participant assumed the starting position, physically produced the movement, then reassumed the starting position and imaged producing the

movement. Finally, the participants rated the ease/difficulty of imaging making the movement. Upon completion, participants signed-up for an individual time and date in which to perform the golf putting task.

Based on their total score on the MIQ-R, participants were classified as having either high or low imagery ability. Specifically, all participants' MIQ-R scores were rank ordered and a median split divided participants into two groups: high or low imagery ability. Participants within each imagery ability block were then randomly assigned to either a negative imagery group (N), a positive followed by negative imagery group (P-N), a negative followed by positive imagery group (N-P), or a control group (C). Thus, there were eight groups: N high imagery ability (6 males, 2 females), N low imagery ability (4 males, 4 females), P-N high imagery ability (7 males, 1 female), P-N low imagery ability (6 males, 2 females), N-P high imagery ability (6 males, 2 females), N-P low imagery ability (4 males, 4 females), C high imagery ability (5 males, 3 females), and C low imagery ability (7 males, 1 female).

Immediately prior to performing the pre- posttest putting task, each participant was initially blocked for putting ability in an effort to reduce possible floor and ceiling effects resulting from putting ability (Woolfolk et al., 1985b). Specifically, participants putted a total of 10 times from a distance of 5.5 ft (1.68 m). Participants making 9 or 10 of their putts from this distance subsequently putted from 7.5 ft (2.29 m) for both the pretest and posttest. Participants making 7 or 8 putts putted at 6.5 ft (1.98 m). Participants making 4 to 6 putts remained at 5.5 ft (1.68 m). Participants making 2 or 3 putts putted at 4.5 ft (1.37 m). Finally, participants making 1 or no putts subsequently putted from 3.5 ft (1.07

m). Specifically, 9 participants putted from 3.5 ft, nineteen from 4.5 ft, twenty-three from 5.5 ft, 10 from 6.5 ft, and 3 from 7.5 ft. This method of assignment was successful and all participants produced midrange performances (30% to 70% successful putts on the pretest).

Participants then performed the pretest from their assigned putting distance which was determined by their putting ability as described above. Participants alternated among four putting locations spaced 2 ft apart (each equal distance from the cup). The pretest and posttest each consisted of 20 putts, with five putts at each of the four putting locations. During both the pretest and posttest a 1 min rest interval was provided after attempting 10 putts. Participants, for both the pretest and the posttest, were instructed to try to sink each putt attempted. The total number of putts sunk, and for unsuccessful putts, whether the putt was missed to the left, center or to the right of the cup, was recorded by the experimenter.

After performing the pretest, participants assigned to a imagery group were informed that they would be using mental imagery before each putt on the posttest. Next, participants were provided with an introduction to mental imagery (See Appendix E). Specifically, the experimenter defined mental imagery, described the senses involved (e.g., visual, kinesthetic, tactile, auditory), and explained the difference between an internal and an external perspective. Then, participants were provided with instructions to follow prior to performing each putt during the posttest. Specifically, participants were asked to line up each putt, assume their normal putting stance, and then rehearse the image(s) assigned to them once with eyes closed while refraining from physical

movement. Participants were encouraged to image from an internal perspective paying particular attention to the visual and kinesthetic senses. An internal perspective was suggested in order for the participants to better capture the feel of the putting stroke during the imagery rehearsal.

After providing the introduction and instructions, the experimenter led all imagery participants through the procedure to be followed prior to performing each putt, including a guided imagery rehearsal of their assigned image(s). Participants were told that it was vital to the experiment that they follow this procedure and not to alter in any way the image(s) they were instructed to rehearse. Questions related to the directions were addressed as they arose. Participants with questions regarding the specific purpose of the study were told that this would be explained to them after completing the post-experimental questionnaire. The four conditions are described below.

Negative Imagery Group (N). Participants in this group began by assuming their normal putting stance, after lining up each putt. Next, participants were instructed to close their eyes and mentally rehearse (paying particular attention to the visual and kinesthetic senses) performing a putting stroke, striking the ball, and then to image the ball "rolling, rolling toward the cup but then missing about a foot to the left."

Positive followed by Negative Imagery Group (P-N). Participants in this condition were instructed to first rehearse a positive image in which the outcome consisted of the ball "rolling, rolling and dropping right into the cup." Next, participants were instructed to take a step back and line up the putt again, then reassume their normal putting stance,

and at this time rehearse the negative image following the identical procedure performed by the negative imagery group.

Negative followed by Positive Imagery Group (N-P). Participants in this condition were instructed to first rehearse the negative image, following the identical procedure performed by the negative imagery group. Next, participants were instructed to take a step back and line up the putt again, then reassume their normal putting stance, and at this time rehearse the positive image.

Control Group (C). Participants in this group were not provided any specific instructions to follow during the posttest. However, between the pretest and the posttest, participants in the control group were provided the opportunity to perform stretches. The purpose was to match the time interval (approximately 4 min) between the pretest and posttest needed to train the imagery groups.

The posttest also consisted of 20 putts and followed the same procedure as the pretest with the exception that participants in the imagery conditions were instructed to rehearse their assigned image(s) prior to each individual putt. Further, for the 1 min interval after 10 putt attempts, participants in the imagery conditions were instructed to rehearse their assigned image(s). Again, the total number of putts sunk, and for unsuccessful putts whether the putt was missed to the left, center or to the right of the cup, was recorded by the experimenter.

Following the posttest, each participant was administered the post-experimental questionnaire. After completing the post-experimental questionnaire, each participant was then debriefed (See Appendix F).

CHAPTER IV

RESULTS

The results of this study are organized into five sections. Group MIQ-R scores are presented in the first section. The second section provides the results of the putting performance scores. The third section provides the results of the putting direction scores. The fourth section provides the results of the correlation for imagery ability and negative imagery effects. Lastly, the results of the post-experimental questionnaire are provided.

MIQ-R Scores

The means and standard deviations for each group's Movement Imagery Questionnaire - Revised (MIQ-R) visual, kinesthetic, and total scores are presented in Table 1. Possible total scores on this instrument range from 8 to 56 (4 to 28 for each subscale). Although both visual and kinesthetic subscales are provided, the total imagery score was used to determine imagery ability. Specifically, all participants' MIQ-R scores were rank ordered and a median split divided participants into two groups: high or low imagery ability. The total imagery ability scores ranged from 31 to 43 for the low imagery ability participants and 44 to 56 for the high imagery participants.

Table 1

Movement Imagery Questionnaire-Revised Scores

Group	Imagery	Visual M	Visual SD	Kinesthetic M	Kinesthetic SD	Total M	Total SD
N	High	26.75	1.58	22.63	4.34	49.38	4.57
N	Low	20.50	5.15	16.75	2.92	37.25	6.61
P-N	High	22.75	3.15	24.38	3.11	47.12	3.23
P-N	Low	20.25	1.67	18.63	2.00	38.88	1.89
N-P	High	26.25	2.05	23.00	3.46	49.25	4.20
N-P	Low	21.00	4.07	19.25	3.54	40.25	3.28
C	High	25.50	2.51	21.25	1.67	46.75	2.05
C	Low	22.50	5.32	15.88	5.14	38.37	6.00

Putting Performance

To test the hypotheses regarding the effects of the imagery instructions on putting performance, three types of analyses (paired t-tests, ANOVA, post hoc contrasts) were performed. A one-way analysis of variance was conducted to test if the group putting performance scores (number of made putts) on the pretest differed by a significant amount. Results of the analysis of variance were not significant, $F(3, 60) = 2.36$, $p > .05$. A paired t-test was performed to examine Hypothesis 1 that the N group would experience a significant decrease in putting performance from pre- to posttest. The N group did not show a statistically significant decrease in putting performance from pre- to posttest, $t(15) = -1.85$, $p = .08$. Although significance was approached in the expected

direction (see Table 2 for means and standard deviations), this finding failed to support Hypothesis 1.

Additional t-tests were performed to test the pre-post putting performance results for each of the other groups. The P-N group showed a statistically significant increase in putting performance from pre- to posttest, $t(15) = 2.49$, $p < .05$. Possible explanations for this unexpected finding are offered in the discussion. Results showed no statistically significant changes from pre- to posttest for either the N-P group, $t(15) = .60$, $p > .05$, or the C group, $t(15) = .37$, $p > .05$. See Table 2 for means and standard deviations.

Table 2

Group Putting Performance Pre and Post Scores

	Pretest			Posttest		
Group	M	SD	N	M	SD	N
N	10.44	2.42	16	8.56	3.46	16
P-N	8.25	2.35	16	10.00	3.43	16
N-P	8.94	2.29	16	9.38	2.55	16
C	9.13	2.45	16	9.44	2.48	16

To test Hypothesis 2, a 2 x 4 x 2 (imagery ability x group x trials) analysis of variance with repeated measures on the last factor was performed on the putting performance scores. It was expected that the N group would experience a decrease in putting performance from pre- to posttest in comparison to the P-N, N-P, and C groups. A significant group by trials interaction emerged, $F(3, 56) = 3.26$, $p < .05$. There failed to

be a significant main effect for group, F (3,56) = .09, p > .05, imagery ability, F (1,56) = .03, p > .05, or trials, F (1,56) = .14, p > .05. Further, there were no significant interactions for group by imagery ability, F (3,56) = .01, p > .05, imagery ability by trials, F (3,56) = .68, p > .05, or group by imagery ability by trials, F (3,56) = .98, p > .05. Consequently, imagery ability will be excluded in the presentation of the scores in the present section. The group means and standard deviations for the pre- to posttest putting performance scores are presented in Table 2. Putting performance scores, including imagery ability, are presented in Appendix G.

Post hoc contrasts for the putting performance posttest change scores showed the N group's performance to be significantly lower than that of the P-N group, t = 3.09, p = .003. The N group did not significantly differ from either the N-P group, t = 1.97, p = .053, or the C group, t = 1.87, p = .07, although both groups approached significance. These findings provide partial support for Hypothesis 2 and suggest that preceding a negative image with a positive image is successful as a intervention strategy. Further, significance was approached for the N-P group outperforming the N group from pre- to posttest suggesting that following a negative image with a positive image may also be successful. The observed power for the group by trials interaction was .72, indicating that the sample size may not have been sufficient to detect significant performance differences between the N group and the N-P and C groups.

Putting Direction

To test the hypotheses regarding the effects of the imagery instructions on putting direction, three types of analyses (paired t-tests, ANOVA, ANCOVA) were performed. A one-way analysis of variance was conducted to test if the group putting direction scores (number of putts missed to the left of the cup) on the pretest differed by a significant amount. Results of the analysis of variance were significant, $F(3, 60) = 3.29$, $p < .05$. A Newman-keuls post hoc analysis revealed a significant difference between the N and P-N groups, $p < .05$. Possible explanations for the pretest variance between groups are offered in the discussion section. A paired t-test was performed to examine Hypothesis 3 that the N group would experience a significant increase in missed putts to the left of the cup from pre- to posttest. The N group showed a statistically significant increase in putts missed to the left of the cup from pre- to posttest, $t(15) = 2.31$, $p < .05$. This finding supported hypothesis 3, revealing systematic biasing effects on putting direction produced by negative imagery.

Additional t-tests were performed to test the pre-post putting direction results for each of the other groups. Results showed no statistically significant changes from pre- to posttest for the P-N group, $t(15) = -.44$, $p > .05$, the N-P group, $t(15) = -.46$, $p > .05$, or the C group, $t(15) = .00$, $p > .05$. Thus, systematic biasing effects on putting direction were not observed for these groups.

Table 3

Group Putting Direction Pre and Post Scores

Group	Pretest M	Pretest SD	Pretest N	Posttest M	Posttest SD	Posttest N
N	3.19	1.94	16	5.50	3.81	16
P-N	5.94	2.49	16	5.63	3.05	16
N-P	4.06	2.05	16	3.81	1.97	16
C	4.63	3.42	16	4.63	2.60	16

To test Hypothesis 4, a 2 x 4 x 2 (imagery ability x group x trials) analysis of covariance with repeated measures on the last factor was performed on the putting direction scores. It was expected that the N group would experience an increase in putts missed to the left of the cup from pre- to posttest in comparison to the P-N, N-P, and C groups. There failed to be a significant main effect for group, $F(3,55) = 1.55$, $p > .05$, or imagery ability, $F(1,55) = .02$, $p > .05$. Further, there was no significant interaction for group by imagery ability, $F(3,55) = .53$, $p > .05$. Thus, results of the ANCOVA failed to support Hypothesis 4. The observed power for the group main effect was .40, indicating that the sample size may not have been sufficient to detect significant direction differences between the N group and the P-N, N-P and C groups. The group means and standard deviations for the pre-post putting direction scores are presented in Table 3. Putting direction scores, including imagery ability, are presented in Appendix G.

Imagery Ability

To test Hypothesis 5, a correlation was obtained on the putting performance scores on the posttest for the N group in order to explore the influence of imagery ability on negative imagery effects. According to the hypothesis, there would be a negative relationship between imagery ability and putting performance on the posttest for the N group. Results did not reveal a significant correlation, $r = .02$, $p > .05$. Thus, Hypothesis 5 was not supported.

Post-Experimental Questionnaire

Imagery Groups. The post-experimental questionnaire consisted of seven questions for the N, P-N, and N-P groups. Means and standard deviations for the imagery groups' responses to these questions are presented in Table 4. All open-ended responses to questions one, six, and seven are provided in Appendix H.

Question 1 explored the extent to which participants rehearsed their assigned image(s) prior to each putt on the posttest. A one-way analysis of variance was conducted to test if the groups differed with regard to imagery rehearsal. Results of the analysis of variance were not significant, $F(2,45) = .94$, $p > .05$. All imagery participants reported rehearsing their image(s) at least "sometimes" or between 7-13 of the twenty posttest putts. Overall, means from each imagery group fell approximately between "often" (14-19 putts) and "always" (all 20 putts). It is important to note that this question contained unequal response intervals. A more precise measure of adherence to the instructions would have been to ask for a specific number out of twenty in which the participant rehearsed the assigned image(s).

Question 2 measured visual imagery, with regard to the ease/difficulty of rehearsing their assigned image(s). A one-way analysis of variance was conducted to test if the group responses differed by a significant amount. Results of the analysis of variance were not significant, F (2,45) = .23, p > .05.

Question 3 measured kinesthetic imagery, with regard to the ease/difficulty of rehearsing their assigned image(s). A one-way analysis of variance was conducted to test if the group responses differed by a significant amount. Results of the analysis of variance were not significant, F (2,45) = .38, p = > .05.

Questions 4 and 5 assessed the internal and external imagery perspective employed by the participants, respectively. For question 4, a one-way analysis of variance was conducted to test if the group responses differed by a significant amount. Results of the analysis of variance were not significant, F (2,45) = .10, p = > .05. For question 5, a one-way analysis of variance was conducted to test if the group responses differed by a significant amount. Results of the analysis of variance were not significant, F (2,45) = .03, p > .05.

Question 6 assessed participants' beliefs about the effect of the image(s) on their performances. A one-way analysis of variance was conducted to test if the groups differed with regard to beliefs about imagery rehearsal. Results of the analysis of variance revealed a significant main effect, F (2,45) = 4.08, p < .05. A Newman-keuls post hoc analysis revealed a significant effect, p < .05, with the N group significantly different from the P-N and N-P groups. Overall, means for the N group fell approximately between "harmful" and "no effect". In contrast, means for the P-N and N-

P groups fell approximately between "no effect" and "helpful". The means are consistent with the putting performance scores for each group.

Question 7 investigated whether participants changed their putting strategy from the pretest to the posttest due to the imagery manipulation. A chi-square was conducted to test if the groups differed with regard to putting strategy. Results were not significant, χ^2 $(1, \underline{N} = 54) = 1.33$. $\underline{p} > .05$. Overall, nine participants in the N group, eleven participants in the P-N group, and eight in the N-P group reported that they changed their putting strategy as a result of rehearsing their image(s).

Table 4

Post-Experimental Questionnaire Scores for Imagery Groups

	Q1		Q2		Q3		Q4		Q5		Q6		Q7	
Group	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
N	4.56	.63	5.06	1.39	4.06	1.12	4.50	.82	1.50	.82	2.56	1.09	1.44	.51
P-N	4.75	.45	5.25	1.06	4.44	1.09	4.44	.73	1.56	.73	3.38	1.02	1.31	.48
N-P	4.50	.52	4.94	1.44	4.19	1.47	4.38	.81	1.56	.82	3.50	.89	1.50	.52

Questionnaire Key:	Measurement Scale:
Q1: How often did you rehearse your image(s)?	(1 = Never; 5 = Always)
Q2: Rate the ease/difficulty of "seeing" your image(s).	(1 = Very hard; 7 = Very easy)
Q3: Rate the ease/difficulty of "feeling" your image(s).	(1 = Very hard; 7 = Very easy)
Q4: How often did you image from an internal perspective?	(1 = Never; 5 = Always)
Q5: How often did you image from an external perspective?	(1 = Never; 5 = Always)
Q6: What effect did the image(s) have on your performance?	(1 = Very harmful; 5 = Very helpful)
Q7: Did the image(s) change your putting strategy?	(1 = Yes; 2 = No)

Control Group. Participants in the control group completed a questionnaire regarding self-employed imagery use. Means and standard deviations for the control group's responses to these questions are presented in Table 5. Question 1 explored control participants own use of visual imagery during the posttest. The mean response was approximately "sometimes" or between 7-13 of the twenty posttest putts. Question 2 explored the use of kinesthetic imagery. The mean response fell approximately between "sometimes" (7-13 putts) and "hardly ever" (1-6 putts). Finally, Question 3 assessed participants' beliefs about the effect of the imagery on their performances. Overall, the mean response was approximately "helpful". These findings demonstrated that self-employed mental imagery was used by the control group and was perceived to be generally helpful. All open-ended responses to these questions are provided in Appendix H.

Table 5

Post-Experimental Questionnaire Scores for Control Group

	Q1		Q2		Q3	
Group	M	SD	M	SD	M	SD
C	3.00	.63	2.57	1.50	4.27	.59

Questionnaire Key:
Q1: How often did you rehearse a visual image? (1 = Never; 5 = Always)
Q2: How often did you rehearse a "feeling" image? (1 = Never; 5 = Always)
Q3: What effect did the image(s) have on your performance? (1 = Very harmful; 5 = Very helpful)

Measurement Scale:

CHAPTER V

DISCUSSION AND CONCLUSIONS

This chapter consists of four sections. The first section provides a discussion of the findings of the present study. The second section presents the conclusions. The third section discusses implications of the findings, and the fourth section offers suggestions for future research.

Discussion

The purpose of the present study was to extend our understanding of the effects of preperformance negative imagery on putting performance by examining motor skill performance in a natural setting. The results of this study partially replicated the findings of past research (Powell, 1973; Woolfolk et al., 1985a; Woolfolk et al., 1985b) pertaining to the deleterious effects of negative imagery on performance. Although the N group did not show a significant decrease in putting performance from pre- to posttest, there was a trend in this direction. As mentioned in the results section, insufficient power may have precluded significant findings for the between group trends for putting performance and direction.

A major aim of the present study was to explore the efficacy of a cognitive intervention strategy intended to offset the potentially harmful effects of negative images by preceding or following them with positive ones, subsequent to performance. The rationale for using positive imagery as a intervention strategy derives from the evidence supporting the use of positive imagery to enhance performance (Powell, 1973; Woolfolk

et al., 1985b), and visual interference to offset imagery's biasing effects (Johnson, 1982). The results partially supported this hypothesis. The N group's performance declined significantly in comparison to the P-N group. However, the N group did not significantly differ from the N-P group, although significance was approached. These findings suggest that positive images may be used prior to the negative image to successfully offset the potentially harmful effects, and perhaps a combination of positive and negative images are more beneficial to subsequent performance than an isolated negative image. Participant responses on the post-experimental questionnaire are consistent with and add support to these findings. Specifically, the N group reported that overall they believed their image was significantly more harmful to their subsequent putting performance than indicated by either the P-N or N-P groups.

Another aim of the study was to search for possible systematic biasing effects, with respect to the direction of missed putts, produced by the negative images. It was suggested that systematic biasing effects would reveal a mechanism underlying negative imagery effects and would compliment studies demonstrating specific interference effects of imagery on performance (Finke, 1979; Hall, Bernoties & Schmidt, 1995; Johnson, 1982). Thus, how one images missing would influence how one actually misses putts and negative imagery would then impair performance in a specific manner.

The N group showed a significant increase in missed putts to the left of the cup from pre- to posttest (in the direction they imaged missing). In contrast to the N group, the P-N, N-P, and C groups did not exhibit biasing with respect to putting direction. Thus, the biasing produced by the negative image did not occur when this image was preceded or

followed by a positive image. If positive imagery functioned as a form of visual interference, this finding would be consistent with the results of the second experiment by Johnson (1982) indicating that visual interference offsets imagery's biasing effects, which in turn lends support to the symbolic learning theory. However, in order to directly compare the predictions from the symbolic learning theory and the psychoneuromuscular theory, both visual (e.g., positive imagery) and motor (e.g., putting stroke) interference would need to be examined.

The results did not support the hypothesis that the N group would miss significantly more putts to the left of the cup compared with the P-N, N-P, and C groups. Significant differences on the pretest between the groups with respect to the direction of missed putts may have contributed to the lack of any significant differences between the groups from pre- to posttest. One factor likely contributing to the significant differences on the pretest was the variable putting surface conditions. Because the experiment was performed on an outdoor practice green, along with variable cup locations from day to day, it was impossible to have a completely flat or consistent surface. Thus, some straight putts may have broken slightly to the left for some participants, while to the right for others putting at a different location. Another possible factor accounting for the pretest direction scores are differences with respect to handedness. In general, it has been noted by golf instructors that right-handed golfers tend to miss more putts to the right of the cup, while left-handed golfers tend to miss more to the left of the cup. This can result from the tendency to align oneself to the target, and not the ball path (e.g., Webb, 1997). Because the ball is in front of the body, it will consequently miss to the

right for right-handed golfers aligned to the target. Handedness was not controlled for in the present study and between group differences with respect to the number of right-handed versus left-handed participants may have played a role if random assignment was not successful in producing equal groups with respect to handedness and the aforementioned tendencies were present.

The present study failed to find any influence of imagery ability on performance. Specifically, it was hypothesized that higher skilled imagers would be harmed more by negative images than lower skilled imagers. It was reasoned that if higher skilled imagers benefit more from correct or positive images then they would be harmed more by negative images. The imagery ability scores ranged from 31 to 43 for the low imagery ability group and 44 to 56 for the high imagery group. Possible total scores on this instrument range from 8 to 56. Thus, a restriction in range resulted and it can be argued that the comparison was really between high and medium imagers. Perhaps greater differences in imagery ability scores are needed to detect possible mediating influences of imagery ability with respect to negative images on performance.

The present study determined imagery ability for participants based on their total score on the MIQ-R. A more effective approach in determining imagery ability would have been to compare participants scoring high for both visual and kinesthetic to participants scoring low for both visual and kinesthetic. This approach would prevent a high and a low skilled imager differing on only one of the measures from receiving the same overall score.

Conclusions

Based on the findings of this study with respect to the research hypotheses, the following conclusions are made:

1. The N group did not experience a significant decrease in putting performance from pre- to posttest.

2. The N group made significantly fewer putts from pre- to posttest in comparison to the P-N group.

3. The N group missed significantly more putts to the left of the cup from pre- to posttest.

4. The N group did not make significantly more putts to the left of the cup from pre- to posttest in comparison to P-N, N-P, and C groups.

5. The correlation between imagery ability and putting performance on the posttest for the N group was not statistically significant. Further, there was no significant influence of imagery ability on performance for the imagery groups.

Implications for Athletes

The findings of this study provide partial, yet encouraging, support for the efficacy of using positive imagery to offset negative imagery effects. Specifically, athletes may benefit by rehearsing a positive preperformance image in order to offset any adverse effects of a subsequent spontaneous negative image. Athletes who experience a negative preperformance image may also benefit if they attempt to follow the failure image with a positive image prior to performing. Although the N group was not significantly different from the N-P group in putting performance, there was a significant difference with

respect to the participants' perceptions regarding the effects of the images. As stated above, the N group reported that the negative image was more harmful to their subsequent performance compared with both the P-N and N-P groups.

The findings also provided evidence for negative imagery producing systematic biasing effects on performance with respect to putting direction. If this finding transfers to other closed motor skills, then athletes performing these tasks would benefit from the knowledge of how negative images specifically impact performance. Thus, athletes prone to negative images should be made aware of a possible tendency to miss their actual attempt in the precise manner in which they imaged missing.

Suggestions for Future Research

Future research on this topic should consider alternative intervention strategies intended to offset the adverse effects of negative imagery on performance. Athletes prone to experiencing negative images prior to performance or athletes unable to control their images may benefit more from another strategy. Positive affirmations or self-talk may present an additional strategy to block negative images from harming performance.

As stated above, methodological problems with respect to inconsistent putting surfaces, and no control for handedness, could have effected the results with respect to between group systematic biasing effects. Further research could avoid these concerns by employing a flat indoor putting surface and/or controlling for handedness. Moreover, determining putting accuracy by measuring the distance and direction from the cup for missed putts, in addition to whether the putt was made or missed to one side, would provide a more precise account of the imagery effects. Finally, determining putting

accuracy would preclude any judgment calls with respect to putting direction and reduce possible experimenter bias. The experimenter in the present study recorded the outcome of the putting attempts and was thus not "blinded" to the group assignments.

Although there was no support for the hypothesis of a negative relationship between imagery ability and putting performance for participants in the negative imagery group, it is possible that with greater differences in imagery ability scores from those obtained in the present study a mediating influence may be detected. If a negative relationship exists, higher skilled imagers experiencing negative images subsequent to athletic performance would experience greater harm and may benefit more from effective blocking strategies. However, this possibility is unlikely given the small, positive correlation obtained for imagery ability and putting performance on the posttest for the negative imagery group.

As noted by Murphy (1994), imagery theories have been inadequate in explaining how negative images hinder performance. However, there is considerable empirical support for the symbolic learning theory in explaining both the performance and biasing effects of imagery. Further, responses by participants in the N group indicate that variables including concentration ("Thinking too hard - distraction."), confidence ("Mentally when I opened my eyes I expected to miss the putt."), and motivation ("Messed up goal of what I really wanted to do.") must also be considered (Murphy, 1994).

Finally, although the results provided partial evidence for the adverse effects of negative imagery, one participant indicated that the negative images were "helpful", while two participants felt the negative images to be "very helpful." The perception by

some participants that negative images can be beneficial was also noted in past studies (Schmidt, 1992; Woolfolk et al., 1985a). Responses by these participants in the present study may have provided additional clues to explain this surprising finding. Participants who felt the negative images were helpful indicated that imaging missing the putt to the left of the cup helped with aim and alignment for the actual putt ("It helped my direction of putts.") Further, the negative images also helped with concentration and focus ("I concentrated on the putt more.") It is possible that negative imagery for closed motor skills can also be used to provide valuable feedback to the participant allowing one to learn from the "miss" and then to self-correct on the actual attempt. Future research could explore ways in which these potentially beneficial aspects of negative images can be employed or added to positive imagery without including the harmful components. The potentially beneficial uses of negative imagery may help explain the unexpected finding regarding the P-N group which experienced a significant increase in putting performance from pre- to posttest. Perhaps these participants were able to make use of the beneficial aspects of both negative and positive imagery.

APPENDICES

APPENDIX A

UNIVERSITY COMMITTEE ON RESEARCH INVOLVING HUMAN SUBJECTS APPROVAL

MICHIGAN STATE
UNIVERSITY

July 8, 1996

TO: James A. Afremow
237 Whitehills Dr.
E. Lansing, MI 48823

RE: IRB#: 96-413
TITLE: NEGATIVE IMAGERY AND PERFORMANCE: SEARCHING FOR BIASING EFECTS AND A BLOCKING STRATEGY
REVISION REQUESTED: 07/01/96
CATEGORY: 1-A
APPROVAL DATE: 06/18/96

The University Committee on Research Involving Human Subjects' (UCRIHS) review of this project is complete. I am pleased to advise that the rights and welfare of the human subjects appear to be adequately protected and methods to obtain informed consent are appropriate. Therefore, the UCRIHS approved this project and any revisions listed above.

RENEWAL: UCRIHS approval is valid for one calendar year, beginning with the approval date shown above. Investigators planning to continue a project beyond one year must use the green renewal form (enclosed with the original approval letter or when a project is renewed) to seek updated certification. There is a maximum of four such expedited renewals possible. Investigators wishing to continue a project beyond that time need to submit it again for complete review.

REVISIONS: UCRIHS must review any changes in procedures involving human subjects, prior to initiation of the change. If this is done at the time of renewal, please use the green renewal form. To revise an approved protocol at any other time during the year, send your written request to the UCRIHS Chair, requesting revised approval and referencing the project's IRB # and title. Include in your request a description of the change and any revised instruments, consent forms or advertisements that are applicable.

PROBLEMS/ CHANGES: Should either of the following arise during the course of the work, investigators must notify UCRIHS promptly: (1) problems (unexpected side effects, complaints, etc.) involving human subjects or (2) changes in the research environment or new information indicating greater risk to the human subjects than existed when the protocol was previously reviewed and approved.

If we can be of any future help, please do not hesitate to contact us at (517) 355-2180 or FAX (517) 432-1171.

Sincerely,

David E. Wright, Ph.D.
UCRIHS Chair

DEW:bed

cc: Lynnette Y. Overby

OFFICE OF
RESEARCH AND GRADUATE STUDIES

University Committee on Research Involving Human Subjects (UCRIHS)
Michigan State University
232 Administration Building
East Lansing, Michigan
48824-1046

517/355-2180
FAX: 517/432-1171

APPENDIX B

MOVEMENT IMAGERY QUESTIONNAIRE-REVISED (MIQ-R)

INSTRUCTIONS

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

Each of the following statements describe a particular action or movement. Read each statement carefully and then actually perform the movement as described. Only perform the movement a **single** time. Return to the starting position for the movement just as if you were going to perform the action a second time. Then depending on which of the following you are asked to do, either 1) form as clear and vivid a visual image as possible of the movement just performed, or 2) attempt to feel yourself making the movement just performed without actually doing it.

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

RATING SCALES

Visual Imagery Scale

7	6	5	4	3	2	1
Very easy to see	Easy to see	Somewhat easy to see	Neutral (not easy nor hard)	Somewhat hard to see	Hard to see	Very hard to see

Kinesthetic Imagery Scale

7	6	5	4	3	2	1
Very easy to feel	Easy to feel	Somewhat easy to feel	Neutral (not easy nor hard)	Somewhat hard to feel	Hard to feel	Very hard to feel

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

ACTION: Raise your right knee as high as possible so that you are standing on your left leg with your right leg flexed (bent) at the knee. Now lower your right leg so that you are again standing on two feet. Perform these actions slowly.

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

RATING: _____

2. **STARTING POSITION:** Stand with your feet slightly apart and your hands at your sides.

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

MENTAL TASK: Assume the starting position. Attempt to see yourself making the movement just performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: _____

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

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

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

RATING: _____

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

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

MENTAL TASK: Assume the starting position. Attempt to see yourself making the movement just performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which your were able to do this mental task.

RATING: _____

5. STARTING POSITION: Stand with your feet slightly apart and your hands at your sides.

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

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

RATING: _____

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

ACTION: Raise your right knee as high as possible so that you are standing on your left leg with your right leg flexed (bent) at the knee. Now lower your right leg so that you are again standing on two feet. Perform these actions slowly.

MENTAL TASK: Assume the starting position. Attempt to <u>see</u> yourself making just the movement performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: _____

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

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

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

RATING: _____

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

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

MENTAL TASK: Assume the starting position. Attempt to <u>see</u> yourself making the movement just performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which your are able to do this mental task.

RATING: _____

APPENDIX C

POST-EXPERIMENTAL QUESTIONNAIRES

N group

Name: _____

Directions: Each question below refers to your previous 20 putts. Please circle the number for the most appropriate response - do not mark between the numbers.

1. Prior to physically putting the ball, how often did you image yourself missing the putt to the left of the cup?

1	2	3	4	5
Never	Hardly ever	Sometimes	Often	Always
(0)	(1-6)	(7-13)	(14-19)	(20)

Please describe any differing images you experienced:

2. Please rate the ease/difficulty with which you were able to see yourself performing the putting stroke and the outcome of the putt during your images.

1	2	3	4	5	6	7
Very hard to see	Hard to see	Somewhat hard to see	Neutral (not easy nor hard)	Somewhat easy to see	Easy to see	Very easy to see

3. Please rate the ease/difficulty with which you were able to feel yourself performing the putting stroke during your images.

1	2	3	4	5	6	7
Very hard to feel	Hard to feel	Somewhat hard to feel	Neutral (not easy nor hard)	Somewhat easy to feel	Easy to feel	Very easy to feel

4. How often did you image from the perspective of viewing your performance as though seeing through your own eyes (internal perspective)?

1	2	3	4	5
Never	Hardly ever	Sometimes	Often	Always
(0)	(1-6)	(7-13)	(14-19)	(20)

5. How often did you image from the perspective of viewing your performance outside of your body, as though you were observing yourself perform on TV (external perspective)?

1	2	3	4	5
Never	Hardly ever	Sometimes	Often	Always
(0)	(1-6)	(7-13)	(14-19)	(20)

6. What effect did imaging yourself missing the putt to the left of the cup have on your subsequent performance?

1	2	3	4	5
Very harmful	Harmful	No effect	Helpful	Very helpful

Please explain:

7. Did imaging yourself missing the putt to the left of cup change your putting strategy?

1 - Yes 2 - No

Please explain:

P-N group

Name: _____

Directions: Each question below refers to your previous 20 putts. Please circle the number for the most appropriate response - do not mark between the numbers.

1. Prior to physically putting the ball, how often did you image yourself sinking the putt followed by imaging missing the putt to the left of the cup?

1	2	3	4	5
Never	Hardly ever	Sometimes	Often	Always
(0)	(1-6)	(7-13)	(14-19)	(20)

Please describe any differing images you experienced:

2. Please rate the ease/difficulty with which you were able to see yourself performing the putting stroke and the outcome of the putt during your images.

1	2	3	4	5	6	7
Very hard to see	Hard to see	Somewhat hard to see	Neutral (not easy nor hard)	Somewhat easy to see	Easy to see	Very easy to see

3. Please rate the ease/difficulty with which you were able to feel yourself performing the putting stroke during your images.

1	2	3	4	5	6	7
Very hard to feel	Hard to feel	Somewhat hard to feel	Neutral (not easy nor hard)	Somewhat easy to feel	Easy to feel	Very easy to feel

4. How often did you image from the perspective of viewing your performance as though seeing through your own eyes (internal perspective)?

1	2	3	4	5
Never	Hardly ever	Sometimes	Often	Always
(0)	(1-6)	(7-13)	(14-19)	(20)

5. How often did you image from the perspective of viewing your performance outside of your body, as though you were observing yourself perform on TV (external perspective)?

1	2	3	4	5
Never	Hardly ever	Sometimes	Often	Always
(0)	(1-6)	(7-13)	(14-19)	(20)

6. What effect did imaging yourself sinking the putt followed by missing the putt to the left of the cup have on your subsequent performance?

1	2	3	4	5
Very harmful	Harmful	No effect	Helpful	Very helpful

Please explain:

7. Did imaging yourself sinking the putt followed by imaging missing the putt to the left of cup change your putting strategy?

1 - Yes 2 - No

Please explain:

N-P group

Name: _____

Directions: Each question below refers to your previous 20 putts. Please circle the number for the most appropriate response - do not mark between the numbers.

1. Prior to physically putting the ball, how often did you image yourself missing the putt to the left of the cup followed by imaging sinking the putt?

1	2	3	4	5
Never	Hardly ever	Sometimes	Often	Always
(0)	(1-6)	(7-13)	(14-19)	(20)

Please describe any differing images you experienced:

2. Please rate the ease/difficulty with which you were able to see yourself performing the putting stroke and the outcome of the putt during your images.

1	2	3	4	5	6	7
Very hard to see	Hard to see	Somewhat hard to see	Neutral (not easy nor hard)	Somewhat easy to see	Easy to see	Very easy to see

3. Please rate the ease/difficulty with which you were able to feel yourself performing the putting stroke during your images.

1	2	3	4	5	6	7
Very hard to feel	Hard to feel	Somewhat hard to feel	Neutral (not easy nor hard)	Somewhat easy to feel	Easy to feel	Very easy to feel

4. How often did you image from the perspective of viewing your performance as though seeing through your own eyes (internal perspective)?

1	2	3	4	5
Never	Hardly ever	Sometimes	Often	Always
(0)	(1-6)	(7-13)	(14-19)	(20)

5. How often did you image from the perspective of viewing your performance outside of your body, as though you were observing yourself perform on TV (external perspective)?

1	2	3	4	5
Never	Hardly ever	Sometimes	Often	Always
(0)	(1-6)	(7-13)	(14-19)	(20)

6. What effect did imaging yourself missing the putt to the left of the cup followed by imaging sinking the putt have on your subsequent performance?

1	2	3	4	5
Very harmful	Harmful	No effect	Helpful	Very helpful

Please explain:

7. Did imaging yourself missing the putt to the left of the cup followed by imaging sinking the putt change your putting strategy?

1 - Yes 2 - No

Please explain:

C group

Name: _____

Directions: Each question below refers to your previous 20 putts. Please circle the number for the most appropriate response - do not mark between the numbers.

1. How often did you image yourself putting the ball and/or "see" the ball rolling toward the cup prior to physically putting the ball?

1	2	3	4	5
Never	Hardly ever	Sometimes	Often	Always
(0)	(1-6)	(7-13)	(14-19)	(20)

Please describe any visual images you experienced:

2. How often did you image feeling the putting stroke and/or striking the ball prior to physically putting the ball?

1	2	3	4	5
Never	Hardly ever	Sometimes	Often	Always
(0)	(1-6)	(7-13)	(14-19)	(20)

Please describe any feeling images you experienced:

3. If you experienced any images prior to putting, what effect do you think they had on your subsequent performance?

1	2	3	4	5
Very harmful	Harmful	No effect	Helpful	Very helpful

Please explain:

APPENDIX D

STATEMENT OF INFORMED CONSENT

INFORMED CONSENT

This study aims to investigate the influence of mental rehearsal on golf putting performance. Your participation in this study will contribute to our knowledge about how psychological processes effect sport performance, and therefore, your participation in this experiment is valuable and appreciated. Your participation may include the learning and use of a mental practice technique. You may be asked to rehearse this technique prior to performance during a golf putting task. In addition to putting a golf ball, you will be required to complete either two or three questionnaires. The entire procedure should take approximately twenty-five minutes.

Data obtained during the experiment will be treated with strict confidence and you will remain anonymous in any report of the results. Whether or not you choose to participate in this study will have no effect on your golf class grade. Participation in this study is voluntary and at any time you may discontinue without penalty. You may also refuse to answer any of the items on the questionnaires. Participation does not have any known risks, nor are any beneficial effects guaranteed. If you have any questions you can ask the experimenter at any time.

If you have any questions or concerns following your participation, you are welcome to call Jim Afremow (333-3686), principal investigator or Dr. Lynnette Overby (355-3775), project supervisor.

I have read the above and understand the purpose of the experiment, the procedures, and my rights as a subject. By signing below, I agree to participate as a volunteer in this study.

Signature:_____ Date:_____

Print name:_____

APPENDIX E

INTRODUCTION AND INSTRUCTIONS SCRIPT
(N, P-N, N-P groups)

For the next 20 putts, you will rehearse a specific mental image(s) prior to each putt. Imagery, sometimes referred to as visualization, is the mental rehearsal of a task in the mind's eye. It is creating or recreating an experience in the mind using the senses. Thus, you can use imagery to rehearse putting a golf ball, although your eyes may be closed and your body remains still. In addition to sight, imagery can include all of our senses, including feeling your muscles moving during movement, to simulate the experience of actually performing. You can also use your sense of sound, touch, and so on. Keep in mind that the goal of imagery is to recreate as vividly and realistically as possible the experience of actually performing. It is also possible to image from an internal or an external perspective. An internal perspective involves seeing yourself perform through your own eyes, while an external perspective involves seeing yourself perform from outside your body - as if you were watching yourself on TV.

Your specific instructions for the next 20 putts are to:

1) Line up each putt,

2) Assume your normal putting stance,

3) (N group) Image yourself (with eyes closed and refraining from physical movement) performing a putting stroke, striking the ball, and then see the ball rolling, rolling toward the cup but then missing about a foot to the left of the cup. Try to use an internal perspective (through your own eyes) and feel the movement and see the image as vividly as you can. Once you have a vivid image of the golf ball at rest in this spot, begin the next step.

3) (P-N group) Image yourself (with eyes closed and refraining from physical movement) performing a putting stroke, striking the ball, and then see the ball rolling, rolling and dropping right into the cup. Then, image yourself performing a putting stroke, striking the ball, and then see the ball rolling, rolling toward the cup but then missing about a foot to the left of the cup. Try to use an internal perspective (through your own eyes) and feel the movement and see the image as vividly as you can. Once you have a vivid image of the golf ball at rest in this spot, begin the next step.

3) (N-P group) Image yourself (with eyes closed and refraining from physical movement) performing a putting stroke, striking the ball, and then see the ball rolling, rolling toward the cup but then missing about a foot to the left of the cup. Then, image yourself performing a putting stroke, striking the ball, and then see the ball rolling, rolling and dropping right into the cup. Try to use an internal perspective (through your own eyes) and feel the movement and see the image as vividly as you can. Once you have a vivid image of the golf ball dropping into the cup, begin the next step.

4) Upon rehearsing the image(s), physically putt the golf ball, trying to sink the putt.

5) Then, repeat the previous steps. After 10 putts you will have a one minute interval to rest and rehearse your image(s), before completing the next 10 putts.

It is vital to the experiment that you follow this procedure prior to each of the remaining putts. Do not alter the image(s) you are to rehearse or change the order in any way. Also, try your best to see and feel the image(s) as clearly and as realistically as you can. Now, let me guide you through the rehearsal of your image(s) before you begin.

APPENDIX F

DEBRIEFING SCRIPT

Thank you again for your participation. Mental imagery (sometimes referred to as visualization) has become a very popular technique both in sport and out. Athletes report experiencing both positive (i.e., successful) and negative (i.e., unsuccessful) images. Research has found that in general rehearsal of positive images can help performance, while rehearsal of negative images can be harmful. The purpose of this study was to learn more about the specific effects of negative images on performance and a strategy to block these effects.

APPENDIX G

TABLES FOR PUTTING PERFORMANCE AND PUTTING DIRECTION

Putting Performance Pre and Post Scores by Group and Imagery Ability (Based on MIQ-R Median Split)

Group	Imagery	Pretest M	Pretest SD	Pretest N	Posttest M	Posttest SD	Posttest N
N	Hi	10.38	2.88	8	8.63	3.58	8
N	Lo	10.50	2.07	8	8.50	3.59	8
N	Total	10.44	2.42	16	8.56	3.46	16
P-N	Hi	8.63	1.92	8	9.50	4.17	8
P-N	Lo	7.88	2.80	8	10.50	2.67	8
P-N	Total	8.25	2.35	16	10.00	3.43	16
N-P	Hi	8.63	2.62	8	9.63	3.07	8
N-P	Lo	9.25	2.05	8	9.13	2.10	8
Total		8.94	2.29	16	9.38	2.55	16
C	Hi	9.63	2.50	8	8.75	1.67	8
C	Lo	8.63	2.45	8	10.13	3.04	8
Total		9.13	2.45	16	9.44	2.48	16

Putting Direction Pre and Post Scores by Group and Imagery Ability

Group	Imagery	Pretest M	Pretest SD	Pretest N	Posttest M	Posttest SD	Posttest N
N	Hi	3.38	2.07	8	5.00	4.78	8
N	Lo	3.00	1.93	8	6.00	2.78	8
N	Total	3.19	1.94	16	5.50	3.81	16
P-N	Hi	7.13	1.96	8	6.38	3.34	8
P-N	Lo	4.75	2.49	8	4.88	2.75	8
P-N	Total	5.94	2.49	16	5.63	3.05	16
N-P	Hi	5.00	2.14	8	3.88	2.70	8
N-P	Lo	3.13	1.55	8	3.75	1.04	8
Total		4.06	2.05	16	3.81	1.97	16
C	Hi	4.00	3.46	8	4.88	3.23	8
C	Lo	5.25	3.49	8	4.38	2.00	8
Total		4.63	3.42	16	4.63	2.60	16

APPENDIX H

RESPONSES TO OPEN-ENDED QUESTIONS FROM POST-EXPERIMENTAL QUESTIONNAIRE

Please Describe Any Differing Images you experienced

(N group)
Sometimes I imagined making it. Then, I would imagine hitting the ball again and my final imagine was always to the left of the hole.

One image the ball went in the cup.

Sometimes the ball goes slightly right, went in and all the way left. 4 to 5 went to the right or in.

Sometimes the ball went in cup (3-4 times).

Sometimes the ball went in the cup (4) or stopped short of the cup (2).

(P-N group)
Difference was in distance of missing on left, hit edge, went long, or short.

Many of the misses fell. 6 out of 20 fell.

A little bit shorter than the hole (1-2) or the same direction as the first imagine missing (1-2).

Going to the right (2).

(N-P group)
When attempting to image making the putt, I would imagine coming up short (5 times).

Missed to the right (2-3 times).

3 right of the cup.

Missing to the right of the cup (3). Not imaging the entire swing (e.g., just the ball going into the cup (2).

Sometimes the ball came short or to the right; 10 times I missed when imaging trying to sink it.

A couple times my images were that I missed to the right of the cup. 5-8 times I imagined making it then missing it.

When imagining missing left; went in 2 or 3 times.

What Effect Did Your Image(s) Have On Your Subsequent Performance?

(N group)
Lack of confidence in ability to make the actual putt. Made myself mad also.

When trying to swing, I could feel my arms turning the putter head to make the ball go left.

It helped my direction of putts. I relaxed more and I believe that I was focusing on my movements more.

Posture, aim, stroke image.

It caused me to miss the putt because I could see myself doing it.

Cause me to aim to the right.

My confidence level was effected because I felt I failed, I saw myself missing the cup.

I concentrated on the putt more. Club head straight, etc.

Messed up goal of what I really wanted to do. Yes, it hurt my performance because I was concentrating on missing it and then when I putted I tried to make it.

Thinking too hard - distraction.

Bothered putting stroke. Felt like I was pulling to left.

Mentally when I opened my eyes I expected to miss the putt.

That's what I saw, so it was difficult to push the putt back to the putt.

I didn't feel like I was going to make it as often. I wasn't as confident.

(P-N group)
I tried to correct missing left and thus, I missed right at times.

Over-compensated to try to make the putt.

When I missed it was always to the left. Without positive image I think negative image would have been more harmful.

Could see putting stroke and club hitting the ball. Helped with aiming.

Vision of missing was left in my head.

Imagining making a putt helped me see the correct form versus missing.

I had more time to concentrate. The first image of sinking the putt was stronger than the second image.

You think your going to make it but then you image yourself missing.

If I missed the putt first, the second putt correct direction.

Move my feet to better line up.

Almost like a practice shot.

Seeing yourself sinking the putt.

Make me concentrate better.

Easier to visualize the line of the putt.

(N-P group)
Easier to focus and concentrate on all movements.

You could feel the errors, missing and correct yourself making the putt.

By visualizing making the putt, I got more of a feel for the putting stroke.

It let me to re-adjust my standing before actually hitting the ball. Making it helps me to have confidence a little bit.

Imagining myself missing the putt made me nervous, but seeing myself make the putt helped me more.

Because it felt like each putt was more consistent.

Somewhat; the image of me making the putt was help in developing a putting stroke.

The putting motion appeared easier and more accurate after imagining myself successfully completing the putt.

Some help, some hurt.

Imaging going through the motion helped me know the distance and the angle I was at - aiming.

When I imaged missing the putt it threw me off when I actually came to putt. Positive image helped but didn't block out the negative image when I actually went to putt.

Didn't concentrate on the true putts as much.

Help concentrate. Worked harder to make it.

Distraction.

Did Your Image(s) Change Your Putting Strategy?

(N group)
I would not line up my putt to the hole as carefully.

Stance adjustment. Imagined not pulling ball.

Tried to aim to the right.

I tried to correct my putt to the left by aiming for the right of the cup.

I tried to aim better.

Over compensating.

Putting stroke felt less smooth.

Didn't look at cup before hitting.

I aimed a little to the right side of the cup in an attempt to "fix" my left putt.

(P-N group)
Tried to focus in on aiming ball correctly towards the cup.

For the last 5-10 putts, when attempting to make the shot I would aim towards the right side of the cup.

Made sure club path remained straighter - less to the left.

When clear image of missing to the left was present, I then aimed more to the right on actual putt.

More time (concentration).

If I missed the putt first, I change my putt's direction.

Aim more to the right.

Feet alignment, hitting the sweet spot.

Had urge to hit to the left.

I was more conscious of missing the putt to the left so I would compensate my putt lie accordingly.

(N-P group)
I concentrated more.

Tried to putt to the right.

I would take more time to adjust my standing and aim at the hole for the next 20 putts than the first 20.

Step up to ball in one position (as if to hit). After the image, I would readjust or re-evaluate my stance. I readjust in order to keep from going left, because I normally don't go too far right.

I aimed my shot more accurately.

When I image hitting to the left, I change my alignment and hit it to the right.

I aimed more to the right of the cup.

I tried harder; combined with actually missing my putts it did help me focus.

Control Group

Please Describe Any Visual Images You Experienced

I visualized the ball going in a line and into the hole.

Imagined the ball rolling more to the left - would try to compensate to make the ball go left.

Imagined the break of the green.

I saw that the ball is going to roll by the edge of the putt before I touched the ball.

See the line.

Tried to see the path the ball would take.

Going in line.

Viewed the ball along the line, but not really falling in the cup.

How the ball would bounce toward the cup. How it would circle the cup as it went in.

I see myself striking the ball and the ball rolling into the cup.

Saw the finish position and the ball rolling into the cup.

The swing of my club and how the clubhead was positioned so the ball would go in.

I saw the ball curve on the green towards the cup. I saw the break on the ball.

Saw the line.

Please Describe Any Feeling Images You Experienced

I tried to feel how the stroke would feel if it was done correctly in order to make the ball go in.

Same feel of the putter every swing for consistent distance.

I felt the force of the stroke.

Pace of hands through ball.

Hitting the ball.

Remembered how fast/hard I would move the putter on previous shots - used to hit the right range.

Tried to practice putt without hitting the ball to get a feel for what I wanted, then tried to repeat it when I hit the ball.

Tried to get the proper head speed of the putter.

I just don't think I feel anything most of the time, sometime I did I guess.

I tried to image how far back the club should go, so the ball would end up in the hole.

Always felt the feel of putting stroke.

<u>If You Experienced Any Images Prior to Putting, Please Explain What Effect You Think They Had On Your Subsequent Performance?</u>

I believe that the putting strokes that I imagined had a better chance of going in rather than just hitting the ball.

The second twenty putts - the ball went more to the left- but still stayed to the right of the hole.

It helped me prepare for the next putt.

Preparation for putt.

Helped to get proper placement. Also with aim.

Confidence, line.

As far as feeling my practice putts, I feel they are very important, but seeing the ball fall in the cup using imagery isn't quite as important.

The conscious thought of going to the subconscious action, helps control the action.

I feel that all the ones I made I imaged before, but I also missed some after imaging, but I missed few if any after imaging.

If I think I am going to miss my shot, most likely, I will. Confidence is higher when I see (imagine) my putt.

The last 20 ball, most of them went in, through use of these images.

It calms me down.

It helps relax and give a good touch.

APPENDIX I

ANOVA AND ANCOVA SUMMARY TABLES

TABLE 1

Analysis of Variance of Putting Performance Scores for Pre- to Posttest

Source	SS	DF	MS	F	Sig
Group (G)	2.78	3	.93	.09	.963
Imagery Ability (IA)	.28	1	.28	.03	.867
G X IA	.16	3	.05	.01	.999
Error	554.75	56	9.91		
Trial (T)	.78	1	.78	.14	.709
G X T	54.16	3	18.05	3.26	.028
IA X T	3.78	1	3.78	.68	.412
G X IA X T	16.28	3	5.43	.98	.409
Error	310.00	56	5.54		

TABLE 2

Analysis of Covariance of Putting Direction Scores for Pre- to Posttest

Source	SS	DF	MS	F	Sig
Group	36.61	3	12.20	1.55	.211
Imagery Ability (IA)	.16	1	.16	.02	.886
G X IA	2.57	3	4.19	.53	.662
Error	432.46	55	7.86		
Regression	71.41	1	71.41	9.08	.004

TABLE 3
Analysis of Variance of Post-Experimental Questionnaire #1

Source	SS	DF	MS	F	Sig
Group	.5417	2	.2708	.9420	.3974
Error	12.9375	45	.2875		
Total	13.4792	47			

TABLE 4
Analysis of Variance of Post-Experimental Questionnaire #2

Source	SS	DF	MS	F	Sig
Group	.7917	2	.3958	.2317	.7941
Error	76.8750	45	1.7083		
Total	77.6667	47			

TABLE 5
Analysis of Variance of Post-Experimental Questionnaire #3

Source	SS	DF	MS	F	Sig
Group	1.1667	2	.5833	.3787	.6869
Error	69.3125	45	1.5403		
Total	70.4792	47			

TABLE 6
Analysis of Variance of Post-Experimental Questionnaire #4

Source	SS	DF	MS	F	Sig
Group	.1250	2	.0625	.1016	.9036
Error	27.6875	45	.6153		
Total	27.8125	47			

TABLE 7
Analysis of Variance of Post-Experimental Questionnaire #5

Source	SS	DF	MS	F	Sig
Group	.0417	2	.0208	.0336	.9670
Error	27.8750	45	.6194		
Total	27.9167	47			

TABLE 8
Analysis of Variance of Post-Experimental Questionnaire #6

Source	SS	DF	MS	F	Sig
Group	8.2917	2	4.1458	4.0834	.0235
Error	45.6875	45	1.0153		
Total	53.9792	47			

TABLE 9
Analysis of Variance of Post-Experimental Questionnaire #7

Source	SS	DF	MS	F	Sig
Group	.2917	2	.1458	.5769	.5657
Error	11.3750	45	.2528		
Total	11.6667	47			

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