

“Don’t Miss!” The Debilitating Effects of Suppressive Imagery on Golf Putting Performance

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The present study examined the impact of suppressive imagery (i.e., trying to avoid a particular error), the frequency of this suppression, and attempts to replace negative error-ridden images with positive ones on golf putting performance. Novice golfers ($N = 126$) were assigned to a no-imagery control group or to 1 of 6 groups in a 3×2 design, with imagery type (positive, suppression, suppression-replacement) and imagery frequency (before every putt, before every third putt) as factors. Results showed that the accuracy of the positive imagery group improved across imaging blocks—regardless of imagery frequency. The suppression and suppression-replacement imagery groups’ accuracy improved when imaging before every third putt, yet declined when imaging before every putt. These findings suggest that frequent application of suppressive imagery hurts performance and that attempting to replace negative images with corrective ones does not ameliorate the damage.

Key words: mental imagery, thought suppression

The ability to control thoughts and images prior to and during sensorimotor skill performance is thought to be a crucial determinant of successful skill execution (Bandura, 1997; Zinsser, Bunker, & Williams, 1998). Both negative self-talk (Johnston-O’Conner & Kirschenbaum, 1986) and negative imagery (Woolfolk, Parrish, & Murphy, 1985) immediately prior to performance have been shown to hurt skill execution. Furthermore, the mere mention of the negative concept of *choking*, defined as an inability to perform up to previous skill level under increased pressure to succeed, has been shown to lead to a breakdown in performance (Leith, 1988). Because negative pre-performance thoughts and images play a large role in performance, it is worthwhile to explore the underlying cognitive variables that mediate their control, but it is also important to determine how attempts to control or regulate these thoughts and images might influence the performance itself.

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Thought and Image Control

Studies of the processes involved in thought suppression have demonstrated that attempts to suppress thoughts from one’s conscious awareness may actually increase the probability that the to-be-suppressed thought will influence subsequent thoughts and actions (Macrae, Bodenhausen, Milne, & Jetten, 1994; Wegner, 1994; Wegner & Erber, 1992; Wegner, Schneider, Carter, & White, 1987). Wegner (1994) has proposed a theory of “ironic mental processes” to account for this phenomenon. Wegner’s ironic-process theory is based on the notion that successful thought management relies on two cognitive processes: one controlled and the other automatic. The controlled process is initiated when an unwanted thought comes to mind. The role of the controlled process is to replace any unwanted thought with a more appropriate task related thought. As with most controlled processes, this target-replacing mechanism is characterized as being intentional, flexible, and constrained by the availability of resources (Hasher & Zacks, 1979; Logan, 1988; Macrae et al., 1994). In contrast, the automatic search process is thought to be highly proceduralized, closed to introspection and report, and not constrained by attentional resources. The job of the automatic monitoring system is to scan the contents of consciousness for any trace of unwanted thoughts (Macrae et al., 1994). When an unwanted thought is detected, the controlled system then “kicks in” and replaces this item with a different task related thought (Wegner & Erber, 1992).

According to Wegner (1994), both the controlled and automatic processes must be in operation in order to assure successful thought suppression. When attentional resources are taxed, the controlled replacing process (which requires attention in order to be successfully initiated) is compromised, while the automatic target search process is carried out successfully, highlighting the unwanted thought. This is postulated to lead to the *hyperaccessibility*, and in turn the rebound of unwanted thoughts (Wegner, 1994).

While Wegner’s theory has received some support (see Wegner & Bargh, 1998), unwanted thoughts have also been shown to persist in situations that do not tax attentional capacity. In three experiments designed to access perceivers’ stereotypes and their subsequent evaluations and behavior toward a stereotyped target, Macrae et al. (1994) found that in situations devoid of attentional stress, instructions to inhibit a specific stereotyped thought led to increased activation of the to-be-suppressed thought. It was suggested that detection of unwanted thoughts by the automatic target-search mechanism postulated in Wegner’s (1994) ironic-process theory actually increases the activation of the to-be-suppressed thought. Macrae et al. suggested that the more frequently an unwanted thought is activated or primed by the automatic search mechanism, the more likely it will be brought into conscious awareness, regardless of cognitive load. Furthermore, Wegner et al. (1987) have also found that cognitive load is not necessary for thought rebound. Wegner and colleagues demonstrated that even in the absence of cognitive load, merely asking participants to “not think about a white bear” increased the probability of the occurrence of this thought.

Thought Replacement

Not only did Wegner et al.’s (1987) “white bear” study demonstrate that rebound may occur in the absence of cognitive load, it was also found that rebound

could be attenuated through the use of a focused distracter thought. When participants were given a specific thought as a distracter (e.g., a red Volkswagen) during the time they were instructed to suppress an unwanted target thought, they were less likely to become preoccupied with the to-be-suppressed thought. Wegner (1994) built this finding into his theory, proposing that replacement of an unwanted thought with a neutral or task-appropriate thought is a cure for the rebound effect.

Imagery and Motor Skill Performance

An empirical question concerns whether theories of thought suppression, rebound, and replacement apply specifically to the kinds of thought processes called imagery. However, there is no theoretical reason to believe it should not. Investigating this question is important to the use of imagery when preparing for performance because one of the suggested primary determinants of the performance-enhancing capability of mental imagery is its controllability (Goss, Hall, Buckholz, & Fishburne, 1986). Controllability refers to an individual's ability to image what he or she intends to, while at the same time being able to manipulate aspects of the image he or she is not satisfied with (Goss et al., 1986; Janelle, 1999). Thus, the notion that specific negative thoughts may influence later performance, and that consciously attempting to suppress these thoughts may increase their subsequent mental and behavioral manifestation, carries implications for the use of mental imagery in sensorimotor skill settings.

Imagery Outcome

Reviews of the literature on mental practice (Driskell, Copper, & Moran, 1994; Feltz & Landers, 1983; Martin, Moritz, & Hall, 1999), as well as testimonials from successful athletes, indicate that mental imagery can be an effective means of enhancing performance. However, many variables have been shown to either mediate or moderate the relationship between imagery and performance (Feltz & Landers, 1983). Imagery outcome is one such factor (Woolfolk, Murphy, Gottesfeld, & Aitken, 1985). The outcome of imagery refers to whether the imaged rehearsal of a task includes a successful end result (positive imagery) or an unsuccessful end result (negative imagery). Because imagery may be either positive or negative, the type of image that a performer has will help determine the impact of that image on subsequent skill execution. This notion is especially important in light of the fact that studies examining the use of imagery in real-world settings have reported that athletes sometimes image themselves performing incorrectly and/or unsuccessfully in both practice and competition (Barr & Hall, 1992; Orlick & Partington, 1988). Nevertheless, while the effects of positive imagery have been frequently pursued, few studies have explored the effects of negative imagery.

Powell (1973) conducted one of the first studies to examine the impact of negative imagery on motor skill performance. Powell found that combining physical practice with negative imagery in a dart throwing task (i.e., imaging the dart landing near the edge of the board) led to a decrease in dart throwing accuracy versus combining physical practice with positive imagery (i.e., imaging the dart landing near the center of the target). Subsequent laboratory studies have provided additional support for the deleterious effects of pre-performance negative imagery on skill execution: In two studies exploring the effects of positive and negative

imagery on motor skill performance, Woolfolk, Murphy, et al. (1985) and Woolfolk, Parrish, and Murphy (1985) found that golf putting accuracy declined when individuals employed negative imagery prior to putting.

Suppression of Negative Imagery

The above studies demonstrate that negative performance related images may have a detrimental influence on motor skill execution. One might be tempted to conclude from these studies that performers should try to avoid negative imagery, and that if they image negative outcomes, they should immediately attempt to suppress them. However, findings from the literature on thought suppression indicate that efforts to suppress negative images might backfire (Macrae et al., 1994; Wegner, 1994; Wegner & Erber, 1992; Wegner et al., 1987). If attempting to suppress unwanted thinking actually primes or activates the unwanted thought, producing a rebound of the to-be-suppressed ideas, and if this theory applies to mental imagery, then suppression may unwittingly compound the problems for performance already created by negative imagery by making it more likely that the negative images will arise.

We are not aware of any study to date that has explored negative image suppression or its behavioral consequences for subsequent performance of the imaged activity. However, a limited amount of research has examined the behavioral effects of keeping unwanted thoughts out of mind. Because there appear to be a number of parallels between performance related thoughts and performance related images (Janelle, 1999), studies of thought suppression might provide some guidance as to what to expect in a study of imagery. A particularly intriguing study was reported by Wegner, Ansfield, and Pilloff (1998), who explored the relationship between thought suppression and action in both a golf putting task and a task that required swinging a hand-held pendulum in a specific pattern. In both tasks, instructing the participants not to perform a certain action actually increased the probability of this action occurring. The increase was largest when participants were under mental or physical load, created by either keeping a 6-digit number in mind while putting, or counting backward by 3's, or holding a weight in one hand during the pendulum task.

Wegner et al. (1998) interpreted these results as evidence for the manifestation of thought "rebound" in physical action. However, two follow-up studies failed to replicate these findings (Braffman, Kirsch, Milling, & Burgess, 1997; Janelle, Murray, de la Pena, & Bouchard, 1999). In the study by Janelle et al. (1999), suggestions not to leave a putt in a particular spot actually resulted in the opposite action. That is, if participants were instructed to "not putt the ball past the target," they left putts significantly short. Janelle et al. concluded that individuals may actually overcompensate as a result of instructions to avoid a particular outcome, at least where overt performance is concerned.

Both Janelle et al. (1999) and Wegner et al. (1998) manipulated cognitive load in their investigation of thought rebound and subsequent action. However, as previously noted, the hyperaccessibility of suppressed thoughts has also been found in conditions that do not deplete attentional resources (Macrae et al., 1994; Wegner et al., 1987). Thus the extent to which the manifestation of unwanted actions occurs in situations devoid of cognitive load remains to be seen. In real life, individuals operate in diverse situations that vary in degree of cognitive demands, and the

practice of skills—in which imagery might be brought to bear to stimulate improvement—often occurs as a single task with few distractions. Therefore, this is an issue that warrants further study.

The Present Study

The present study explored the behavioral consequences of suppression in the context of mental imagery and the sensorimotor task of golf putting. Four main hypotheses were derived. First, according to the literature on thought suppression (Macrae et al., 1994; Wegner, 1994; Wegner & Erber, 1992; Wegner et al., 1987), attempting to suppress negative images related to performance should increase the occurrence of these images. Second, based on Wegner's (1994) theory of ironic processes, attempting to suppress negative images related to performance should result in the behavioral manifestation of these images and thus a decrement in golf putting performance. Furthermore, such decrements should be attenuated by replacing the to-be-suppressed image, whenever it occurs, with a corrective image. Finally, the frequency of attempts to suppress negative images may affect their impact on performance. We hypothesized that attempting to constantly suppress a negative image may add an indirect attentional load to skill performance, diverting attention away from the primary skill and thus resulting in a decrease in putting performance.

Method

Participants

A total of 126 (34 M, 92 F) undergraduate students, ages 17 to 29 ($M = 19.35$ yrs, $SD = 1.68$), who were enrolled in an introductory psychology class at Michigan State University, served as study participants. In order to assure that participants did not have prior experience using imagery to enhance golf putting performance, only novice golfers with no previous golf experience were used. A postexperimental questionnaire concerning participants' previous use of imagery in other sensorimotor and cognitive skill settings was also utilized in order to assess the influence of past imagery experience.

Participants were randomly assigned to a no-imagery control group (C ; $n = 18$) or to one of 6 groups in a 3×2 experimental design, with imagery type (positive, suppression, suppression-replacement) and imagery frequency (before every putt, before every third putt) as factors. The 6 experimental groups, with 18 participants in each, consisted of: a high-frequency positive imagery group (HFPI), a low-frequency positive imagery group (LFPI), a high-frequency suppression imagery group (HFSI), a low-frequency suppression imagery group (LFSI), a high-frequency suppression-replacement imagery group (HFRI), and a low-frequency suppression-replacement imagery group (LFRI).

Questionnaires

Two questionnaires were administered to participants: The Movement Imagery Questionnaire-Revised (MIQ-R; Hall & Martin, 1997) and a postexperimental questionnaire. The MIQ-R is designed to assess visual and kinesthetic imagery ability. In order to complete it, participants performed a series of motor

movements and then were instructed to either "see" or "feel" themselves performing each movement. They were then asked to rate on a 7-point Likert scale the ease or difficulty of imaging the movements. The postexperimental questionnaire was administered to each participant upon completing the experiment. It was designed to assess the imagery perspective that participants utilized during putting in the present experiment, as well as their prior use of imagery. It was administered after the experiment in order to assure that questioning the participants as to their perceptions of prior imagery use would not influence the imagery manipulations in the present experiment. Also, administering the questionnaire post hoc allowed reports of imagery use in the present experiment, as well as any prior imagery use, to be collected in a similar context after undergoing the imagery manipulation.

Procedure

After providing informed consent and completing a demographic sheet concerning previous golf experience, participants were told that the purpose of the study was twofold: (a) to examine the accuracy of golf putting over several trials of practice; and (b) to assess the influence of mental imagery rehearsal on putting performance. Then they were provided with an introduction to mental imagery as defined in the MIQ-R instructions (see Hall & Martin, 1997). Specifically, the experimenter defined mental imagery as a way of mentally performing movements and informed the participants that individuals often utilize visual imagery, kinesthetic imagery, or both. Visual imagery was described as a visual image or picture of movement in one's mind. Kinesthetic imagery was explained as attempting to feel what performing a movement is like without actually doing the movement. The imagery introduction took approximately 5 minutes, after which the participants could ask questions. They were then administered the MIQ-R.

Following the MIQ-R, participants were given a questionnaire concerning imagery perspective. They were informed that there are two types of perspectives from which individuals can image. An internal perspective was described as experiencing oneself performing from within the body, as if through one's own eyes, while an external perspective was characterized as the experience of oneself performing from outside the body, as if watching oneself on television. Participants were asked to indicate on a 5-point Likert scale, with respect to the 8 movements they had just performed in the MIQ-R, how often they imaged from an internal perspective and how often from an external perspective.

The participants were then asked if they were right-handed or left-handed and were given the appropriate putter. They were told they would be completing a series of golf putts. They were instructed that the object was to putt a golf ball as accurately as possible on a carpeted indoor putting green 3×3.7 m, to a target 2 m away, marked by a square of white tape 4×4 cm on which the ball was supposed to stop. Participants putted with a standard golf ball and putter. All participants completed 5 blocks of 10 putts. The Control group received no imagery instructions while putting. For the remaining 6 groups, the first 2 blocks of putts served as practice and provided pretest measures of performance, comparable to the first 2 blocks of Control group putts, while the remaining 3 blocks involved imagery.

Prior to the imagery trial blocks, participants were told the experimenter would be guiding them through a series of mental images before each remaining putt (for the high-frequency imagery groups) or before some of the remaining

putts (for the low-frequency imagery groups). They were asked to line up their next putt, assume their normal putting stance, and rehearse the images that were given to them; they were to use the imagery perspective they were most comfortable with, keep their eyes closed, and refrain from any physical movement.

The experimenter guided participants through the imagery rehearsal sequence prior to every putt involving imagery. The positive imagery group was instructed to image the ball stopping on the target. The suppression group was instructed to image the ball stopping on the target, but not to image the ball rolling "past" or "short" of the target. The direction of the imagery instruction was alternated every two putts involving imagery. The suppression-replacement group was given additional instructions to replace any incorrect image with an image of the ball on the target. Following every trial on which the putt was preceded by imagery, all participants were asked to describe the image they created on that trial. Specific imagery instructions for each group are reported below.

Participants in the high-frequency imagery groups (HFPI, HFSI, HFRI) imaged before every putt, while those in the low-frequency imagery groups (LFPI, LFSI, LFRD) imaged before every third putt. Every third putt was chosen as the schedule for the low-frequency groups as a means for contrasting imagery prior to every putt with a less frequent yet steady rate of imagery. Following the final putting block, each participant was administered the postexperimental questionnaire and debriefed.

Control Group. Participants completed two sets of 10 putts, followed by a short break in which they were instructed to remain standing. They then completed three more sets of 10 putts without any additional instructions.

High-Frequency Positive Imagery Group. Participants in the HFPI group were specifically instructed, "Try to see and feel yourself taking a swing, followed by the ball rolling, then stopping right on top of the target. When you are ready, you may actually attempt the putt."

Low-Frequency Positive Imagery Group. Participants in the LFPI group completed the same experimental procedure as the HFPI group. However, they were only led through the imagery sequence prior to every third putt attempt. On the other putt attempts, they were instructed to just take a putt.

High-Frequency Suppression Imagery Group. Participants in the HFSI group were specifically instructed, "Try to see and feel yourself taking a swing, followed by the ball rolling, then stopping right on top of the target. While you are doing this, be particularly careful to try not to image hitting the ball *short* of the target. *Don't image undershooting the target!* When you are ready, you may actually attempt the putt." The experimenter guided them through the imagery sequence for the first two putts and then gave them the same imagery scenario for the next two putts, with the exception that "hitting the ball short of the target. *Don't image undershooting the target!*" was replaced with "hitting the ball *past* the target. *Don't image overshooting the target!*" Participants were guided through the imagery sequence prior to every putt, with suggestions not to image *undershooting* the target or *overshooting* the target alternating every two putts, for the three sets of 10 putts that constituted the imagery blocks. The direction of the imagery instructions were alternated in this manner to ensure that participants would not cognitively adapt to performance errors induced by the suggestion of an erroneous performance in one particular direction.

Low-Frequency Suppression Imagery Group. Participants in the LFSI completed the same experimental procedure as the HFSI group. However, they were only led through the imagery sequence prior to every third putt attempt. As in the HFSI group, imagery instructions concerning whether to image hitting the ball *past* or *short* of the target were alternated every two putts that involved imagery.

High-Frequency Suppression-Replacement Imagery Group. Participants in the HFRI group were specifically instructed, "Try to see and feel yourself taking a swing, followed by the ball rolling, then stopping right on top of the target. While you are doing this, be particularly careful to try not to image hitting the ball *short* of the target. *Don't image undershooting the target!* But, if you do happen to image the ball rolling and stopping *short* of the target, immediately try to image the ball sitting *on top* of the target. When you are ready, you may actually attempt the putt." The experimenter guided the participants through the imagery sequence for the first two putts and then gave them the same imagery scenario for the next two putts, with the exception that "hitting the ball *short* of the target" was replaced with "hitting the ball *past* the target." Participants were guided through the imagery sequence prior to every putt, with suggestions not to image "*undershooting* the target" or "*overshooting* the target" alternating every two putts, for the three sets of 10 putts that constituted the imagery blocks.

Low-Frequency Suppression-Replacement Imagery Group. The LFRD participants completed the same experimental procedure as the HFRI group. However, they were only led through the imagery sequence prior to every third putt attempt. As in the HFRI group, imagery instructions concerning whether to image hitting the ball *past* or *short* of the target, followed by a suggested replacement image, were alternated every two putts that involved imagery.

Design and Analysis

One-way ANOVAs were used to assess group differences on the MIQ-R, imagery perspective questionnaire and the postexperimental questionnaire. An arc-sine transformation was performed on all imagery reports. One-way ANOVAs were then conducted on these transformations in order to assess differences in imagery content between the experimental groups. In terms of putting performance, a 3 (Positive group, Suppression group, Suppression-Replacement group) \times 2 (Low frequency images, High frequency images) \times 2 (First pretest block, Last imagery trial block) repeated measures ANOVA was conducted, and Fisher's LSD tests were conducted post hoc. Finally, ball destinations were assessed using a series of *t*-tests designed to separately ascertain the influence of specific imagery suppression instructions and frequency of imagery on ball outcomes. Bonferroni adjustments were performed on the critical *p*-value of these *t*-tests in order to guard against inflation of Type I error rate.

Results

Movement Imagery Questionnaire-Revised

One-way ANOVAs performed separately on the visual and kinesthetic imagery scales of the MIQ-R revealed nonsignificant difference between groups (i.e., the 6 imagery groups and the control group) in terms of both visual, $F(6, 119) < 1$,

and kinesthetic imagery ability, $F(6, 119) = 1.92, p > .08, MSE = 41.91$, as measured by the MIQ-R. All groups scored relatively high on both the visual ($M = 24.5, SD = 3.47$) and kinesthetic ($M = 22.71, SD = 6.61$) imagery scales, on which scores can range from 4 to 28. Thus, the between-group differences in imagery and putting accuracy reported below do not appear to be mediated by individual differences in visual and kinesthetic imagery ability. Mean and standard error information for the MIQ-R by group are reported in Table 1.

Imagery Perspective Questionnaire

Following the MIQ-R, participants were given an introduction to imagery perspective and asked to report on a 5-point Likert scale how often they used an internal and how often an external imagery perspective while imaging during the MIQ-R. Both scales ranged from 1 = never, to 5 = always (with 3 = sometimes). One-way ANOVAs revealed no significant differences between groups (i.e., the 6 imagery groups and the control group) in terms of either internal, $F(6, 119) = 1.27, p > .28$, or external imagery perspective, $F(6, 119) < 1$. All groups reported using an internal perspective ($M = 3.38, SD = 1.12$) and external perspective ($M = 3.21, SD = 1.19$) close to the scale's midrange. Thus, between-group differences cannot be accounted for by individual differences in imagery perspective.

Postexperiment Questionnaire

The postexperiment questionnaire was administered after the study was completed. It was designed to assess imagery perspective during putting, as well as prior experience using imagery as a performance enhancing technique. Partici-

Table 1 MIQ-R and Post-Experimental Questionnaire Scores for the Control Group and the 6 Imagery Groups

Group	MIQ-R- Visual		MIQ-R- Kinesthetic		Post Quest.- Internal		Post Quest.- External		Post-Previous Imagery	
	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>
Control	24.89	0.88	22.56	1.07					3.87	0.24
HFPI	24.28	0.70	22.67	1.05	4.17	0.25	2.33	0.31	3.53	0.29
LFPI	25.22	0.64	22.56	0.92	4.11	0.28	2.56	0.36	3.36	0.23
HFSI	23.56	1.10	21.39	1.27	3.89	0.35	2.33	0.40	4.00	0.23
LFSI	25.00	0.73	27.38	2.80	3.78	0.26	2.33	0.28	3.81	0.21
HFRI	24.94	0.73	21.17	1.43	4.06	0.24	2.72	0.33	3.33	0.24
LFRI	23.61	0.89	21.39	1.30	3.72	0.29	2.67	0.30	3.56	0.29

HFPI = High-frequency positive imagery; LFPI = Low-frequency positive imagery; HFSI = High-frequency suppression imagery; LFSI = Low-frequency suppression imagery; HFRI = High-frequency suppression-replacement imagery; LFRI = Low-frequency suppression-replacement imagery.

pants were asked to report on a 5-point Likert scale how often they used an internal imagery perspective and how often an external one while imaging during the experiment. Both scales ranged from 1 = never to 5 = always (with 3 = sometimes). One-way ANOVAs revealed no significant differences between the 6 imagery groups in terms of either an internal or an external imagery perspective while putting, $F_s < 1$, respectively. All participants, regardless of imagery group, reported using an internal perspective ($M = 3.95, SD = 1.17$) significantly more than an external perspective ($M = 2.49, SD = 1.39$) during putting trials, $t(107) = 6.34, p < .001$.

In order to assess prior experience using imagery, participants who indicated they had previously used imagery as a performance aid were asked to report on a 5-point Likert scale how often they used mental imagery to prepare for performance. Nineteen reported never using imagery, and thus did not fill out the imagery use scale. A one-way ANOVA demonstrated that the number of participants reporting no previous use of imagery did not differ significantly between groups (i.e., the 6 imagery groups and the control group), $F(6, 119) = 1.11, p > .36$. The imagery use scale ranged from 1 = very infrequent to 5 = very often (with 3 = sometimes). There was no significant difference between groups concerning prior experience using imagery as a pre-performance aid, as demonstrated by a one-way ANOVA, $F(6, 100) = 1.05, p > .40$. All participants who reported using mental imagery as a pre-performance aid used it close to the scale's midrange ($M = 3.63, SD = 0.98$). Thus, differences in putting performance or imagery use between groups cannot be accounted for by differences in past imagery experience. Mean and standard error information for the postexperimental questionnaire by group are reported in Table 1.

Imagery Reports

Immediately following every putting trial preceded by imagery instructions, participants recalled the image they had prior to that particular putt. The reports of image outcomes were coded into four mutually exclusive categories: "positive," imaging the ball stopping on the target; "negative," imaging the ball stopping either short or long of the target; "replacement," imaging the ball stopping either short or long of the target but replacing it with an image of the ball on the target; or "other," a scenario not related to putting, or not imaging a scenario at all. Table 2 contains means and standard errors of imagery occurrences by group.

A one-way ANOVA on the arcsine transformation of positive imagery reports revealed a significant effect of group, $F(5, 102) = 2.47, p < .037, MSE = .17$. Post hoc Fisher's LSD tests demonstrated that the HFPI group (82.9% positive images) reported a significantly larger portion of positive images than all other groups, all $p < .05$. The LFPI group and all conditions involving suppressive imagery (HFSI, LFSI, HFRI, and LFRI groups) did not differ significantly from each other in terms of positive image reports. Thus, trying to produce positive imagery on every trial increased the accuracy of imagery relative to less frequent positive imagery as well as all conditions involving suppression.

A one-way ANOVA on the transformation of negative imagery reports produced a marginally significant effect of group, $F(5, 102) = 2.04, p < .079, MSE = .08$. Because significant differences were found between groups in terms of positive imagery reports, post hoc tests were conducted in order to assess group differ-

Table 2 Type of Image Outcome (%) for the 6 Imagery Groups

Group	Positive		Negative		Replacement		Other	
	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>
HFPI	82.9	5.2	12.9	3.9	0.0		4.1	1.9
LFPI	68.5	5.5	28.7	5.3	0.0		2.8	1.5
HFSI	66.5	5.6	32.4	5.8	0.0		1.1	4.7
LFSI	59.7	5.9	35.7	5.8	0.0		4.2	1.5
HFRI	66.3	6.6	16.3	5.9	13.9	2.4	3.5	1.7
LFRI	63.9	7.0	17.1	6.6	17.1	3.4	1.9	1.4

HFPI = High-frequency positive imagery; LFPI = Low-frequency positive imagery; HFSI = High-frequency suppression imagery; LFSI = Low-frequency suppression imagery; HFRI = High-frequency suppression-replacement imagery; LFRI = Low-frequency suppression-replacement imagery.

ences in negative imagery reports, even though the main effect of group was only marginally significant. Fisher's LSD tests showed that both the high-frequency suppression imagery group (HFSI, 32.4% negative images) and the low-frequency suppression imagery group (LFSI, 35.7% negative images) reported significantly more negative images than the high-frequency positive imagery group (HFPI, 12.9% negative images), all $p < .05$. The LFSI group also reported significantly more negative images than the high-frequency replacement imagery group (HFRI, 16.3% negative images), $p < .05$, marginally more negative images than the low-frequency replacement imagery group (LFRI, 17.1% negative images), $p < .081$, and more than the LFPI group, $p < .432$, although this effect was not significant. The HFSI group reported marginally more negative images than the HFRI group, $p < .1$, and more than the LFPI, $p < .644$, and LFRI groups, $p < .154$, although these effects were not significant. The HFSI and LFSI groups did not differ in negative imagery reports. In summary, the HFSI and LFSI groups reported more instances of negative images than all other groups. Thus, it appears that attempting to suppress negative performance images increases the occurrence of negative images.

The type of negative images that participants reported were also compared with the specific imagery instructions (e.g., instructions not to image hitting the ball past or short of the target) given prior to each putt. For the HFSI and LFSI groups, a negative image was considered to "match" the imagery instructions they received if the image they reported was similar in content to the action that the instruction proscribed. For example, an instruction "not to image hitting the ball past the target" and a participant report of "I imaged the ball landing past the target" was considered a match. Likewise, a negative image was considered to be an "overcompensation" of the imagery instructions given to a participant if it was opposite in content to the instruction. For example, an instruction "not to image hitting the ball past the target" and a participant report of "I imaged the ball landing short of the target" was considered an overcompensation of the imagery instructions. Negative imagery reports for the suppression-replacement groups (HFRI

and LFRI) were also coded as matches or overcompensations. Furthermore, negative images that contained a successful replacement image (e.g., "I imaged the ball past the target but was able to replace it with one of the ball on the target") were coded as matches or overcompensations because these images at some point contained part of the to-be-suppressed image.

One-way ANOVAs conducted on both the arcsine transformation of imagery reports that matched imagery instructions and imagery reports that were overcompensations of imagery instructions revealed no significant differences between those groups receiving negative imagery suppression instructions (HFSI, LFSI, HFRI, LFRI), $F(3, 68) = 1.55, p > .209, MSE = .028$, and $F(3, 68) = 1.06, p > .37, MSE = .073$, respectively. Thus, attempting to suppress negative images did not produce a systematic difference in imagery matches or overcompensations, regardless of imagery frequency or replacement imagery instructions received.

In order to assess differences in matches or overcompensations across all groups, a *t*-test was performed on the arcsine transformation of imagery reports collapsed across groups receiving negative imagery, $t(71) = 3.19, p < .002$. Overall, the HFSI, LFSI, HFRI, and LFRI groups were more likely to create images that overcompensated for these instructions than images that matched them (Table 3).

Table 3 Type of Image Outcome (%) in Relation to Imagery Instructions Received for the 4 Imagery Groups Receiving Negative Imagery

Group	Match		Match/ Replace		Over- compensate		Over/ Replace		Total Replace	
	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>
HFSI	5.6	1.5	0.0		26.9	6.1	0.0		0.0	
LFSI	8.3	3.2	0.0		27.3	6.2	0.0		0.0	
HFRI	15.2	2.8	7.2	2.4	15.0	2.9	6.7	2.4	13.9	2.4
LFRI	13.9	3.5	7.4	2.3	20.4	4.5	9.7	4.4	17.1	3.4

HFSI = High-frequency suppression imagery; LFSI = Low-frequency suppression imagery; HFRI = High-frequency suppression-replacement imagery; LFRI = Low-frequency suppression-replacement imagery.

Following the assessment of matches and overcompensations in the HFRI and LFRI groups, the percent of matches and overcompensations that also contained a replacement image, and the percent of total images that consisted of a match or overcompensation followed by a positive replacement image, were also assessed. The HFRI group reported being able to replace 47.6% of negative images that matched imagery instructions (7.2% of all images), and 44.5% of overcompensation images (6.7% of all images). The LFRI group reported being able to replace 53.3% of negative images matching imagery instructions (7.4% of all images), and 47.7% of overcompensation images (9.7% of all images). Overall, the

Table 4 Mean Distance From the Target (cm) for the Control Group and the 6 Imagery Groups

Group	Pretest 1		Pretest 2		Trial 1		Trial 2		Trial 3	
	M	SE	M	SE	M	SE	M	SE	M	SE
Control	29.82	2.18	22.64	1.68	23.79	2.41	22.47	2.35	21.15	2.01
HFPI	29.94	2.19	23.38	2.08	26.61	1.77	21.59	1.49	19.97	1.64
LFPI	29.55	2.03	25.36	1.83	25.52	2.06	22.85	1.97	22.59	1.82
HFSI	28.90	1.89	25.36	1.83	26.46	1.99	26.34	2.01	26.46	2.37
LFSI	27.21	1.67	27.34	1.81	24.24	1.47	23.69	1.25	20.52	1.37
HFRI	29.14	2.21	25.64	2.38	27.81	2.77	27.19	3.11	28.39	2.83
LFRI	31.65	1.91	26.07	1.72	26.66	2.07	23.99	2.10	22.16	1.82

HFPI = High-frequency positive imagery; LFPI = Low-frequency positive imagery; HFSI = High-frequency suppression imagery; LFSI = Low-frequency suppression imagery; HFRI = High-frequency suppression-replacement imagery; LFRI = Low-frequency suppression-replacement imagery.

rate of successful replacement of negative images was 46.0% in the HFRI group (13.9% of all images) and 50% in the LFRI group (17.1% of all images). Though the rate of successful replacement was lower in the HFRI group, this difference was not significant.

Putting Performance

Putting performance was measured by the distance (cm) away from the target that the ball landed after each putt regardless of direction. Table 4 lists means and standard errors of putting performance by group. A 3 (Positive group, Suppression group, Suppression-Replacement group) \times 2 (Low frequency images, High frequency images) \times 2 (First pretest block, Last imagery trial block) repeated measures ANOVA conducted on putting performance produced a significant Imagery Type \times Frequency \times Trial block interaction, $F(2, 102) = 3.74, p < .027, MSE = 42.22$ (Figure 1). A 3 (Positive group, Suppression, Suppression-Replacement) \times 2 (Low frequency images, High frequency images) general factorial ANOVA computed as a simple effects test on the first pretest trial block (Pre 1) revealed no main effect of group, frequency, or interaction of Group \times Frequency, $F_s < 1$. A 3 (Positive group, Suppression, Suppression-Replacement) \times 2 (Low frequency images, High frequency images) general factorial ANOVA on the last imagery trial block (Trial 3), however, revealed a significant Group \times Frequency interaction, $F(2, 102) = 3.06, p < .05, MSE = 74.32$. Post hoc Fisher's LSD showed that the HFRI group performed significantly worse than the HFPI, LFPI, LFSI, and LFRI groups, all $p < .05$. Similarly, the HFSI group performed significantly worse than the HFPI and LFSI, $p < .026$ and $p < .041$, respectively, and worse than the LFPI and LFRI groups, $p < .182$ and $p < .138$, respectively, although these effects were not significant. The HFRI and HFSI groups did not differ.

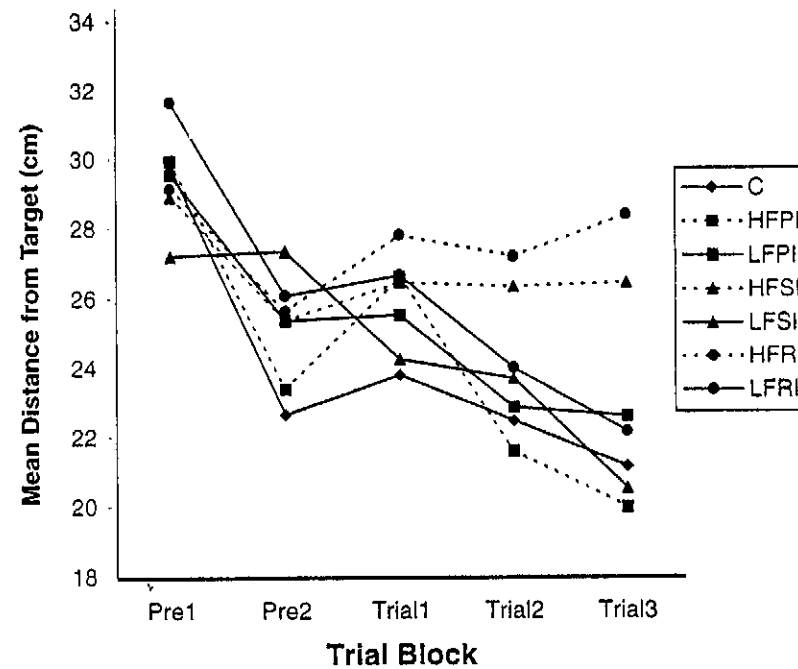


Figure 1 — Mean distance from the target (cm) across trial blocks for the Control group (C) and the 6 imagery groups: high-frequency positive imagery (HFPI); low-frequency positive imagery (LFPI); high-frequency suppression imagery (HFSI); low-frequency suppression imagery (LFSI); high-frequency suppression-replacement imagery (HFRI); and low-frequency suppression-replacement imagery (LFRI).

Additionally, the HFRI group performed significantly worse than the Control group, $t(34) = 2.09, p < .045$, and the HFSI group performed marginally worse than the Control group, $t(34) = 1.71, p < .096$, during the last block of imagery trials. However, neither of the positive imagery groups (HFPI or LFPI) performed significantly better than the Control group during the last block of imagery trials, $t(34) = .455, p > .652$, and $t(34) = .534, p > .597$, respectively. The same pattern was reported by Woolfolk, Parrish, and Murphy (1985), who found that pre-performance negative imagery hurt golf putting accuracy compared to not using imagery at all or using positive imagery. However, no significant differences were found between no-imagery use and pre-performance positive imagery.

Finally, putting improvement across trial blocks was assessed by group. In order to control for the inflation of Type 1 error rate as a result of multiple t -tests, a Bonferroni conversion on the critical p -value for this set of comparisons was performed, resulting in a p -value of $p < .008$. The Control group significantly improved from the first pretest (Pre 1) to the last block of imagery trials (Trial 3), $t(17) = 5.90, p < .001$. Likewise, there were significant improvements in putting

performance in the HFPI group, $t(17) = 5.45, p < .001$; the LFPI group, $t(17) = 5.52, p < .001$; the LFSI group, $t(17) = 3.45, p < .003$; and the LFRI group, $t(17) = 5.09, p < .001$. In contrast, as shown in Figure 1, the HFSI and the HFRI groups' putting performance was quite different. In these two groups, putting accuracy declined during the trial blocks involving imagery. By the third imagery block, accuracy was no better than in the first pretest block of putts, $t(17) = 1.14, p > .27$, for the HFSI group, and $t(17) = 0.22, p > .83$, for the HFRI group.

Ball Destination

Ball destination (or constant error, CE) refers to whether the ball stopped short of the target, on the target, or past the target. The relationship between ball destination and the experimenter-suggested image was explored for all 6 imagery groups.

The initial analysis of ball destination was restricted to the very first putt preceded by imagery instructions. This was done to compare the results of the present research to Wegner et al.'s (1998) study of instructions to avoid a particular outcome. Wegner et al. calculated putting performance as the difference between 1 practice putt (under no experimental manipulation) and 1 experimental putt (preceded by instructions not to overshoot the target). Averaged across participants, experimental putts were longer than practice putts, leading Wegner et al. to conclude that attempting to avoid a certain action prompted the behavioral manifestation of that action. We sought to discover whether attempting to avoid imaging a certain action would have similar consequences on the first putt.

In the present study, regardless of frequency of imaging, all 6 imagery groups were given imagery suggestions prior to the first putt in the imagery trial blocks. Thus, for the analysis of ball destinations for the first putt involving imagery, the HFPI and LFPI were collapsed into one positive imagery group, the HFSI and LFSI were collapsed into a suppression imagery group, and the HFRI and LFRI were combined into one suppression-replacement imagery group. The first putt in the imagery trial blocks for the positive imagery group was preceded by instructions to image the ball "stopping right on top of the target." The first putt in the imagery trial blocks for all participants receiving negative imagery was preceded by instructions to image the ball landing on the target, but to be sure not to image hitting the ball "past the target." This directive is analogous to Wegner et al.'s (1998) instruction not to putt the ball past the target. The suppression-replacement group received additional instructions to replace any negative images with an image of the ball "sitting on top of the target."

Putting performance for the first putt was measured as the difference between the last pretest putt and the first putt involving imagery in centimeters past the target. This performance measure was used to assess the impact of imagery corrected for individual differences in average accuracy, which might be biased in one direction or the other regardless of imagery's added effect. The positive group, on average, left putts -1.5 cm shorter of the target on the first imagery trial than on the last pretest putt. The suppression group overshot the target by 10.31 cm on the first imagery trial compared to the last pretest putt, a result much like Wegner et al.'s (1998). However, the suppression-replacement group produced a result opposite of Wegner et al.'s, undershooting the target by -11.83 cm on the first imagery

Table 5 Ball Destination (cm) Relative to Imagery Instructions for the 4 Imagery Groups Receiving Negative Imagery

Group	Long Instruction		Short Instruction	
	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>
HFSI	-6.75	2.61	6.74	2.66
LFSI	0.91	2.39	9.32	2.23
HFRI	-1.55	2.73	5.64	3.56
LFRI	-1.28	4.15	2.80	4.07

HFSI = High-frequency suppression imagery; LFSI = Low-frequency suppression imagery; HFRI = High-frequency suppression-replacement imagery; LFRI = Low-frequency suppression-replacement imagery.
Note: A "minus" sign indicates ball destination was short of target.

trial compared to the last pretest putt. A one-way ANOVA was performed on these differences; however, the effect of group was not significant, $F(2, 105) = 2.25, p > .11$.

Next, ball destinations were assessed for all putts involving imagery, rather than just for the first putt. Destinations for the positive imagery groups (HFPI and LFPI) were equally likely to be long or short of the target in all three imagery trial blocks. Mean absolute distance from the target was 22.72 cm ($SD = 5.57$) for the HFPI group and 23.65 cm ($SD = 6.77$) for the LFPI group. However, this was not the case for groups involving negative imagery, as can be seen in Table 5. In order to determine whether there was a significant difference from chance level between the number of times the ball destinations matched (i.e., ball destination in the same direction as participants were instructed to suppress an image) or were overcompensations (i.e., ball destination in the opposite direction of the to-be-suppressed image) of imagery instructions across all groups, a paired sample t -test was conducted on ball destinations collapsed across the 4 groups receiving negative imagery instructions. Ball destinations were significantly more likely to be overcompensations of imagery instructions than chance, $t(71) = 3.73, p < .01$.

Finally, ball destinations were assessed individually by group. In order to control for the inflation of Type 1 error rate as a result of multiple t -tests, a Bonferroni conversion was performed on the critical p -value for this set of comparisons, resulting in a p -value of $p < .013$. In the HFSI, ball destinations were significantly more likely to be overcompensations of image instructions than chance level, $t(17) = 2.94, p < .009$, and marginally more likely for the HFRI group, $t(17) = 2.53, p < .022$. Thus, although attempting to suppress a negative image on every trial reduced putting accuracy, this did not seem to result directly from a systematic behavioral manifestation of the to-be-suppressed image. Instead, it appears that when participants attempted to avoid a particular negative image, they were likely to overcompensate in performance. Comparable patterns of ball destinations were found for the LFSI and LFRI groups, $t(17) = 1.34, p < .20$, and $t(17) = 1.06, p < .28$, respectively, although these differences were not significant.

Discussion

The main goal of this study was to explore the influence of suppressive imagery on motor skill performance. Frequency of imagery rehearsal and type of imagery suggestion (i.e., positive, suppression, suppression-replacement) were manipulated in an attempt to test four main hypotheses: (a) Attempting to suppress negative performance related images will increase the likelihood of the occurrence of these images. (b) Attempting to suppress negative performance related images will result in the behavioral manifestation of these images and thus a decrement in golf putting performance. (c) Decrements in performance as a result of attempted image suppression may be attenuated by replacing the to-be-suppressed image, whenever it occurs, with a corrective image. (d) Increased frequency of attempts to suppress negative images may exacerbate their impact.

Attempted Image Suppression and Imagery Reports

In terms of the first hypothesis stated in the present study, participants' reports of imagery outcomes illustrate that the suppression imagery groups (HFSI and LFSI) had more frequent negative images than those groups receiving replacement imagery (HFRI and LFRI) or positive imagery instructions (HFPI and LFPI). Thus, attempting to suppress negative performance related images appears to increase the occurrence of negative images.

Participants' reports of the occurrence of positive images demonstrates that the high-frequency positive imagery group (HFPI) was able to image the ball stopping on the target (i.e., a positive image) more so than the low-frequency positive imagery group (LFPI), and all conditions involving suppressive imagery. Interestingly, instructions to rehearse a positive image prior to each putting attempt increased imagery accuracy relative to less frequent positive imagery instructions. This may be due in part to the use of novice golfers in the present study. Because novice golfers are not accustomed to mentally imaging golf putting scenarios, imaging before every trial may have afforded those in the HFPI group the practice time needed to successfully control more images compared to the participants who were given less frequent positive imagery or additional suppression instructions.

Nonetheless, even when individuals in the HFPI and LFPI groups were given only positive imagery suggestions, they still reported having negative images (i.e., imaging the ball stopping either short or long of the target) 12.9% and 28.7% of the time, respectively. Currently there is debate as to the incidence of negative images in mental practice situations. Janelle (1999) has suggested that "negative images often contaminate the ability to generate positive, confidence-building images" (p. 207). However, researchers have also found that high level athletes do not experience very much negative imagery (Barr & Hall, 1992; Hall, Rodgers, & Barr, 1990).

It may be that the novice performers in the present study did not have enough experience utilizing the visual and kinesthetic cues inherent in the golf putting skill to control their image outcomes. If so, this idea would be consistent with Barr and Hall (1992) and Hall et al. (1990) mentioned above, as well as with research suggesting that mental practice is most helpful in situations where a significant amount of actual practice precedes imagery attempts (Feltz & Landers, 1983). It may also be that more experienced performers are just more practiced at using

mental imagery as a performance aid and thus are better at controlling their images than novices, aside from actual practice experience. In a recent review of the mental practice literature, Martin et al. (1999) suggested that the ability to effectively image physical movements is associated with higher levels of motor skill performance.

Additionally, it should be noted that participants in the present study scored relatively high on the MIQ-R. Thus it may be that individuals in the present study, possessing a relatively high imagery ability to begin with, are more likely to be able to generate positive images than individuals with lower imagery abilities. However, the MIQ-R measures vividness of images and not necessarily the ability to control an unwanted image once it has occurred. Thus, more studies are needed of attempted imagery suppression in individuals with differential imagery controllability and vividness abilities.

Furthermore, the imagery report protocols of the present research assessed image outcomes (i.e., the result of the putting process: where the ball landed) rather than step-by-step images of skill execution (i.e., the processes involved in taking the putt: appropriate back swing, contact with the ball). While these two processes cannot always be separated in many motor skills, such as in gymnastics, this is obviously not the case in golf putting. It may be that participants in the present study were able to image the correct golf putting process, yet were not able to achieve a positive outcome. Alternately, participants may have imaged incorrect execution processes and used these negative process cues as a basis for forming negative performance outcome images. However, it is unlikely that the novice golfers in the present study had enough putting knowledge to judge the accuracy of the processes involved in their skill execution images. Regardless of the cause, the fact that individuals reported not being able to control their images following only positive imagery suggestions is striking and warrants further exploration of the imagery-performance relationship.

In light of the above, it should be pointed out that the imagery manipulations in the present study did not improve golf putting performance relative to no imagery use (the Control group). This finding is similar to that reported by Woolfolk, Parrish, and Murphy (1985) in which novice golfers' putting accuracy was not affected by pre-performance positive imagery; and it contrasts with research showing improvements in performance following imagery interventions (Driskell, Copper, & Moran, 1994; Feltz & Landers, 1983). It should be noted that improvements due to positive imagery are variable and not always significant, and their average impact as reported by Feltz and Landers (1983) is often small. In this context, the pattern of data in the present study suggests that while positive imagery may or may not benefit performance, attempting to frequently suppress negative images definitely hinders it. Thus, it may be beneficial to use imagery with caution, especially when negative images are likely to occur and subsequent attempts are made to suppress them.

In terms of the relationship between specific image outcomes and imagery instructions, both suppression groups (HFSI and LFSI) and the LFRI group reported images that were overcompensations of the to-be-suppressed imagery instructions more so than images that matched the outcome of imagery instructions received. The HFRI group reported images that matched imagery instructions and images that were overcompensations of imagery instructions about equally. Thus,

in general, instructing participants to suppress a specific performance scenario is likely to result in the opposite image outcome. This pattern of overcompensation is evident not only in imagery reports but also in the overall ball destination frequencies described below in relation to the second question posed in the present study.

Attempted Image Suppression, Ball Destinations, and Putting Performance

Analysis of ball destinations and putting accuracy for all putts involving imagery produced two main findings. First, neither the main effect of imagery instruction (i.e., positive, suppression, or suppression-replacement instructions) or frequency of imaging (i.e., imaging every putt or imaging every third putt) exerted a systematic, interpretable impact on putting performance. Instead, putting accuracy across groups differed as a function of the imagery frequency \times imagery instruction interaction. This finding is given further attention below. Second, analysis of ball destinations shows that both the suppression (HFSI and LFSI) and suppression-replacement groups (HFRI and LFRI) were more likely to overcompensate for imagery instructions than to match them, hitting the ball in the opposite direction of the to-be-suppressed image. The tendency to leave the ball in the opposite direction of imagery suggestions corresponds with Janelle et al.'s (1999) finding that individuals overcompensate in overt performance when instructed to avoid a particular outcome. This type of controlled or intention-driven overcompensation seems likely to occur in real-world situations. For example, a golfer who is attempting to break a pattern of consistently leaving putts short of the hole might hit the ball well past the cup to make sure the ball is not left short of the hole again.

While overcompensation has been found in studies of attempted thought suppression and subsequent motor skill performance (Braffman et al., 1997; Janelle et al., 1999), to our knowledge it has not been documented in research dealing with thought control without ensuing sensorimotor skill execution. It may be that overcompensation is more likely to occur in relation to imaged performance outcomes than thought control. This may be due to the fact that it is easier to generate the opposite of an action related outcome (e.g., the opposite of hitting a putt long is to leave it short) than to produce the overcompensation of a specific thought (e.g., the opposite of a white bear is not clear).

Attempted Image Replacement and Putting Performance

The third hypothesis concerned the efficacy of an image-replacement intervention strategy intended to dissipate possible ironic effects associated with unwanted images. Wegner et al. (1987) found that giving individuals a specific thought to use as a distracter when they were instructed to suppress their thoughts reduced the likelihood of later rebound of the to-be-suppressed thought. In the present study it was suggested that a positive task related image (i.e., an image of the ball on top of the target) used to replace a to-be-suppressed negative image would reduce the occurrence of the unwanted image and improve putting accuracy.

As can be seen from Figure 1, putting performances of the two replacement imagery groups (HFRI and LFRI) were quite different from one another. While the LFRI group improved in performance across imagery trials, the HFRI group actu-

ally got worse. Therefore, attempting replacement more frequently harmed performance. It is possible that the replacement image utilized in the present study, of the ball sitting on top of the target, was not effective because this image was too similar to the negative performance images that participants were attempting to control. It may be that a replacement image completely unrelated to the putting process would be better able to divert attention away from negative putting related images, and thus would be better at inoculating individuals against detrimental performance following frequent negative image suppression. Indeed, in Wegner et al.'s (1987) "white bear" study, the replacement image, a red Volkswagen, which was found to prevent subsequent preoccupation with the to-be-suppressed thought, was completely unrelated to the target thought, a white bear. Future research on negative image suppression and motor skill performance would clarify this issue.

Overall, the pattern of results in the present study suggests that image replacement is not an effective strategy for eliminating performance decrements associated with unwanted images, at least not if the replacement image is task related. However, the differences in putting performance between the LFRI and HFRI groups is noteworthy and speaks to the fourth hypothesis, namely, that the frequency of attempting to suppress negative images will influence their behavioral impact.

Frequency of Image Suppression and Putting Performance

The Control group, the positive imagery groups regardless of frequency of imaging, and the suppression and suppression-replacements groups when imaging before every third putt improved in putting accuracy across imaging trials. In contrast, the accuracy of both the suppression and suppression-replacement groups declined during imagery blocks when imaging before every putt, resulting in no net improvement from the first trial block. It appears that frequent application of suppressive imagery—trying to avoid a particular error—hurts motor skill performance, and that attempting to replace an erroneous image with a corrective one does not ameliorate the damage.

Attempting to constantly suppress a negative image may add an unmanageable attentional load to skill performance. Because participants in the present study were novice golfers, attention to skill processes and procedures may have been especially important for successful skill execution (Proctor & Dutta, 1995). When participants were instructed to suppress negative images infrequently, they may still have been able to allocate most of their attention to the primary putting task, preventing significant disruption. However, when they attempted to suppress negative images before every putt, their attentional resources may have been overly taxed, diverting too much attentional capacity from putting to maintain accurate performance. It should be noted that frequent thought or image suppression has not been classically thought of as a form of cognitive load. However, if frequently attempting to suppress negative ideas forces performers to allocate attention to extinguishing unwanted thoughts or images from mind, which in turn draws attention away from the primary task at hand, it seems logical that this might deplete attentional resources. Future research using dual-task manipulations to compare the attentional capacity of those employing frequent thought or image suppression with those attempting less frequent suppression may further clarify this issue.

Conclusion

Suppressive imagery in motor skill domains is a relatively new concept that has not yet been fully explored. Both empirical and anecdotal evidence has shown that negative images occur (Woolfolk, Parrish, & Murphy, 1985). Thus it is important to understand the behavioral consequences of negative images, as well as the effects of actively attempting to suppress these images, so that measures may be developed to guide performance related images. There is a common understanding among athletes that thinking too much about a particular flaw in one's performance can backfire, making the performance even worse. The present results demonstrate the truth of this and begin to define what "thinking too much" about a flaw might mean and how it might degrade performance.

On a practical level, it would be beneficial to compare the efficacy of strategies used by athletes when confronted with unwanted ideas. It is not known how frequently thought or image suppression is employed and what types of intervention strategies athletes use to expel unwanted ideas from mind. It would also be of interest to examine how expert performers might be affected by the manipulations used in the present study, as they may be better able than novices to control or suppress unwanted images.

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