IJSEP, 2008, 6, 207-223

Exploring a Modified Conceptualization of Imagery Direction and Golf Putting Performance

Richard Ramsey[1], Jennifer Cumming[2], and Martin Gareth Edwards[2]

[1]*University of Nottingham*
[2]*University of Birmingham*

Abstract

This study investigated a modified conceptualization of imagery direction and its subsequent effects on golf putting performance. A progression in the directional imagery literature was made by eliminating the need for participants to *intentionally* create persuasively harmful images as they rarely occur, if at all, in the sporting domain. Thus, we explored a more ecologically valid conceptualization of debilitative imagery and measured the effects on sports performance (golf putting). Seventy five participants were randomly allocated to one of three conditions: (a) facilitative imagery, (b) suppressive imagery (debilitative), or (c) no-imagery control. After performing imagery, the facilitative imagery group successfully putted significantly more golf balls than the suppressive imagery group. This finding suggests that a non-persuasive conceptualization of debilitative imagery can result in disparate effects on performance compared to facilitative imagery. In doing so, this adds ecological strength to the imagery direction literature by suggesting debilitative imagery need not be persuasive to influence motor skill performance.

Keywords: imagery, golf putting, ironic mental processes

Introduction

Previous imagery direction research has typically compared the effects of "positive" and "negative" images on subsequent performance, and the findings have proven to be inconsistent (e.g., Shaw & Goodfellow, 1997; Taylor & Shaw, 2002; Woolfolk, Murphy, Gottesfeld, & Aitken, 1985; Woolfolk, Parrish, & Murphy, 1985). Some studies demonstrated improved performance following "positive" imagery and impaired performance following "negative" imagery, while others only demonstrated the latter of these two effects. One reason purported for these inconsistencies is that so-called negative outcomes are not always deemed detrimental by the individual (Short et al., 2002). For example,

Corresponding author: Richard Ramsey, School of Psychology, University of Nottingham, University Park, Nottingham, NG7 2RD, UK. Email: richard.ramsey@nottingham.ac.uk

imagery direction studies have previously asked participants to image themselves performing a difficult golf putt with the ball landing very close to the hole (e.g., Taylor & Shaw, 2002). Although researchers intended this image to describe a negative outcome (i.e., missing the putt), it could nevertheless be interpreted as a good performance for those individuals with limited experience and/or a low level of self-efficacy for the task (Nordin & Cumming, 2005; Short et al., 2002). Therefore, Short et al. recommended that imagery direction should be conceptualized as either facilitative (helpful) or debilitative (hurtful). Facilitative imagery was defined as imagery designed to have a positive effect on one's ability to learn and perform, modify important cognitions such as self-efficacy, and regulate arousal and anxiety. By comparison, debilitative imagery was conceived as imagery designed to impede an individual's ability to achieve these same results. Defining imagery direction in this manner, Nordin and Cumming (2005) found debilitative imagery to have stronger and quicker effects on dart throwing performance. In addition, Cumming, Nordin, Horton, and Reynolds (2006) found that combining facilitative imagery with facilitative self-talk can be beneficial, while combining debilitative imagery with debilitative self-talk can be detrimental to performance.

Conceptualizing imagery direction as facilitative or debilitative represents a step forward for the area of research. Nevertheless, there is a key issue that has not yet been considered. An aim of imagery direction studies has been to instruct participants to intentionally use harmful images to impair subsequent performance. To this end, persuasively debilitative imagery has been administered in some studies (Nordin & Cumming, 2005; Cumming et al., 2006). That is, the scripts were written in such a way to make it very clear to the participant that the imagery was intended to be harmful to their performance. While this persuasive imagery has served to illustrate the immediate and strong effects of debilitative images (e.g., Nordin & Cumming, 2005), these instructions are limited in their applied value. It could be argued that few athletes intentionally harm their performance by engaging in persuasively debilitative imagery. Instead, they are far more likely to engage in helpful forms of imagery (Hall, 2001).

That is not to say, however, that athletes never experience images that are intrusive in nature. There are instances when debilitative images might occur automatically. Injured athletes, for example, have reported images depicting themselves taking longer than expected to recover (Driediger, Hall, & Callow, 2006) or experiencing involuntary negative "flashbacks" of the injury occurrence (Evans, Hare, & Mullen, 2006). Additionally, athletes with low self-confidence report negative images about upcoming performance and greater recall of previous poor performance as symptoms of pre-competitive anxiety (Hanton, Mellalieu, & Hall, 2004).

Importantly, it must be highlighted that unintended images are not the only images that can be detrimental to performance; some purposeful forms of imagery can also inadvertently debilitate an athlete's performance. For example, it is common for applied practitioners to encourage athletes to image a scene in as much detail as possible (e.g., Krane & Williams, 2006). However, this instruction may prove to be counterproductive if individuals then become overly focused on details that are extraneous to performance. That is, focussing on irrelevant or distracting details may negate the positive outcome that was intended. One example from basketball would be imaging a successful free throw shot that includes the simultaneous activity of the crowd (i.e., detail external to performing the skill). Consistent with this notion, Holmes and Collins (2002) argue that matching attentional demands experienced during imagery to those experienced during actual performance will enhance the functional equivalence between the two activities. The theory of functional equivalence is based largely on brain imaging evidence demonstrating that motor imagery and motor execution share similar neural mechanisms (Ehrsson, Geyer, & Naito, 2003; Fadiga et al., 1999). The theory states that the degree of equivalence between the imagery experience and the physical experience is a major determinant of imagery's effectiveness at modulating behavior (for a review on functional equivalence, see Murphy, Nordin, & Cumming, in press). Recent empirical evidence has supported this claim by demonstrating more dramatic effects on the performance of specific sporting skills following more functionally equivalent imagery compared to less functionally equivalent imagery (Smith & Holmes, 2004; Smith, Wright, Allsopp, & Westhead, 2007).

In light of this theoretical framework and recent experimental findings, it makes intuitive sense to endeavor to reduce the number of undesirable details that occur during imagery in order to bolster functional equivalence and ultimately performance. This concept is corroborated in sporting settings by athletes, as attempts to diminish unwanted thoughts are often made using thought suppression techniques (Krane & Williams, 2006). For example, individuals taking a shot in golf may try to suppress thoughts about their ball landing in the rough as this would be a negative performance outcome. However, attempting to suppress such thoughts can lead to paradoxical effects. These effects have been explained through ironic mental processing theory (Wegner, 1994). Wegner's theory states that attempting to suppress an unwanted thought can ironically make that thought more prevalent. For example, in their reputed "white bear" study, Wegner, Schneider, Carter, and White (1987) demonstrated that attempting to suppress thoughts of a white bear while verbalizing consciousness resulted in increased thoughts of a white bear. Further investigation demonstrated these ironic effects exist with the mental control of action (Wegner, Ansfield, & Pilloff, 1998). Participants overshot the hole during a golf putting task and swung a pendulum in an undesired direction when instructed not to do so in both cases.

Extending this literature further, Beilock, Afremow, Rabe, and Carr (2001) explored thought suppression and the control of action in the context of suppressive imagery and the performance of a motor task (golf putting). Based on mental processing principles (Wegner, 1994) and behavioral evidence (Wegner et al., 1998), Beilock and colleagues proposed that attempting to suppress negative images related to performance should increase the occurrence of these images and result in the behavioral manifestation of the same images. Furthermore, as a consequence of this behavioral change, a decrease in golf putting performance would occur. As predicted, participants who used imagery to suppress thoughts of overshooting the putt (e.g., do not image hitting the ball "past the target") subsequently hit the ball past the target square marked on the floor. Although this finding demonstrated ironic mental processing using thought suppressive imagery, the authors did not find any enhancement of performance following positively framed imagery (i.e., imagery without any thought suppressive images) compared to a no imagery control. A possible explanation for this result is that the imagery performed was too brief to significantly affect performance (Landau, Leynes, & Libkumen, 2001). Participants only took 30 putts in the imagery phase of the study and only some experimental conditions imaged prior to every putt. Alternatively, these findings may reflect debilitative imagery having stronger and quicker effects than facilitative imagery (Nordin & Cumming, 2005). Evidently, suppressive imagery (like negative and debilitative imagery) can lead to damaging effects on performance. Irrespective of the terminology used, these types of imagery have a common feature; they contain details adjacent to the desired outcome. In functional equivalence parlance, this type of imagery is less equivalent to the desired physical performance than facilitative imagery and is therefore less effective at modulating performance.

In summary, the majority of imagery direction studies carried out thus far have compared the effects of intentionally helpful imagery with intentionally harmful imagery on motor performance. As previously mentioned, the notion of purposely creating a detrimental image seems contrary to the images typically employed by athletes. It could be argued, therefore, that the findings of these studies are limited in their generalizability to only those situations when athletes intentionally conjure debilitative images. The resultant is a gap in the literature for a modified, more ecologically valid conceptualization of imagery direction. Specifically, a step forward is required that goes beyond investigation of intentionally harmful images per se. Furthermore, previous studies exploring the effects of directional imagery on motor performance have provided equivocal findings warranting further research.

Thus, the aim of the current study was twofold. The first aim was to extend previous imagery direction and performance research using a more ecologically valid conceptualization of imagery direction. To do this we compared the effects of two facilitative imagery scripts on motor skill performance (golf putting). Both skill-based imagery scripts detailed successful completion of the golf putting task. The only difference was that one script instructed participants not to image putting towards a distracter (a sand bunker). In doing so, we circumvented the need to use intentionally harmful imagery. This also permitted a comparison between two types of imagery more likely to occur in a real sporting setting as one script is entirely facilitative and the other is largely facilitative but includes some thought suppressive images. A second aim was to further delineate how directional imagery can influence motor skill performance. Specifically, we extended the work of Beilock et al. (2001) by using a similar task but improving the imagery administered and increasing the number of performance measures. The imagery scripts were longer, more detailed skill-based imagery scripts similar to those facilitative scripts used by Nordin and Cumming (2005) and Cumming et al. (2006). Importantly, the scripts were performed in a functionally equivalent manner in an attempt to improve the effectiveness of imagery (Holmes & Collins, 2001; Smith & Holmes, 2004). That is, participants performed their imagery while positioned in their usual stance, standing on the putting surface, and holding the putter in an attempt to directly emulate actual performance of the task. Using a specially designed golf putting mat, we additionally recorded the total number of successful putts, as this is the most fundamental and important aspect of golf putting performance.

We predicted that golf putting performance (number of successful putts and average distance from the hole) would improve following facilitative imagery (FI). Additionally, since there was no mention of the bunker within this script, we predicted neither the participant's awareness of the bunker nor number of bunker putts would be altered from baseline to intervention. Comparatively, for the suppressive imagery (SI) condition we predicted that including suppressive images of the bunker (i.e., be sure not to image the bunker) would affect golf putting performance in either one of two ways: performance would decrease or remain the same. The latter of the two possible results would represent a negation of the otherwise facilitative imagery experience. Additionally, including suppressive images of the bunker would paradoxically increase the rated awareness of the bunker and cause a behavioral manifestation of this image to be suppressed (i.e., an increased number of bunker putts). Finally, performance of the no-imagery control group was predicted to remain constant throughout the experiment.

Method

Participants

The participants (N = 75) were male (n = 36) and female (n = 39) with a mean age of 21 years (SD = 2.08). The majority of participants were undergraduate university students who received course credit for their participation. All participants were right handed but varied in golf putting experience. Novice golfers (n = 47) were defined as those who had no previous experience of playing golf and experienced golfers (n = 28: 13 played weekly; 3 monthly, and 12 annually) were defined as those who had some previous experience of playing golf.

Equipment

The equipment consisted of an IZZO putting mat, a standard Proline golf putter, 15 Top Flite golf balls, and fine sand. The putting surface was made from polypropylene grass and was 1 meter wide and 3 meters long. Three different holes were situated at the same end of the mat (all were approximately 10 cm in diameter). Each hole could be covered with a 10 cm diameter piece of polypropylene grass allowing for the selective presentation of each or all holes. Two blue cardboard strips were placed beyond the three holes to represent water but they did not affect the motion of the ball. Sand was placed on the left hand side of the putting green to represent a golf bunker and was capable of stopping the motion of the golf ball. The experimental setup is depicted in Figure 1.

Measures

Imagery ability. The Movement Imagery Questionnaire, Revised (MIQ-R; Hall & Martin, 1997) was employed to ensure that all participants had adequate general movement

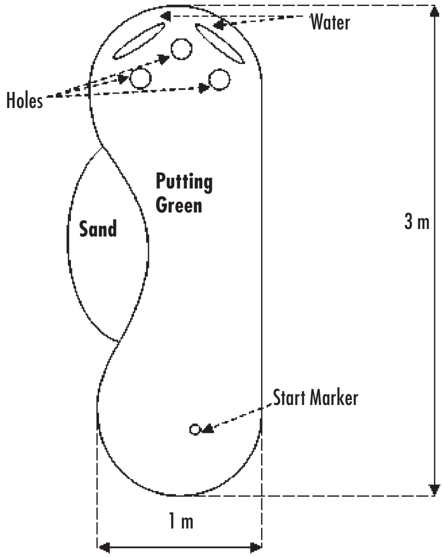

Figure 1. A Schematic of the Experimental Setup

imagery ability. The MIQ-R is an 8-item questionnaire asking participants to first physically perform and then visually or kinesthetically image four simple movements. Following imagery performance, participants rate their ability to visually or kinesthetically image the movement on a 7-point Likert scale ranging from 1 (*very hard to see/feel*) to 7 (*very easy to see/feel*). The items were then averaged to form visual and kinesthetic subscales. Both subscales had acceptable levels of internal reliability with Cronbach alpha coefficients being .90 for visual imagery and .88 for kinesthetic imagery. All participants had acceptable levels of movement imagery ability (i.e., scores of 16 or higher on each subscale) and, therefore, nobody was omitted from the experiment.

Performance. Three measures of performance were taken: average distance from the hole (cm), number of putts successfully holed, and number of putts bunkered. The average distance away from the hole was calculated by measuring the horizontal distance (x) and the vertical distance (y) of the ball from the hole with a tape measure. These two distances were then used to calculate the direct distance from the hole using Pythagoras' Theorem $\sqrt{(x^2 + y^2)}$. Both the number of putts holed successfully and the number of putts ending in the bunker were recorded.

Post experimental evaluation. Manipulation checks were carried out post baseline and post intervention. In both situations, items assessed how aware participants were of the bunker (1 = *extremely unclear*, 7 = *extremely vivid*) and how they felt this awareness affected their putting performance (1 = *hurtful*, 7 = *helpful*). Additionally, imagery group participants were assessed on their imagery use following the intervention. These participants were asked to rate how easy or difficult it was to visually and kinesthetically image the golf putting task (1 = *very hard to see/feel*, 7 = *very easy to see/feel*). They were also asked to rate the clarity and vividness of their imagery (1 = *extremely unclear*, 7 = *extremely vivid*). All participants were asked to record any psychological strategy used in addition to the instructions provided by the researcher. Finally, all participants were asked to complete 13 items from the Marlowe-Crowne Social Desirability Scale (Crowne & Marlowe, 1960) measuring their general need for approval. The items describe either (a) desirable but uncommon behaviors (e.g., admitting mistakes) or (b) undesirable but common behaviors (e.g., gossiping), and participants responded whether each statement was true or false for them. Each item is scored as 1 or 0, and scores on the undesirable but common behaviors were reverse coded. The resulting range of possible scores is 1-13, with higher scores representing a higher need for approval.

Procedure

Introduction. Participants were asked to watch a presentation displayed on a computer through Microsoft Powerpoint to inform them of the experimental procedure. After informed consent was obtained, participants were then provided with a common definition of mental imagery (White & Hardy, 1998) and completed the MIQ-R. Before the experiment began all participants were asked to take six practice putts (two to each hole) to establish a standardized familiarization period.

Baseline Performance. All participants made 45 golf putts divided into three blocks of 15 putts. Each set of 15 putts was directed at a different hole (right, left, and center) with the order of hole randomized among all participants. Instructions were to putt the golf ball as accurately as possible to achieve a successful putt. After each attempt, successful putts or bunker putts were recorded; for all others the horizontal (x) and vertical (y) distance from the hole was measured. Between each block of 15 putts, participants worked on a word search puzzle for approximately two minutes. This was done in an attempt to prevent participants from using their own imagery. The timeframe mimicked the amount of time participants would later spend performing imagery between blocks during the intervention phase. By doing so, the amount of time spent 'off task' was the same during baseline and intervention phases. The post baseline evaluation questionnaire was then administered and completed assessing the awareness of the bunker.

Intervention Performance. For the remainder of the experiment participants were randomly allocated to one of the three experimental conditions (n = 25/condition), namely a facilitative imagery group (FI), a suppressive imagery group (SI), or a control group (C). In the same format as the baseline phase, the intervention phase consisted of each participant making 45 putts split into three blocks of 15 putts. Each set of 15 putts was directed at a different hole with order of hole again randomised.

The control condition did not receive the intervention. Instead, they simply repeated the baseline procedure for a second time (i.e., 15 putts followed by two minutes of working on a word search puzzle; repeated over all three holes). Participants in the two imagery conditions listened to an imagery script (recorded on a CD-ROM and played through a stereo) while standing on the mat side-on holding the putter in their usual golf putting position and stance (i.e., the position and stance they typically used in the previous baseline putts). This was done in an attempt to increase the functional equivalence between the imagined and actual experience of golf putting (Holmes & Collins, 2001). Instructions were to image the scenario depicted as clearly and vividly as possible.

The imagery scripts (available by contacting the lead author) were based on those previously reported in the literature (Nordin & Cumming, 2005; Short et al., 2002). The FI script described being focussed on the target hole and successfully sinking the putt. For example, "Imagine that you are, once again, standing on the putting mat. You look over at the hole and clearly see the path that your ball has to follow…watch the ball roll down the putting green and sink into the hole." The SI script also described how participants should focus on the target hole so they can successfully sink each putt, but to avoid imaging the distracter. The SI script used was identical to the one used in the FI condition, except for the inclusion of three mentions of the sand bunker. For example, "Imagine that you are once again, standing on the putting mat, ignoring the bunker to your left…watch the ball roll down the putting green avoiding the sand bunker and sink into the hole." Both imagery scripts lasted approximately two minutes and were played before each block of 15 putts during the intervention phase of the experiment. Participants in both imagery conditions were asked to use this image prior to every putt. In an attempt to ensure that imagery was performed prior to each putt, reminders were given by the experimenter every five putts in each block of 15 putts.

Closing. Following the intervention phase participants completed a post-experimental evaluation. Participants were given a full debrief on the nature experiment and thanked for their participation.

Results

Preliminary Analyses

A series of preliminary analyses were conducted to examine whether variables, other than the imagery intervention, had influenced golf putting performance. Eight separate one-way ANOVAs examined whether baseline differences in the dependent variables (i.e., average distance from the hole, total number of successful putts, total number of bunker putts, and the self-rated awareness of the bunker) existed according to previous golf experience and gender. A bonferoni adjustment was made for multiple comparisons ($p = .025$). The results of these analyses are reported in Table 1. Gender and previous golf experience were found to influence performance. In general, males were found to perform better than females and those participants with some golfing experience performed better than those with no experience. Therefore, both gender and previous golf experience were included as covariates for the main analyses. A MANOVA revealed no significant differences in general imagery ability as measured by the MIQ-R between the two imagery groups, Pillai's Trace = 0.12, $F(1, 48) = 3.21$, $p > 0.05$, $\eta^2 = .12$. The control group was not included in this analysis because they were not required to perform imagery during the experiment.

Post experimental evaluation. A MANOVA explored differences in the ability of participants to image the scripts that they performed during the experiment. It was demonstrated that both imagery groups were able to image the scripts in a similar fashion.

Table 1. Dependent Measures at Baseline According to Gender and Golf Experience

Dependent Variable	GENDER						GOLF EXPERIENCE					
			Male		Female				Novice		Experienced	
	DF	F	*M*	*SD*	*M*	*SD*	DF	F	*M*	*SD*	*M*	*SD*
Distance from hole	1, 73	17.57	19.03	8.64	37.45**	25.02	1, 73	13.33	34.95	23.06	17.97**	10.95
Total putts holed	1, 73	15.97	18.75	5.23	13.51**	6.11	1, 73	30.25	13.45	5.03	20.38**	5.64
Total putts bunkered	1, 73	4.28	0.94	1.78	1.64	0.98	1, 73	1.92	1.49	1.67	1.00	1.09
Bunker awareness	1, 73	2.71	3.81	1.03	4.16	0.84	1, 73	11.09	4.26	0.89	3.55**	0.89

Note. Significant differences are with respect to the other gender or golf experience group.
** = $p < 0.01$

Table 2. Post-Experimental Manipulation Checks

	Facilitative Imagery		Suppressive Imagery	
	M	*SD*	*M*	*SD*
Specific visual imagery ability (1 = very hard to see, 7 = very easy to see)	5.28	1.40	4.40	1.04
Specific kinesthetic imagery ability (1 = very hard to feel, 7 = very easy to feel)	4.60	1.55	4.32	1.55
Specific vividness (1 = extremely unclear, 7 = extremely vivid)	5.10	1.11	4.60	1.19
Use of imagery as instructed (1 = not at all, 7 = always)	4.48	1.08	4.20	1.53

There were no significant differences between the FI group and SI group in terms of how vivid their imagery was or whether they used the imagery as instructed. Additionally, there were no differences between the two imagery groups in terms of how well they could see or feel themselves performing the movement during their imagery. Means and standard deviations for these analyses are presented in Table 2. Fifty one participants (68%) reported using a strategy other than those given to them during the experiment. The use of their own imagery was reported by 10 participants (13.3%); self talk by 23 participants (30.7); goal setting by 9 participants (12%); and 2 participants (2.7%) reported using other strategies. Chi-square analysis determined the use of such strategies differed between the experimental groups $\chi^2(8) = 26.53$, $p = .001$. A greater proportion of the FI group (n = 9) and the SI group (n = 10) reported using self-talk more than the control group. Furthermore, a proportion of the control group (n = 10) report using their own imagery. A 3 (experimental group) x 2 (time; baseline and intervention) mixed-design ANOVA was performed for all three performance measures and showed the use of these additional psychological skills did not influence performance for any group during the experiment. The average social desirability scores on the Marlowe-Crowne Scale were fairly low (*M* = 5.37, *SD* = 2.34), suggesting that the participants generally did not respond in a socially desirable fashion. An ANOVA indicated that no group differences existed between the three intervention conditions.

Main Analyses

The main analyses determined whether there were any differences in the four dependent measures (i.e., the three measures of golf putting performance and self-rated bunker awareness) between the three experimental groups. First, one-way ANOVAs established that no significant differences existed in baseline performance between the groups on the four dependent measures using an adjusted alpha level (p = .0125). Subsequently, a 3 (experimental group) x 2 (time; baseline and intervention) mixed-design ANOVA, revealed whether the groups differed in their golf putting performance following the imagery intervention. For these analyses, the experimental group served as the between-groups independent variable and time as the within-groups independent variable. Gender and golf experience served as covariates. The data was collapsed across the three holes to show the overall findings. Means and standard deviations are presented in Table 3 for all dependent variables according to group.

Distance from the hole. A significant main effect was found for time, $F(1,70) = 16.88$, $p < .001$, $\eta^2 = .19$, with all three groups achieving a shorter distance from the hole during intervention compared to baseline. There was no main effect for group, $F(2,70) = 2.94$, $p = 0.59$, $\eta^2 = .07$, and no interaction between time and group, $F(2,70) = 1.54$, $p = 0.22$, $\eta^2 = .04$.

Number of successful putts. There was no main effect of time, $F(1,70) = 0.72$, p = 0.40, $\eta^2 = .01$, or group, $F(2,70) = 1.10$, $p = 0.34$, $\eta^2 = .03$. There was a significant interaction between time and group, $F(2,70) = 29.7$, $p = .038$ $\eta^2 = .89$. Tukey HSD post-hoc analysis revealed that the FI group successfully putted a significantly greater number of balls during the intervention performance compared with the SI group. Within group comparison of means using paired samples t-tests (separate analyses for each condition), $t(24) = 2.56$, $p = .017$, revealed improvements for the FI group from baseline to intervention. This result did not reach significance, however, when a corrected alpha level ($p < .017$) was applied. Similar t-tests for the control group $t(24) = 1.04$, $p = .307$ and the SI group $t(24) = .91$, $p = .373$ revealed no significant differences.

Number of bunker putts. There was no main effect for time, $F(1, 70) = 1.88$, $p = 0.18$, $\eta^2 = .03$, or group $F(2, 70) = 0.18$, $p = 0.84$, $\eta^2 = .01$, and no interaction between time and group, $F(2,70) = 0.03$, $p = 0.98$, $\eta^2 = .001$.

Bunker awareness. There was no main effect for time, $F(1,70) = 0.44$, $p = 0.51$, $\eta^2 = .01$, or group $F(2,70) = 1.00$, $p = 0.37$, $\eta^2 = .03$, and no significant interaction between time and group, $F(2, 70) = 0.92$, $p = 0.40$, $\eta^2 = 0.03$.

Table 3. Means and Standard Deviations of Performance Scores over Time

Group	BASELINE								INTERVENTION							
	Distance from the hole (cm)		Total number of successful putts		Total number of bunker putts		Bunker awareness		Distance from the hole (cm)		Total number of successful putts		Total number of bunker putts		Bunker awareness	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Facilitative Imagery	25.48	11.35	15.96	5.17	1.28	1.59	4.16	0.88	19.82	9.26	18.24*	4.76	1.09	1.08	3.88	0.96
Suppressive Imagery	35.60	30.65	15.80	6.61	1.24	1.61	4.01	1.03	28.51	25.74	15.00*	5.76	1.04	1.27	3.64	1.01
Control	24.75	14.85	16.32	6.97	1.40	1.29	3.80	0.94	21.74	9.86	17.08	7.24	1.20	1.58	3.75	1.01

Note. * = a significant difference ($p < .05$)

Discussion

The main purpose of the current study was to explore the effects of a modified conceptualization of directional imagery on golf putting performance. To do so, we compared a no imagery control group (who worked on a word search puzzle) to two imagery groups (FI and SI). Both imagery conditions were very similar to each other with the only difference being the inclusion of instructions to avoid thinking about the sand bunker in the SI protocol. Thus, both imagery conditions were largely facilitative and consistent with how athletes would typically use imagery. We predicted that the FI group's golf putting performance would improve and that their self-rated awareness of the bunker and number of bunker putts would not change following the intervention. In comparison, the inclusion of suppressive images (SI condition) was predicted to affect performance in either one of two ways: performance would decrease or remain the same (i.e., participants would not benefit from the otherwise facilitative imagery). Additionally, it was predicted that attempts to suppress images of the bunker would paradoxically result in an increased self-rated awareness of the bunker. Furthermore, this increased bunker awareness would manifest itself into golf putting performance (i.e., increased bunker putts). Finally, the control group's performance was predicted to remain constant throughout the experiment.

In terms of the number of successful putts made, the results partly concur with our predictions. The control group's performance remained the same throughout the experiment as predicted. Participants in the FI group successfully putted significantly more golf balls than those in the SI group following the imagery manipulation. This finding demonstrates a clear disparity in golf putting performance following imagery with differential directional content. More specifically, engaging in facilitative imagery resulted in a greater level of performance than suppressive imagery and supports previous research demonstrating facilitative imagery to be more beneficial to performance compared to debilitative imagery (Beilock et al., 2001; Nordin & Cumming, 2005; Shaw & Goodfellow, 1997; Short et al., 2002; Woolfolk, Parrish et al., 1985). Importantly, however, improved golf putting performance was not found following facilitative imagery, as no differences were apparent compared to the control group (who received no intervention) and no significant within group effects of the intervention were found. That is, the number of successful putts did not significantly improve from baseline to intervention. There was a clear trend for the FI group to perform better during the intervention compared to baseline, but this marginally missed significance due to a corrected alpha level. Consequently, this trend might be explained as Type I error. Albeit divergent with our predictions (i.e., FI would improve performance) many previous studies also have not shown direct performance improvements following facilitative/positive imagery (Beilock et al., 2001; Nordin & Cumming, 2005; Taylor & Shaw, 2002; Woolfolk, Murphy et al., 1985). That said, a number of experiments have found performance improvements following similar imagery (Shaw & Goodfellow, 1997; Short et al., 2002; Woolfolk, Parish et al., 1985). Taken together with this previous literature, the present findings highlight the consistently disparate effects imagery of differential direction can have on performance. Moreover, the constant theme is that facilitative imagery is more helpful to performance than debilitative.

Consistent with our predictions, golf putting performance remained the same following suppressive (debilitative) imagery. That is, performance did not differ compared to the control group and no performance impairment occurred from baseline to intervention. Moreover, the more "realistic" debilitative imagery in the present study did not cause a decrease in performance as previously found when the imagery scripts were more persuasively written (Beilock et al., 2001; Nordin & Cumming, 2005). However, three brief mentions of the sand bunker did cause disparate effects on golf putting performance with the SI group's performance being significantly lower than the FI group. In doing so, support is offered for Beilock et al's (2001) proposal that frequently using suppressive imagery can hurt motor skill performance. This less distinct influence of debilitative imagery on performance most probably reflects the less persuasive nature of the script compared to those previously employed in other studies. Indeed, central to the aim of the present study was to use a more realistic debilitative condition. In doing so, we would be able to improve the ecological validity of the imagery direction literature. Crucially, our findings suggest that a less persuasive conceptualization of debilitative imagery can have dissimilar effects on sporting performance in comparison to facilitative imagery, but these effects appear smaller in magnitude to previous studies. Thus, debilitative imagery does not need to be persuasively administered in order to significantly influence motor skill performance. The data further suggests that even those individuals with largely facilitative imagery only need a small portion of their imagery to be debilitative to cause differential effects to motor performance.

Although the number of successful putts is the most important indicator of golf putting performance, it was not the sole dependent measure included in the present study.

We also measured the average distance from the hole for those shots when the ball did not land in the hole. Contrary to predictions, we found that participants improved on this measure regardless of their group assignment. More specifically, we predicted that the FI group would show a facilitation effect in terms of distance from the hole (i.e., have their balls finish closer to the hole) following the intervention but did not expect the same finding to occur for the SI group and the control group. These results, however, are probably best explained as practice effects from having all participants physically perform the task during the baseline phase of the study. The amount of physical practice throughout the experiment was substantial (90 putts), especially when compared to other similar studies (e.g., 50 putts in the Beilock et al., 2001 study). This considerable physical practice may have overridden, and therefore limited, any possible effect of the imagery intervention. In other words, imagery did not contribute to improvements over and above that caused by physically practicing the task in terms of the average distance from the hole.

We also examined whether referring to the sand bunker in the SI protocol would paradoxically lead to an increased self-rated awareness of the bunker, and in turn, a greater number of balls landing in the bunker. Contrary to our predictions, we found no change in the three experimental group's awareness of the bunker and number of bunker putts following the intervention. Upon examination of the mean values for bunker awareness, it appeared that participants were fairly aware of the bunker throughout the experiment (means ranging from 3.64 to 4.18 on a 7-point rating scale). Asking participants in the SI group to ignore the bunker did not subsequently increase this awareness. Furthermore, no difference was found between the three groups in terms of the number of balls landing in the bunker. Unlike Beilock et al.'s (2001) study, it appeared that the inclusion of suppressive images did not lead to ironic effects of increasing bunker awareness, nor was there a behavioral manifestation of that image in the present study. Perhaps the more subtle approach used to conceptualizing debilitative imagery might explain why more pronounced effects were not observed for the SI group. In the current study, a two-minute imagery script was employed that contained infrequent suppressive images and this may not have been potent enough to modify the conscious appraisal of the bunker. In contrast, Beilock et al. used short statements that were more clearly suppressive in nature. To explore this, future research may vary the amount of suppressive content included in imagery protocols to delineate if paradoxical thought processes and behaviors occur at a certain threshold when performing suppressive imagery. Alternatively, the lack of between-group differences in bunker awareness may have been caused by the attention drawn to the bunker in the post-baseline questionnaire that was administered to all groups.

Taking these findings together, it seems that using a less persuasive conceptualization of debilitative imagery can still have significantly different effects on sporting performance (as measured by the number of successful putts in golf) compared to facilitative imagery even if these effects are less marked than previous findings. Specifically, the mere inclusion of three suppressive images in a largely facilitative imagery experience resulted in contrasting effects on golf putting performance. This said, there is one caveat;

not all the performance measures taken were differentially affected by the two imagery practices as the distance from the hole, and the number of bunker shots did not differ between the imagery groups. The act of suppressing unwanted thoughts is commonly cited by athletes as a tool for ameliorating performance (Krane & Williams, 2006). Therefore, from an applied perspective, these findings provide strength for the assertion that suppressing unwanted images can have counterproductive consequences to motor performance even though it seems intuitive to suppress these negative images (Beilock et al., 2001; Wegner et al., 1998). Importantly for athletes, who typically do not use persuasively debilitative imagery, these findings highlight that debilitative imagery need not be persuasive to significantly influence motor skill performance. Complementing this notion, coaches who encourage imagery practices need to be mindful of the extent external details are included in an athlete's imagery. Frequently coaches encourage athletes to image a scene in as much detail as possible (Krane & Williams, 2006), but this can potentially interfere with the benefit of using facilitative imagery. As demonstrated in the current study, the infrequent inclusion and suppression of external details irrelevant to the performance of the task disadvantaged the SI group. When designing imagery training for athletes, coaches need to consider the amount of detail included that is external to performing the task and to what extent they encourage athletes to suppress negative performance outcomes, irrespective of how small or infrequent these details are as they can be harmful to performance.

Adding the findings from the current study to previous imagery direction research, it is clear that whether imagery is deemed helpful or hurtful can have differential effects on performance. The specific nature of this performance modulation is still debated with equivocal findings apparent in the literature. The overwhelming theme, however, is that facilitative imagery is more beneficial to performance than debilitative, even when using non-persuasive debilitative imagery. However, few authors have offered a mechanism by which performance modulation may occur, be it facilitative or debilitative. One plausible mechanism that we put forward is based largely on neuropsychological evidence demonstrating the imagination and execution of action access similar neural regions (Ehrsson et al., 2003; Fadiga et al., 1999) and the notion of functional equivalence (Murphy et al., in press). That is, facilitative imagery has a higher degree of equivalence with the intended performance outcome than debilitative imagery. Therefore, facilitative imagery is more functionally equivalent to performance and more effective at modulating behavior. Thus, the disparity in performance often observed following facilitative and debilitative imagery practices may reflect the disparity in functional equivalence. This is not to say that facilitative imagery should have a more powerful effect on performance than debilitative imagery. On the contrary, many studies show more compelling findings with debilitative imagery (Nordin & Cumming, 2005; Beilock et al., 2001; Taylor & Shaw, 2002; Woolfolk, Murphy et al., 1985). These latter findings suggest that a lack of congruence between the imagined experience and the intended performance (i.e., reduced functional equivalence) can considerably harm performance. This proposed mechanism explaining directional imagery's effects on performance should be approached with an element of caution as it clearly needs empirical support. To this end, evidence unveiling an underlying mechanism that explains directional imagery's effects on performance is a fundamental issue that is crucially absent in the imagery literature. Future research may hope to explore this proposed explanation using techniques not typically used in sport psychology research such as brain imaging (e.g., functional magnetic resonance imaging; fMRI). This line of future research may investigate directly, rather than speculatively, the mechanism controlling directional imagery's effects on motor skill performance.

To add support and assurance to the findings from the current study a series of preliminary analyses were conducted and extensive manipulation checks performed. These allowed us to determine whether any possible confounding variables existed and led us to control for gender and previous golf experience. Although this strengthens the study, the manipulation checks did highlight some potential limitations. More specifically, 68% of the participants reported using at least one other psychological strategy during the experiment. This use of additional psychological strategies seems to be a common finding within experimental imagery studies (e.g., Nordin & Cumming, 2005; Cumming et al., 2006). But, perhaps this should not be too surprising given that the target sample is commonly drawn from undergraduate students who study in a related academic field and are therefore savvy to these psychological strategies. Additionally, as often the case when exploring psychological skills, individuals in the control group reported using their own imagery. However, it is probably natural for people to engage in their own imagery during motor tasks. Importantly, the use of any additional psychological skills made no benefit to golf putting performance.

In conclusion, the findings demonstrate that using a less persuasive approach to debilitative imagery (in comparison to previous literature) can still have significantly diverse effects on sporting performance compared to facilitative imagery. Specifically, the inclusion of three suppressive images to a largely facilitative imagery protocol can have disparate effects on sporting performance compared to purely facilitative imagery. This evidence further highlights the importance of directional content, even if small in magnitude or infrequently included, when using imagery techniques to enhance motor skill performance. This advancement in knowledge is especially noteworthy for coaches and athletes who design and use imagery training regimes in the sporting environment, as they tend not to use persuasively debilitative imagery. That is, debilitative imagery need not be persuasively administered in order to influence motor skill performance. In doing so, the current study's findings add considerable ecological validity to the imagery direction literature.

References

Beilock, S. L., Afremow, J. A., Rabe, A. L., & Carr, T. H. (2001). "Don't Miss!" The debilitating effects of suppressive imagery on golf putting performance. *Journal of Sport and Exercise Psychology, 23,* 200-221.

Crowne, D. P., & Marlowe, D. (1960). A new scale of social desirability independent of psychopathology. *Journal of Consulting Psychology, 24,* 349-354.

Cumming, J., Nordin, S. M., Horton, R., & Reynolds, S., (2006). Examining the directional component of imagery and self-talk strategies on performance and self-efficacy. *The Sport Psychologist, 20,* 257-274.

Driediger, M., Hall, C., & Callow, N. (2006). Imagery use by injured athletes: A qualitative analysis. *Journal of Sports Sciences, 24,* 261-271.

Ehrsson, H. H., Geyer, S., & Naito, E. (2003). Imagery of voluntary movement of fingers, toes, and tongue activates corresponding body-part-specific motor representations. *Journal of Neurophysiology, 90,* 304-331

Evans, L., Hare, R., & Mullen, R. (2006). Imagery use during rehabilitation from injury. *Journal of Imagery Research in Sport and Physical Activity, 1,* 1-21.

Fadiga, L., Buccino, G., Craighero, L., Fogassi, L., Gallese, V., & Pavesi, G. (1999). Corticospinal excitability is specifically modulated by motor imagery: a magnetic stimulation study. *Neuropsychologia, 37,* 147-158.

Hall, C. R. (2001). Imagery in sport and exercise. In R. Singer, H. Hausenblas, & C. Janelle (Eds.), *Handbook of research in sport psychology* (pp. 529-549). New York: John Wiley & Sons.

Hall, C. R., & Martin, K. A. (1997). Measuring movement imagery abilities: A revision of the Movement Imagery Questionnaire. *Journal of Mental Imagery, 21,* 143-154.

Hanton, S., Mellalieu, S. D., & Hall, R. (2004). Self-confidence and anxiety interpretation: A qualitative investigation. *Psychology of Sport and Exercise, 5,* 477-495.

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

Holmes, P. S., & Collins, D. J. (2002). Functional equivalence solutions for problems with motor imagery. In I. Cockerill (Ed.), *Solutions in sport psychology* (pp. 120-140). London: Thompson.

Krane, V., & Williams, J. M. (2006). Personal growth to peak performance. In J. M. Williams (Ed.), *Applied sport psychology: Personal growth to peak performance* (5th Ed.) (pp. 207-227). New York: McGraw Hill.

Landau, J. D., Leynes, P. A., & Libkuman, T. M. (2001). Mental simulation increases physical performance estimates but not physical performance. *Journal of Mental Imagery, 25,* 353-364.

Murphy, S., Nordin, S. M., & Cumming, J. (in press). Imagery in sport, exercise and dance. In T. Horn (ed.), *Advances in sport and exercise psychology* (3rd Ed.). Champaign, IL: Human Kinetics.

Nordin, S. M., & Cumming, J. (2005). More than meets the eye: Investigating imagery type, direction, and outcome. *The Sport Psychologist, 19,* 1-17.

Shaw, D. F., & Goodfellow, R. (1997). Performance enhancement and deterioration following outcome imagery: Testing a demand-characteristics explanation. In I. Cockerill & H. Steinberg (Eds.), *Cognitive enhancement in sport and exercise psychology* (pp. 37-43). Leicester, UK: The British Psychological Society.

Short, S. E., Bruggeman, J. M., Engel, S. G., Marback, T. L., Wang, L. J., & Willadsen, A. (2002). The effect of imagery function and imagery direction on self-efficacy and performance on a golf-putting task. *The Sport Psychologist, 16,* 48-67.

Smith, D., & Holmes, P. (2004). The effect of imagery modality on golf putting performance. *Journal of Sport and Exercise Psychology, 26,* 385-395.

Smith, D., Wright, C., Allsopp, A., & Westhead, H. (2007). It's all in the mind: PETTLEP-based imagery and sports performance. *Journal of Applied Sport Psychology, 19,* 80-92.

Taylor, J. A., & Shaw, D. F. (2002). The effects of outcome imagery on golf-putting performance. *Journal of Sports Sciences, 20,* 607-613.

Wegner, D. M. (1994). Ironic processes of mental control. *Psychology Review, 101,* 34-52.

Wegner, D. M., Ansfield, M., & Pilloff, D. (1998). The putt and the pendulum: Ironic effects of the mental control of action. *Psychological Science, 9,* 196-199.
Wegner, D. M., Schneider, D. J., Carter, S. R., & White, T. L. (1987). Paradoxical effects of thought suppression. *Journal of Personality and Social Psychology, 53,* 5-13.
White, A., & Hardy, L. (1998). An in depth analysis of the uses of imagery by high-level slalom canoeists and artistic gymnastics. *The Sport Psychologist, 12,* 387-403.
Woolfolk, R. L., Murphy, S. M., Gottesfeld, D., & Aitken, D. (1985). Effects of mental rehearsal of task motor activity and mental depiction of task outcome on motor skill performance. *Journal of Sport Psychology, 7,* 191-197.
Woolfolk, R. L., Parrish, M. W., & Murphy, S. M. (1985). The effects of positive and negative imagery on motor skill performance. *Cognitive Therapy and Research, 9,* 335-341.

Acknowledgments

This research was performed while the lead author was at the School of Sport and Exercise Sciences, University of Birmingham, UK. Many thanks to Laura Edwards, Kimberley Hambleton, and Alison McAllister for their role in the data collection of this study.