

## Implicit overcompensation: The influence of negative self-instructions on performance of a self-paced motor task

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### Abstract

According to Wegner's (1994) theory of ironic processes of mental control, self-instructions not to perform in a certain way, together with mental loads, can induce thoughts, emotions, and behaviours that are precisely the opposite of intention. Wegner's theory was tested against the implicit overcompensation hypothesis, which states that movement direction and magnitude are implicitly dictated by self-instruction, irrespective of load, promoting overcompensation of action. Two experiments were conducted using a golf-putting task. In Experiment 1, 48 participants were randomly assigned to one of four load conditions: cognitive, visual, auditory, and self-presentation/incentive. In the experimental trials, participants were instructed to make the putt, but it was emphasized that the putt should not be left short of the target. Following the instructional strategy, putts landed significantly longer than at baseline, irrespective of load. In Experiment 2, 36 participants were divided into one of three groups, without load, in which different instructional sets (control, not putting long, and not putting short) were emphasized. A significant interaction emerged, as participants putted significantly longer or shorter than controls depending on the instructional set given. Overall, our findings support the implicit overcompensation hypothesis. Theoretical and practical considerations are discussed.

**Keywords:** *Ironic processes, movement error, putting, attention, self-talk*

### Introduction

Why do athletes occasionally perform in a way that is precisely opposite to that which they intend? For example, despite a golfer telling herself not to leave a putt short, she may fail to strike the ball hard enough to reach the hole. This unintended result is considered "ironic" in that its manifestation represents exactly what the performer attempts to avoid. In other instances, athletes are prone to exaggerated errors in the opposite direction of self-instruction. For example, following the same self-instruction not to putt it short, a golfer may putt the ball well past the hole. In this case, an attempt at self-regulation yields an ineffective motor action characterized by overcompensation. Motivated by a limited understanding of the mechanisms that underlie overcompensation and ironic movement errors, we sought to determine why these failures of mental control occur.

Wegner's (1994) theory of ironic processes of mental control accounts for the means by which items intended to be suppressed or ignored may emerge as a

direct consequence of attempts to control them. In their classic study, Wegner and colleagues (Wegner, Schneider, Carter, & White, 1987) found that trying not to think about a white bear often resulted in an increase or "rebound" of the white bear into conscious awareness. Recent efforts have been made to investigate ironic effects in sport. For example, Dugdale and Eklund (2002) found that when watching video clips of Australian Rules Football games, players, coaches, and umpires looked at the umpires more when they were told specifically not to look at them versus when no instructions were given. More recently, Bakker and colleagues (Bakker, Oudejans, Binsch, & Van Der Kamp, 2006) found that amateur football (soccer) players tended to view areas within a goal (during a penalty kick) more when they were specifically instructed to avoid these areas than when no instruction was given. Moreover, the increase in visual scanning to the "to-be-avoided" area led to a decrease in performance.

According to Wegner's (1994) theory, mental control is achieved through the interaction of (1) an

intentional and conscious *operating process*, geared towards obtaining a desired state of being, and (2) the involuntary and unconscious *monitoring process*, directed towards ensuring that interference with achievement of the goal state is identified by the operating process. Although unconscious, the monitoring process proceeds uninterrupted as long as effort is being directed towards achieving a desired goal state. The interaction between the two processes of mental control typically proceeds in an effective manner, yet humans are arguably predisposed to control problems due to the tendency of the two control processes to compete with each other for attentional resources (Wegner, 1994). Because the operating process functions at the conscious level, it is typically more salient than the monitoring process. However, when “mental loads” interfere, attentional resources are diverted away from the operating process, resulting in the contents of the monitoring process (unchecked by the operator) now being prioritized. Ironically, the monitoring process therefore activates the exact thoughts and feelings that are to be avoided.

Although most of the research concerning ironic processes has focused on the rebound of unwanted thoughts, Wegner and colleagues (Wegner, Ansfield, & Pilloff, 1998) demonstrated that ironic processes of mental control can manifest in movement errors during performance of a self-paced motor task. Participants were required to keep a six-digit number (i.e. cognitive load) in mind while putting, and told to be careful not to hit the ball past the hole (the target). Results indicated that under conditions of cognitive load, participants were more likely to hit the ball past the hole than in conditions without load. Despite this seminal finding, no known replication of Wegner and colleagues’ (1998) work has been published. Moreover, contradictory data have emerged.

Beilock and colleagues (Beilock, Afremow, Rabe, & Carr, 2001) tested Wegner’s theory in a golf putting task with suppressive imagery. Participants in this study were instructed to image the ball rolling to the intended target, but to be particularly careful not to image leaving the ball short (or long in another condition) of the target. Results were contrary to Wegner’s theory, in that participants in imagery suppression conditions (i.e. “don’t image putting it short”) tended to *overcompensate* and putt the ball significantly past the hole. When considering the findings of Beilock *et al.* (2001) and Wegner *et al.* (1998), there is a clear contradiction with respect to outcome directionality – the former study suggests overcompensation while the latter suggests ironic effects.

In the current study, we sought to test a hypothesis concerning unconscious processes and negatively worded self-instructions that can account for the

disparate findings reported in the literature. While acknowledging that ironic effects may occur, we contend that negatively worded instructions are the primary stimulus driving outcome directionality, which is likely overcompensation rather than ironic effects. Specifically, our *implicit overcompensation hypothesis* postulates that negatively worded instructions trigger an implicit (unconscious) command that exaggerates the negative meaning (e.g. “don’t putt it *short*”), causing a compensatory interpretation of target location and/or distance. Motor effectors are then programmed in accord with the implicit message, thereby augmenting the movement to counteract the explicit instruction. When instructed not to putt it short, therefore, the direction (*short*) is overemphasized, leading to an implicit message that putts left short are unsuccessful. An implicit command then guides movement execution under the misinterpreted conception that it is better to err in the direction past the hole. The command is implicit because the performer is not explicitly focused on putting the ball past the hole. Rather, explicit processing continues to be focused on *not putting it short*. Despite these implicit and explicit instructions, it is important to keep in mind that the desired outcome remains the same – namely, to make the putt.

Several lines of empirical work provide converging evidence to support the implicit overcompensation hypothesis. First, cognitive psychologists have suggested that cognitive processes are designed to process positive information more efficiently than negative information (e.g. Hearst, 1991; Matlin, 2004). For example, comprehension of the statement “John is honest” is more readily achieved than the phrase “John is not dishonest”. Although the latter is indeed understandable, the former is processed more quickly and with less cognitive effort. Similarly, movements are performed more efficiently when self-instruction highlights *what to do* as opposed to *what not to do* (e.g. Gould, Tammen, Murphy, & May, 1989; Harvey, Van Raalte, & Brewer, 2002; Van Raalte *et al.*, 1995).

Second, information is often implicitly processed even when individuals are told to ignore it. For example, Thompson and colleagues (Thompson, Fong, & Rosenhan, 1981) found that jurors are likely to use information that they were told to disregard by a judge. Others have found that media content can influence individuals even when they are told that the particular news story was untrue (Wegner, Wenzlaff, Kerker, & Beattie, 1981). It is therefore plausible that implicit information may influence an athlete’s performance even if that information is counter-productive.

Finally, research in sport psychology has demonstrated that negative outcome images (e.g. Beilock

*et al.*, 2001; Woolfolk, Parrish, & Murphy, 1985) and negatively phrased instructions (e.g. Bakker *et al.*, 2006; Beilock *et al.*, 2001) hinder performance. For example, Woolfolk *et al.* (1985) found that participants who imaged narrowly missing a putt experienced a decrease in performance, whereas those who imaged a successful putt improved performance. Finally, as described earlier, Beilock *et al.* (2001) found that participants who were told not to image putting the ball long (or short) experienced more negative after-images (i.e. rebound) than participants who imagined the ball landing on the target. Rebound of thought clearly did not dictate outcome directionality in this case. Rather, the internalization of negatively phrased instruction apparently led to the putting errors that were exaggerated by the implicit meaning of the instruction itself.

In summary, we argue that the self-instruction “don’t putt it short” subconsciously exaggerates the negative connotation (to leave it short), thereby requiring an overriding implicit counter message. Although not ideal, the implicit message then manifests an interpretation that it is better to err on the side of putting it firm. The implicit overcompensation process proceeds thereafter, leading to predictably exaggerated errors. The implicit overcompensation process *begins before and supersedes* the impact of other loads, and is independent of any rebound of thought. The negatively worded instruction itself, therefore, although subconscious, is more prominent and influential than other loads that are typical (e.g. auditory or visual distracters, cognitive overload, anxiety) in the sporting context.

In the present study, two experiments were conducted using a golf-putting task that was similar to that used by Wegner *et al.* (1998). Our objectives were to determine whether directional self-instruction with and without various loadings would precipitate movement errors, and more specifically, whether these errors would be opposite to or consistent with the direction of self-instruction. According to Wegner, a combination of sufficient load and directional self-instruction (i.e. “don’t putt it short”) should predispose “ironic” directional outcomes (i.e. short putts) more than in conditions that use the directional self-instruction without load. In contrast, the implicit overcompensation hypothesis asserts that negatively worded self-instruction promotes overcompensation, whether or not loads are present. We hypothesized that errors would be predictably exaggerated in a manner such that when instructed to avoid putting the ball short or long, participants would putt further or shorter, respectively, thereby supporting the implicit overcompensation hypothesis.

## EXPERIMENT 1

### Methods

#### *Participants*

48 volunteers (24 males and 24 females, mean age 21.5 years,  $s=3.8$ ) were recruited from various sport and fitness classes at a large southeastern university in the United States, and participated for extra course credit. To minimize learning of the task (e.g. grip, stance), participants were recruited based on the minimal criterion that they were familiar with the putting task (i.e. had played miniature-golf before).

#### *Task and objective*

Participants used a standard putter to putt a regulation golf ball on a  $3 \times 12$  foot ( $0.914 \times 3.66$  m) artificial indoor green and to rest it in a 4.25 inch (10.8 cm) chalked outlined circle (target) located 6 feet (1.83 m) away.

#### *Conditions*

Participants were randomly assigned to one of the following four load conditions:

1. *Visual distraction*: a strobe light (Eliminator model E-105, Canton Ohio) was positioned on the floor directly behind the participant. The light was set at 80 flashes per minute.
2. *Auditory distraction*: participants listened to a pre-recorded audio clip of fan noise, with a commentator in the background giving play by play of a basketball game. The loudness was typical of the volume one would experience while watching television (displayed on a Sony Monitor at 75 dB, with picture occluded; Sony Model PVM 1341, Ichinomiya, Japan).
3. *Cognitive*: participants were given ten s to memorize an eight-digit sequence of random numbers, and then asked to rehearse the sequence aloud during the execution of each putt.
4. *Self-presentation/incentive*: a video camera (Hitachi model VM h825LA, Japan) was positioned in each participant’s sight approximately three feet (0.914 m) to the right of the putting surface. They were told that they were being filmed for biomechanical research and that if they recorded one of the top three accuracy scores in the experiment that they would receive triple extra class credit for their participation. Self-presentational concerns have been reliably demonstrated to occur through the anticipated use of videotaping (e.g. Baumeister & Showers, 1986; Carver & Scheier, 1981; Tugade &

Fredrickson, 2004), and it has been suggested that heightened anxiety may serve as a cognitive load (Janelle, 1999).

### Procedures

Following four practice putts, participants performed three trial blocks of ten putts each. The first block represented baseline putting skill. The second and third blocks were counterbalanced based on load conditions: one with load and the other with no load. Loads were imposed at the beginning of these respective trial blocks according to the load manipulation conditions to which each participant was randomly assigned. Furthermore, before Trial Block 2, participants were given additional information and instructions. Specifically, they were told: "One of the most common mistakes that an individual can make when attempting a putt is leaving it short of the hole. Your goal is to putt the ball and try to make it land on the circle, but be careful not to putt the ball shy of the circle; don't putt the ball short." Immediately before Trial Block 3, they were reminded of the latter sentence with the addition of the word "remember" (i.e. "Remember, your goal is to try and make it land on the circle, but be careful..."). All putts were scored by recording the distance in centimetres travelled from the starting line.

### Data analyses

Two separate analyses were performed: one for all putts taken in a trial block and one for the first putt taken in each trial block. The second analysis was performed to compare the results of the present study with those of Wegner *et al.* (1998), where only one putt was taken. The design for each analysis was a  $2 \times 2 \times 4 \times 3$  (Gender  $\times$  Load  $\times$  Group  $\times$  Trial Block) analysis of variance (ANOVA) with repeated measures on the last factor. Alpha was set at  $P = 0.05$  for all statistical analyses, and Tukey's HSD *post hoc* test was used when necessary to evaluate main effects.

## Results and discussion

### All putts

A significant main effect was found for Trial Block ( $F_{2,88} = 22.86$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.40$ ). Tukey's *post hoc* test revealed that putting distance increased significantly from Trial Block 1 (baseline mean = 197.99 cm,  $s = 13.93$ ) to Trial Block 2 (mean = 215.14 cm,  $s = 21.94$ ) following the introduction of the negatively worded instructional set. Putting distance in Trial Block 3 (mean = 205.20 cm,  $s = 18.74$ ) remained significantly further than baseline, but significantly shorter than Trial Block 2

(see Figure 1). No other significant main effects or interactions were found.

Given the relatively few trials and small sample size, we conducted a *post hoc* test of power to determine that our test was sufficient to detect a difference. Power was favourable for both Trial Block ( $\beta = 1.0$ ) and the Group  $\times$  Trial Block interaction ( $\beta = 0.93$ ). Although the power test did reveal a moderate level ( $\beta = 0.6$ ) for the Group main effect, we interpreted this finding to indicate that the groups were marginally different at baseline ( $P = 0.07$ ) and the trend continued throughout subsequent trials. Moreover, the effect size for Group difference was low ( $d = 0.15$ ; Cohen, 1988).

To determine the effect of the instructions irrespective of whether or not load was present, we compared baseline trials, load trials, and no load trials. We found that the load (mean = 210.82 cm,  $s = 18.01$ ) and no load trials (mean = 210.41 cm,  $s = 23.45$ ) produced significantly longer putts ( $F_{2,80} = 14.65$ ,  $P < 0.001$ ,  $\eta_p^2 = 0.27$ ) than the baseline trials (mean = 197.99 cm,  $s = 13.93$ ) (see Figure 2).

### First putt

The first putt was analysed for three reasons. First, Wegner *et al.* (1998) analysed only one putt

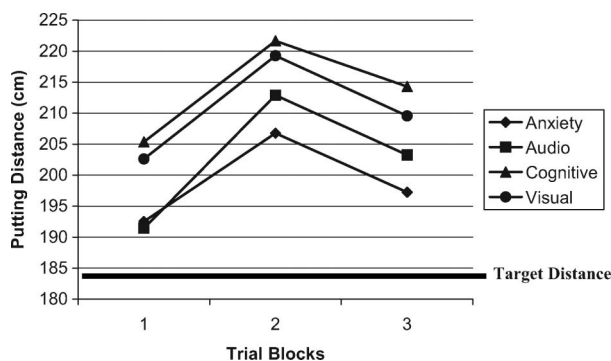


Figure 1. Mean putting distance for all putts across trial blocks (1–3) for each group from Experiment 1. Collective mean distances (cm) past target: TB1 = 15.09, TB2 = 32.24, TB3 = 22.30.

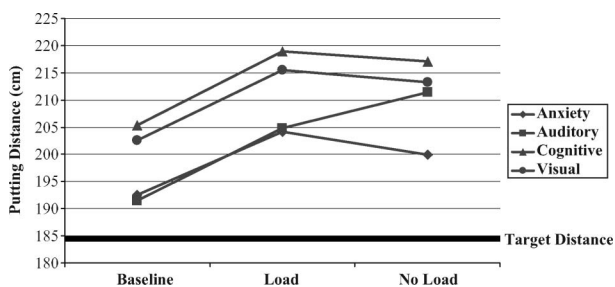


Figure 2. Mean putting distance for comparing baseline, load, and no load trials for each group from Experiment 1. Collective mean distances (cm) past target: Base = 15.09, Load = 27.91, No Load = 27.51.

compared with baseline, so a more direct comparison with their existing work could be achieved by analysis of the first putt only. Second, the novelty of the negative self-instruction with or without load is greatest following the initial introduction of the independent variable. The individual may adapt to the instructions (and/or load) with subsequent putts (as was apparent to some extent with Trial Block 3 with *all putts*). Finally, assessing a single putt is arguably more ecologically valid when considering the typical demands of golf. During competition, a golfer is permitted only one putt from a given location – there are no second chances.

Similar to the results for all putts, analysis of the initial put yielded a significant main effect for Trial Block ( $F_{2,64} = 10.17$ ,  $P < 0.001$ ,  $\eta_p^2 = 0.29$ ). Tukey's *post hoc* test revealed that Trial Block 1 (mean = 193.60 cm,  $s = 43.43$ ) and Trial Block 3 (mean = 203.82 cm,  $s = 48.73$ ) were significantly different from Trial Block 2 (mean = 231.20 cm,  $s = 48.57$ ). This change was in the same direction as the previous analysis, which included all trials.

Descriptive data were also computed to further examine incidences of ironic effects and overcompensation errors. The first putt of Trial Block 2 (trial 11) and Trial Block 3 (trial 21) were compared with the baseline mean. The baseline mean was used as a comparison because participants tended to overshoot the target slightly (see Figure 1) during baseline. Putting errors were considered “ironic” if they were less than baseline means, and “overcompensations” if they were greater than baseline means. Putts scored at or between 177.5 and 188.3 cm were counted as “makes”, as this diameter (10.8 cm) was the length of the target. Following loading conditions, the Friedman Test indicated a significant difference ( $P < 0.001$ ) in that 37.50% participants had ironic results, 60.42% overcompensated, and 2.05% made the putt. Following the no load trial, the Friedman test indicated ( $P < 0.001$ ) that 20.83% had ironic results, 72.92% overcompensated, and 6.25% made the putt. With respect to the ironic effects demonstrated following load, there was no obvious significance with regard to modality. Of the 18 ironic effects, six were from the audio group, five from the self-presentation/incentive group, four from the cognitive group, and three from the visual group.

Collectively, the results of Experiment 1 supported the implicit overcompensation hypothesis. Overcompensation was evident in the second and third trial block regardless of which type of load was induced. Why overcompensation observed during the third trial block remained higher than at baseline, but not as high as with the second trial block, deserves attention. We argue that the introduction of the self-instruction not to putt it short caused the initial increase in error in Trial Block 2. This is evident

because no significant differences were present in the load versus no load trials. In both experiments, after ten trials of repeating the negatively worded instruction, it is likely that its impact was not as great (although still apparent) during Trial Block 3.

The findings of Experiment 1 support the importance of self-instruction and the direct consequences of such recommendations. The instruction not to putt the ball short apparently served as an implicit message that was it was better to putt it firm than short. Given the results of Experiment 1, the purpose of Experiment 2 was to determine whether or not implicit overcompensation could be elicited in either direction (short or long) without the presence of load.

## EXPERIMENT 2

In Experiment 2, no load conditions were manipulated, but the participants were randomly distributed into one of three groups: a “short” group, a “long” group, and a “control” group. The “short” group was instructed not to leave the ball short of the hole, the “long” group was instructed to avoid hitting the ball past the hole, and the control group was not given any directional manipulations – they were told simply to try to make the ball land on the target. We predicted that participants in the “long” and “short” group conditions would significantly overcompensate relative to the control group, and in a direction-specific manner.

## Methods

### Participants

The 36 participants (18 males, 18 females) were undergraduate students (mean age 21.5 years,  $s = 3.0$  years) who volunteered for the study and were given extra credit for their participation. The same criteria for selection were used as in Experiment 1.

### Procedure

The putting task and baseline (Trial Block 1), as well as the dependent measure, were the same as for Experiment 1. In Trial Block 2, the participants were randomly assigned to one of three groups: control, long, and short. The groups differed by the type of instructions given, but in contrast to Experiment 1, mental load was not manipulated. The control group was instructed to “putt the ball and try to make it land on the circle”. The long group was given instructions to “putt the ball and try to make it land on the circle, but be careful not to putt the ball past the circle; don't putt the ball long”. Conversely, the short group was given instructions to “putt the ball and try to make it land on the circle, but be careful

not to putt the ball shy of the circle; don't putt the ball short". Each participant completed 30 trials divided into three trial blocks of ten trials each.

## Results and discussion

### All putts

All putts were analysed using a  $2 \times 3 \times 3$  (Gender  $\times$  Group  $\times$  Trial Block) ANOVA with repeated measures on the last factor. A significant main effect was found for Group ( $F_{2,30} = 30.82$ ,  $P < 0.001$ ,  $\eta_p^2 = 0.67$ ). More importantly, however, a significant Trial Block  $\times$  Group interaction ( $F_{4,60} = 14.82$ ,  $P < 0.001$ ,  $\eta_p^2 = 0.33$ ) was observed. Simple effects tests revealed that there were significant difference between all three conditions (control, long, and short) on both Trial Blocks 2 and 3 (see Table I); however, no significant differences were observed in Trial Block 1 (see Figure 3). No other significant main effects or interactions were found.

### First putt

A significant main effect was also found for Group ( $F_{2,30} = 7.21$ ,  $P < 0.01$ ,  $\eta_p^2 = 0.33$ ) in this analysis. More importantly, a significant Trial Blocks  $\times$  Group interaction ( $F_{4,60} = 4.33$ ,  $P < 0.01$ ,  $\eta_p^2 = 0.22$ ) was

Table I. Experiment 2 – all putts: Trial Block  $\times$  Group interaction.

Group	Trial Block 1		Trial Block 2		Trial Block 3	
	Mean	s	Mean	s	Mean	s
Control	199.72 (16.82)	19.53	186.18 (3.28)	10.37	192.36 (9.46)	10.77
Short	196.60 (13.70)	14.39	222.34 (39.44)	15.78	213.14 (30.24)	13.70
Long	188.46 (5.56)	14.73	170.20 (-12.7)	13.70	169.21 (-13.69)	12.75

\*Figures in parenthesis indicate distance (cm) long (or short) of target.

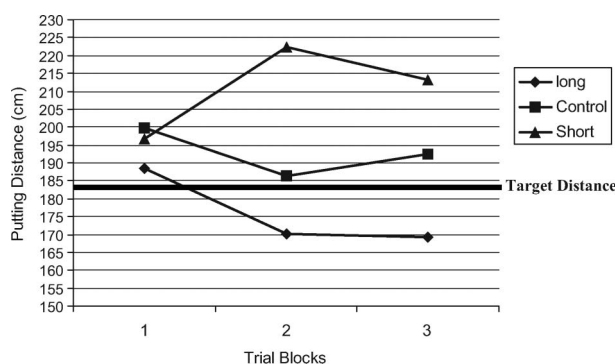


Figure 3. Mean putting distance for all putts across trial blocks (1–3) for each group from Experiment 2.

also observed. Simple effects tests revealed that there was a significant difference between the long and short conditions on Trial Block 2 and between all three conditions (long, short, and control) in Trial Block 3. However, as with the *all putts* analysis, no significant differences were observed in Trial Block 1. In addition to the ANOVA analysis, the Friedman test revealed significant differences between overcompensation and ironic process effects ( $P < 0.001$ ) compared with baseline scores. Immediately after the introduction of the instruction not to putt it short or long, 75% of the individuals overcompensated, 16.7% committed ironic effects, and 8.3% individuals landed the ball on the target. With respect to the control group, in which the goal was simply to land the ball on the target, 41.67% overcompensated, 41.67% experienced ironic effects, and 16.67% of the individuals made successful putts.

Experiment 2 was conducted to determine whether the overcompensation effects that emerged in Experiment 1 would be replicated with a specific focus on the direction of error. We hypothesized that self-instructions not to putt it long (or short) would result in a tendency to overcompensate. Consistent with our predictions, participants tended to either putt the ball long or short depending on the type of instructions given. More specifically, when instructed to avoid putting the ball short, participants typically putted the ball past the hole, and vice versa. The results support the implicit overcompensation hypothesis, which emphasizes the importance of the negatively worded instruction itself and its directional modulation of action, even when loading is absent.

## General discussion

The purpose of Experiments 1 and 2 was to determine whether Wegner's (1994) theory of ironic processes or the implicit overcompensation hypothesis would best account for outcome directionality in a simple golf putt. Overcompensation was more prevalent than ironic effects in both experiments. Findings from Experiment 1 suggested that instructional sets geared towards avoidance of specific errors detrimentally influenced performance in a manner consistent with the implicit overcompensation hypothesis. Moreover, in Experiment 2, the control group performed better than both experimental groups (i.e. "don't putt it long or short"), suggesting that self-instruction alone can undermine performance in an overcompensatory manner.

At first glance, the general findings of the current investigation may appear intuitive. That is, one probably would expect participants to overshoot or undershoot the putt when told not to undershoot or overshoot, respectively. However, such conclusions

would be premature on at least two counts. First, our results are inconsistent with those obtained by Wegner and colleagues (1998) using a similar task. Second, despite the directional clauses specified in the instructional sets, *the goal in every condition was the same*: whether told not to leave the ball long or short, the primary goal remained to land the ball on the target. From a practical point of view, ironic results and/or overcompensation occur from time to time even without conscious regulation of error avoidance (as was demonstrated by the control group in Experiment 2). However, in cases preceded by the self-instruction not to err in a particular direction, implicit overcompensation provides a novel conceptual framework to account for why such instructions can increase the probability of error in a direction-specific manner.

With respect to ironic effects, an obvious question that warrants consideration is why such effects were not statistically significant in Experiment 1 as they were in Wegner and colleagues' (1998) study. An argument could be made that subtle differences in the methodology might be accountable for these inconsistencies. First, the number of putts taken in each study was different. In the current study, participants took four warm-up putts, followed by 10 putts in each of the three trial blocks, compared with an undisclosed amount of warm-up putts, one baseline putt, and one experimental putt in Wegner and colleagues' (1998) study. Additionally, the cognitive task in the current study consisted of participants rehearsing an eight-digit sequence aloud while putting, whereas participants in Wegner and colleagues' study rehearsed a six-digit sequence of numbers to themselves. Furthermore, in the latter study, participants putted in a room lit only by ultraviolet light. The putter glowed orange in one condition (monitoring present) and was black in a second (monitoring absent) condition. This allowed the participant to either monitor the putter (orange) or not (black). Finally, the ball glowed yellow and the target glowed blue. Simply stated, Wegner and colleagues' loading condition may have been greater than those used in the present study. An additional argument can be made that the lighting used by Wegner *et al.* served as a distracter in addition to the cognitive mental load (and perhaps was anxiety inducing), yielding a qualitatively different and stronger mental load. While this interpretation is possible, determining precisely which modalities and threshold levels are requisite for ironic effects to occur remains empirically unclear.

Our findings are perhaps most closely aligned with those of Beilock *et al.* (2001), who found that overcompensation in movement occurred when participants were told not to *image* putting it short, whereas in our study suppression imagery was not

used. Although imagery was not of interest in the current study, Beilock and colleagues' findings can be accommodated within the scope of the implicit overcompensation hypothesis. As is the case when given explicit instructional information, the attempt to suppress an image of not putting it short occasions an implicit message that it is better to putt it firm than to leave it short. We argue that whether or not the performer devotes attentional resources on suppressing the image is irrelevant, because resulting outcome directionality is not dictated by a rebound of thought, but by the preceding implicit message.

Although incidences of overcompensation were more prevalent in the current study, it is important to emphasize that some participants did experience ironic effects. In Experiment 1 (first putt analyses), 37.5% of participants experienced ironic effects following load, compared with just 20.83% with no load, a difference of 16.67%. That many participants experienced ironic effects is interesting and deserves attention, given that there is considerable research supporting the phenomenon of "ironic" rebound effects. It is evident that trying not to think about something can cause a subsequent increase of the particular thought or object. Perhaps the quality of rebound interacts with load differentially on an individual basis. For example, the instruction "don't putt it short" might rebound as just that for one athlete, but might rebound as "don't putt it short or you'll embarrass yourself" for another. We acknowledge the possibility that rebound characterized by anxiety or is exacerbated by other competing sensory modalities (e.g. auditory, visual) may be capable of superseding implicit overcompensation mechanisms, shifting to the ironic processes set forth by Wegner (1994). Perhaps the individuals who experienced ironic effects in the current study (and the greater percentage in Wegner *et al.*, 1998) experienced anxiety more so than participants who overcompensated. Determining whether anxiety or other crucial variables interact with particular loads differentially is a challenge for researchers in the future (Janelle, 1999). Clearly, further exploration within the context of Wegner's theory is warranted and encouraged.

In addition to examining the interaction of load with other constructs, we encourage consideration of methodological limitations that arose in the current study. As mentioned, one could argue that participants in this study performed as they did because they were simply following directions. That is, when they were told not to putt it short, they made the conscious decision to putt it long. Keeping in mind that the goal remained the same (namely to land the ball on the target), it would be advantageous to include a manipulation check in future projects to

ascertain whether participants indeed remained focused on the goal of hitting the target. A second consideration is that of psychological reactance. Brehm and Brehm (1981) argued that reactant individuals purposely behave in a way opposite to that of instructions to preserve personal freedom. Carter and Kelly (1997) found that high-reactant athletes experienced significantly lower somatic state anxiety than low-reactant athletes who were both instructed to image themselves experiencing nervous symptoms prior to shooting a free-throw shot. It is possible that the small percentage of participants who did experience ironic results may have been high-reactant in nature. Future research with outcome directionality should therefore address personality variables as well as employing manipulation checks for target intention.

Sport psychology researchers have just begun to address how psychological factors influence the direction of movement outcome. Clearly, however, understanding influences on movement direction could profoundly influence the content of self-instruction, particularly in self-paced tasks such as the golf putt. While this study highlights potential mechanisms that may cause error through overcompensation, our initial results should be interpreted within the context of its participant sample – normal functioning individuals who have a minimal amount of putting skill. Researchers have recently suggested that for many individuals who experience the “yips” when putting, the primary causal factor of ineffective putting movements is a deterioration of motor pathways (dystonia) associated with the basal ganglia (for a review, see Smith *et al.*, 2003). The basal ganglia bridge the emotion, motivation, cognition, and planning processes that lead to overt movement, thereby holding a critical role in the functional expression of motor action (Haber, 2003). Specifying how cognitive (and affective) instructions yield specific directional effects on movement will aid efforts to delineate the cortical and subcortical mechanisms that yield maladaptive (e.g. the yips) and adaptive (error reduction) motor performance. Given their biological interdependence, researchers should consider emotion, motivation, and attentional factors among athletes of different skill in their future efforts to understand direction-specific movement errors.

In conclusion, we argue that the instruction “not to do something” creates an implicit message that it is better to err on the side opposite of that particular instruction, leading to an overcompensation of movement tendencies. Although the specific planning and control mechanisms that may subserve these movement outcomes continue to be debated (e.g. Shea & Wulf, 2005), our study offers initial preliminary data that following self-instructions not to “putt it short”, misses are more likely to be

overcompensations than any other type of error. Given the amount of explicit instruction that characterizes the typical coach–athlete relationship, especially during the early stages of learning (but also during typical competition), our findings highlight an important principle. Namely, it is better to focus on what *to do* rather than *what not to do*. Although the goals of performing effectively and achieving a particular outcome remain the primary focal points in any task, negatively formulated instruction beyond that concerning the desired outcome should be minimized, as it may lead to overcompensation.

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