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Negative instructions and choking under pressure in aiming at a far target

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Providing instructions to avoid an action may ironically increase the tendency to engage in that action, especially when attentional resources are taxed. In the perceptual-motor domain the role of anxiety in inducing such ironic effects has rarely been investigated even though anxiety both affects attention and plays a crucial role in performance decrements in sports (i.e., choking under pressure). Therefore, we investigated the combined effects of anxiety and negative instructions on perceptual-motor performance. Participants threw darts under one neutral instruction to hit bulls-eye and one negatively worded instruction while positioned either high or low on a climbing wall (i.e., with and without anxiety). Only the combination of high anxiety and the negative instruction led to a significant drop in performance. In line with theories on ironic processes and choking, the results indicate that when negative instructions and anxiety are combined, the likelihood of ironic effects and, thus, choking, is increased.

KEY WORDS: Anxiety, Dart throwing, Ironic effects, Perceptual-motor control.

Choking under pressure is a hindering phenomenon in sports in which athletes perform worse than expected on the basis of their current level of expertise when the pressure to perform increases (Baumeister, 1984; cf. Hill, Hanton, Fleming, & Matthews, 2009). High-pressure situations are often accompanied by distracting thoughts and worries, possibly leading to negative self-instructions, (e.g., "don't miss" or "don't hit the ball in the pond"), which lead to a decrement in performance, a choke (e.g., Cumming, Nordin, Horton, & Reynolds, 2006; Oudejans, Kuijpers, Kooijman, & Bakker, 2011; Van Raalte, Brewer, Rivera, & Petitpas, 1994). More specifically, following the negative intention to avoid specific behavior athletes may ironically do

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precisely that which s/he intended not to do; an ironic effect occurs (e.g., Janelle, 1999; Wegner, 1994, 2009; Wegner, Ansfield, & Pilloff, 1998). For example, in the perceptual-motor domain a soccer player taking a penalty kick may kick the ball within reach of the keeper following the explicit instruction not to let that happen (Bakker, Oudejans, Binsch, & Van der Kamp, 2006). As such, in the perceptual-motor domain an ironic effect may be considered a special case of choking.

A possible explanation for ironic effects is provided by the theory of ironic mental processes (Wegner, 1994), which holds that successful behavior relies on two cognitive processes, an operating process promoting intended behavior, and a monitoring process that checks whether the current state of affairs is consistent with that intended behavior. In brief (for more elaborate descriptions we refer to Wegner, 1994; cf. Janelle, 1999), the monitoring process continuously scans the contents of consciousness for any trace of unwanted thoughts. When an unwanted thought is detected (e.g., in golf, "do not hit the ball into the pond"), the operating process is initiated to replace this thought with a more appropriate thought related to the intended behavior (e.g., "hit the ball on the green"). The operating process requires greater cognitive capacity than the automatic monitoring process. Under conditions that tax attentional resources (e.g., under a high mental load or time pressure), insufficient attention may be left for the operating process to replace the unwanted thought with intended behavior. This results in the manifestation of the unwanted thought and less-than-optimal performance. Sticking to the golf example, a golfer may thus instruct himself not to hit the ball into the pond. As a result, "pond" may linger on in the system hereby undesirably drawing attention. The pressure to perform may prevent the operating process to replace the unwanted thought with a more positive instruction (e.g., "hit the ball on the green"), eventually leading to a bad swing and the ball disappearing in the pond.

According to the theory of ironic processes it is not the (negative) intention alone (e.g., "*do not* miss") that causes ironic effects in the perceptual-motor domain, but also limitations in attentional capacity. Wegner (1994) suggested that cognitive or physical load (e.g., counting backwards in steps of seven or holding a heavy brick, respectively), internal and external distractions (e.g., negative or positive feelings and performing under loud noise, respectively), and emotional loading (e.g., fury or anxiety) can enhance the probability of ironic processes as these factors tax attentional resources. For example, Wegner et al. (1998) examined the combined effects of cognitive load and negative instructions on perceptual-motor performance by asking participants to memorize a six-digit number while they had to putt a golf ball to a fixed mark on a golf green under the instruction not to putt past the mark. Under load participants hit the ball further past the mark than without load. More recent studies were conducted to investigate the role of different loads and the significance of ironic effects in the perceptual motor-domain by using similar golf-putt settings and instructions (e.g., Beilock, Afremow, Rabe, & Carr, 2001; Binsch, Oudejans, Bakker, & Savelsbergh, 2009; De la Peña, Murray, & Janelle, 2008).

Anxiety is one of the types of load that has rarely been investigated in the perceptual-motor domain in combination with negative instructions. It is well known that anxiety often plays a crucial role in performance decrements in sports (choking under pressure). Furthermore, anxiety is often accompanied by negative thoughts and worries (Oudejans et al., 2011) that place a large burden on cognitive resources (e.g., Baumeister, 1984; Beilock & Carr, 2001; Jordet, 2009; Oudejans & Pijpers, 2009; Wilson, Vine, & Wood, 2009). As such, anxiety may increase the chance on the occurrence of ironic effects. As mentioned, if an ironic effect occurs under pressure with increased anxiety (i.e., if one does precisely that which one wishes to avoid under these circumstances) then that can in fact be considered a choke. Only Woodman and Davis (2008) have investigated the combined effects of anxiety, negative instructions and specific dispositions (i.e., anxiety coping styles) in a golf putting task. The authors conclude that particularly participants who experienced low levels of cognitive anxiety but actually had high heart rates during the high anxiety competition putt (so called repressors) showed ironic effects on this putt, as these repressors significantly over-shot the target by 35 cm when they were urged not to overshoot the target. Woodman and Davis did not investigate all four combinations of low and high anxiety, and neutral and negative instructions (low-neutral, high-neutral, low-negative, high-negative), but only low-neutral and high-negative. In short, more research is needed to gain insight into the effects of anxiety and negative instructions, separately, but especially in combination.

Therefore, in the current study we investigated the combined effects of anxiety and instruction on dart throwing performance by investigating all four combinations of low and high anxiety, and neutral and negative instructions (low-neutral, high-neutral, low-negative, high-negative). We used an established method to manipulate anxiety, namely an indoor climbing wall of which there is ample evidence that it can consistently induce high levels of anxiety (see Nibbeling, Oudejans, & Daanen, 2012; Nieuwenhuys, Pijpers, Oudejans, & Bakker, 2008; Oudejans & Pijpers, 2009, 2010). Participants threw darts while positioned either high (with anxiety) or low (without anxiety) on the climbing wall under two instruction conditions, a neutral instruction and a negative instruction. We expected that participants would consistently indicate higher levels of anxiety high on the wall compared to low on the wall. Furthermore, we expected that particularly the combination of high anxiety and a negative instruction would lead to decrements in performance compared to the other conditions.

Method

Participants

Forty undergraduate students (20 men and 20 women, mean age = 21.3 years, *SD* = 1.85; each of them was right-handed by self-report) participated voluntarily. The participants had no climbing and no dart throwing experience.

Task and Design

The task of the participants was to throw 96 darts, that is, 24 darts in each of four experimental conditions. These conditions were the combination of the two height conditions (i.e., high and low on the climbing wall) and the two instruction conditions (i.e., "dart as accurate as possible, thus, try to hit bulls-eye" - "accurate" instruction; and "dart as accurate as possible, thus, try to hit bulls-eye, but be careful not to hit less than X" - "not-less" instruction), where X was the average dart score on a baseline test of 24 throws minus one ring. For example, when a participant achieved an average dart score of 6 in the baseline, the participants' not-less instruction was "dart as accurate as possible, thus, try to hit bulls-eye, but be careful not to hit less than the 5" (see Figure 1). Participants were unaware of the use of their individual baseline

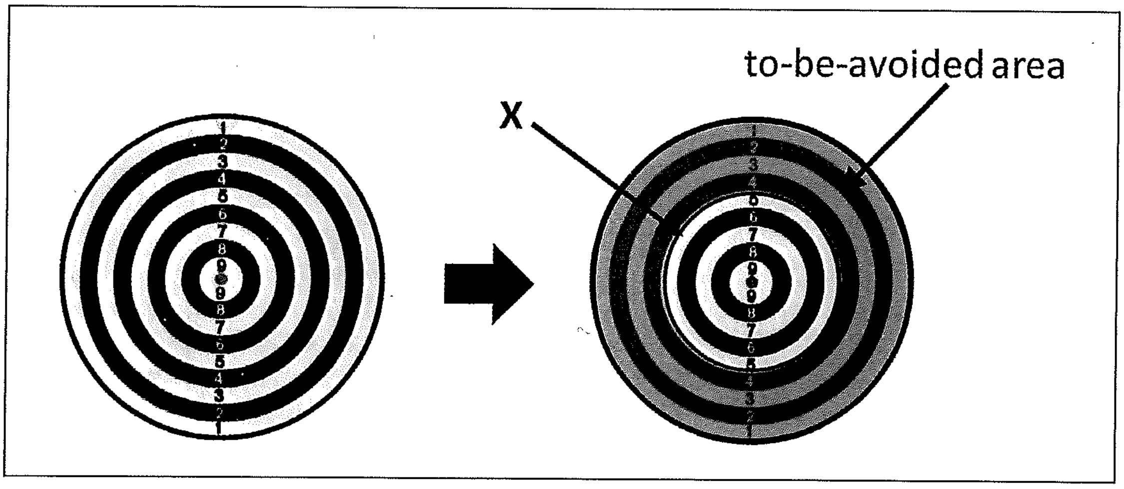

Figure 1. Front view of the dartboard (left) and the consequences of the negative instruction made visible (right). The negative instruction not to score less than X effectively created two (concentric) areas on the board, one to which the participant should throw (i.e., rings X to bulls-eye) and one area that should be avoided (i.e., the outer rings yielding less than X points; grey area).

score. The two height conditions were counterbalanced, implying that half of the participants started high on the wall and the other half started low on the wall. Within the height conditions, the instruction conditions were also counterbalanced, in such a way that (a) half of the participants started with the "accurate" instruction and half with the "not-less" instruction, (b) once the participants performed high or low on the wall they completed both instruction conditions before they changed to the other position on the wall, and (c) for a particular participant the order of instruction conditions was the same both low and high on the wall.

Experimental Set-Up

For the purpose of the high-anxiety manipulation participants threw their darts (BRASS, Tilburg, NLD) while they were positioned on a vertical climbing wall (width: 3.5 m, height: 7.0 m; see Figure 2), which was set up in a gym-sized laboratory. On the wall, at two different heights several holds were bolted, four footholds and three handholds (see Figure 2B). The

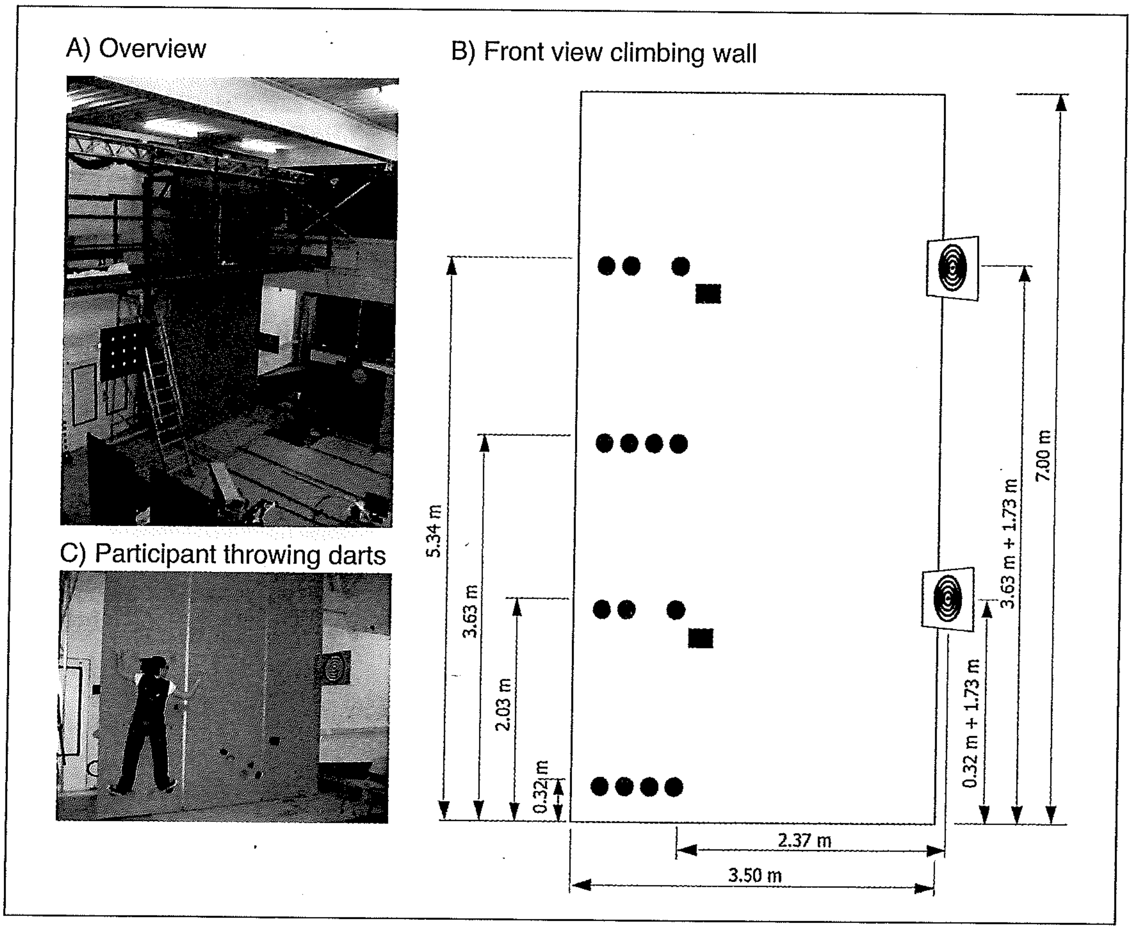

Figure 2. Overview of the experimental set-up of Experiment 2 (A); Front view of the climbing wall with its relevant measures (B); Example of a person throwing darts low on the wall (C) (A and C adopted from, and B adjusted from Oudejans & Pijpers, 2009).

mean height of the footholds in the low condition was 0.32 m above the ground. The height of the two handholds was 2.03 m in this condition. The height of foot- and handholds in the high condition (used to increase anxiety) was 3.63 m and 5.34 m, respectively. In order to take position high on the climbing wall a large stepladder was used. The stepladder had a small platform that allowed participants to rest after having climbed it and to start testing in the high condition in a similar physical condition (i.e., non-fatigued, similar heart rate) as in the low condition. The stepladder was removed from the wall once participants were safely positioned on the wall.

For safety reasons participants had to be secured high on the climbing wall. Therefore, and to keep conditions as similar as possible, participants wore a climbing harness (Singing Rock, Zenith, Type C) and were secured high and low on the wall using the so-called 'top-roping' technique (Skinner & McMullen, 1993).

For both high and low positions on the wall a dart board (Ø = 0.43 cm; Win500, Winmau Diamond, USA) was placed near the right edge of and at right angles with the wall (see Figure 2). Each dart board was attached to the wall on a wooden board with the edge of the dart board at a distance of 15 cm from the wall and for both high and low positions at the regulation distance of 2.37 m from the right foothold. Bulls-eye was placed at a relative height of 1.73 m above the footholds (regulation height). The face of each board showed 10 circles (i.e., one red [bulls-eye], five black, and four white circles). The diameter of the bulls-eye was 1.6 cm and the rim of each black or white circle was 2.3 cm wide. Each circle yielding a certain number of points per dart, starting with 10 when bulls-eye was hit to 0 points when the dart board was not hit at all. Participants were standing on two footholds and holding one handhold while they threw their darts. After each set of six darts an experimenter collected the darts from the board and returned them to a box which was mounted on the wall beside the participant. In the high condition the darts were collected and returned using a mobile footbridge (see Figure 2A). Because parking the footbridge close to the participants would possibly impair the anxiety manipulation, the footbridge was taken to a position of 2.50 m away from the wall after the scores were counted and the darts were collected and returned to the box.

MEASURES

The Dutch version of the A-Trait scale of the State-Trait Anxiety Inventory (STAI) was used as a standard check to measure trait anxiety (Spielberger, Gorsuch, & Lushene, 1970; Van der Ploeg, Defares, Spielberger, 1979). The mean trait anxiety scores for the male and female participants were 31.5 ($SD = 5.2$) and 32.9 ($SD = 4.8$), respectively. These values were significantly lower than the mean values for Dutch male ($M = 36.1$) and female ($M = 37.7$) students obtained by Van der Ploeg, Defares, Spielberger (1980) on a t test between a sample and a population mean for the men, $t(19) = 3.99$, $p < .01$, and women, $t(19) = 4.49$, $p < .001$, respectively. Although significant, the results clearly indicated that the participants had no extraordinary tendency to respond to situations perceived as threatening with an elevation in state anxiety.

The state anxiety scores were obtained using a visual-analogue anxiety scale, called the anxiety 'thermometer', which was validated for the Dutch population by Houtman and Bakker (1989) and successfully used in earlier experiments (e.g., Nibbeling et al., 2012; Oudejans & Pijpers, 2009, 2010). The anxiety thermometer is a 10-cm continuous scale on which participants rated their anxiety feelings, ranging from 0 (*not anxious at all*, the left end) to 10 (*extremely anxious*, the right end). The anxiety thermometer provides a quick and reliable way to measure state anxiety. Generally, validity and test-retest reliability of the anxiety thermometer are fair, with correlation coefficients ranging between .60 and .87 for several comparisons (Bakker, Vanden Auweele, & Van Mele, 2003; Houtman & Bakker, 1989), including comparisons between anxiety scores taken before or after an event. This provides support for the validity of a measurement procedure in which feelings of anxiety are obtained after the event which was done in the current study. After each condition individuals placed a small vertical line on the scale to indicate how they had felt during that condition.

Participants were also equipped with a heart rate transmitter (T31; Polar, Finland) strapped around their chests. The heart rate monitor (wrist unit AXN 700; Polar, Finland) was worn by an experimenter to make sure that participants had no feedback about their somatic indices of anxiety, and to easily save participants' heart rates after each set of six throws.

Procedure

Prior to the experiment the protocol was approved by the ethics committee of the research institute. Participants were tested individually on one day and within one hour. Participants were informed about the procedure, that is, each of them was told that they would complete a series of dart throws on a climbing wall with the objective to throw as accurately as possible under different instructions. After that, participants signed a statement of informed consent after which they did a brief warm-up by throwing between 6 and 18 darts until they felt comfortable to start testing. The participants then completed a baseline test, that is, they took position behind a taped mark on the floor in front of a dartboard (regulation height and distance, i.e., 1.73 and 2.37 m, respectively) and threw 24 darts (i.e., four sets of six darts) under no specific instruction. The participant's score on this baseline test was used in the negative "not-less" instructions in the experimental conditions of that same participant. After the baseline test, participants were equipped with the climbing harness and heart rate transmitter. Then, participants started high or low on the wall (counterbalanced) with the accurate or not-less instruction (counterbalanced).

On the wall, a stable position was obtained using the left handhold and the two footholds, leaving the right arm free for dart throwing. After the participants had reached the starting position, the instruction in question (i.e., "accurate" or "not-less") was given. In addition, the instruction in question was repeated after each third throw. After each set of six throws the participant could, whenever s/he felt the need, grasp the right handhold with the right hand, slightly change position and release the tension on the muscles to prevent fatigue. After the first instruction condition participants continued with the next instruction condition in the same position high or low on the wall. After both instruction conditions were done, the participant came off the wall, rested several minutes and prepared for the other height condition on the wall. Once the participant was in position on the wall and at the new height the two instruction conditions were performed. In each of the four conditions participants threw four sets of six darts, 24 in total. After each condition participants completed a new anxiety thermometer. After the last condition participants stepped-off the wall and filled in the Dutch version of STAI A-Trait inventory. Finally, the participants were fully debriefed, questions were answered and participants were thanked for their participation.

Statistical Analysis

Per condition and participant anxiety scores were registered, average heart rates were computed, and dart performance was determined, operationalized as the average dart score (ranging from 0 to 10) per condition. Anxiety scores, heart rates and dart scores were all analyzed using 2 (Position: high, low) × 2 (Instruction: accurate, not-less) analyses of variance (ANOVAs). Pair-wise comparisons using Bonferroni correction (Field, 2004) were made to identify specific mean differences when appropriate. Effect sizes were calculated using Cohen's f with < 0.10, about 0.25, and > 0.40, representing small, moderate, and large effects, respectively (Cohen, 1988).

Results

Anxiety Scores And Heart Rates

The Position (high, low) × Instruction (accurate, not-less) repeated measures ANOVA on the anxiety scores revealed a main effect for Position, $F(1, 39) = 106.29$, $p < .001$, $f = 1.28$, in the absence of a significant effect for Instruction and a significant interaction between Position and Instruction, Fs < 1.0, ps $> .15$. On average participants indicated higher levels of anxiety when they were positioned high on the climbing wall ($M = 3.84$; $SD = 1.75$) compared to when they were positioned low on the wall ($M = 1.90$; $SD = 1.26$), 95% CI [1.56, 2.32]. The Position × Instruction repeated measures ANOVA on heart rate revealed a significant main effect of Position, $F(1, 39) = 4.18$, $p < .05$, $f = 0.33$, no effect for Instruction, $F < 1.0$, $p > .50$, and no significant interaction between Position and Instruction, $F < 2.75$, $p > .10$. On average heart rates were significantly higher high on the climbing wall ($M = 111.98$, $SD = 18.52$) than low on the wall ($M = 109.25$, $SD = 16.31$), 95% CI [0.02, 3.43]. Overall these results show that our anxiety manipulation was successful, that is, anxiety scores and heart rates were significantly higher high compared to low on the wall. Furthermore, anxiety scores and heart rates were not affected by Instruction.

Dart Performance

The Position (high, low) × Instruction (accurate, not-less) ANOVA on dart performance (i.e., average dart score, Table I) with repeated measures on dart performance revealed a significant main effect of Position, $F(1, 39) = 15.07$, $p < .001$, $f = 0.62$, 95% CI [-0.50, -0.16], and no effect of Instruction, $F(1, 39) = 2.44$, $p = .13$. However, the main effect of Position was superseded by the significant interaction between Position and Instruction, $F(1, 39) =$

TABLE I
Average Dart Scores (And SDS) High And Low On The Wall Land Following The Accurate And Not-Less Instruction Conditions.

Position	Instruction	
	accurate	not-less
low	5.68 (1.25)	5.78 (1.20)
high	5.56 (1.30)	5.25 (1.34)

10.99, $p < .01$, $f = 0.53$, observed power = .90 (see Table I and Figure 3). Post hoc pair-wise comparisons revealed that only high on the wall and in combination with the not-less instruction performance was negatively affected, $p < .01$, 95% CI [-0.50, -0.11]. Low on the climbing wall the not-less instruction

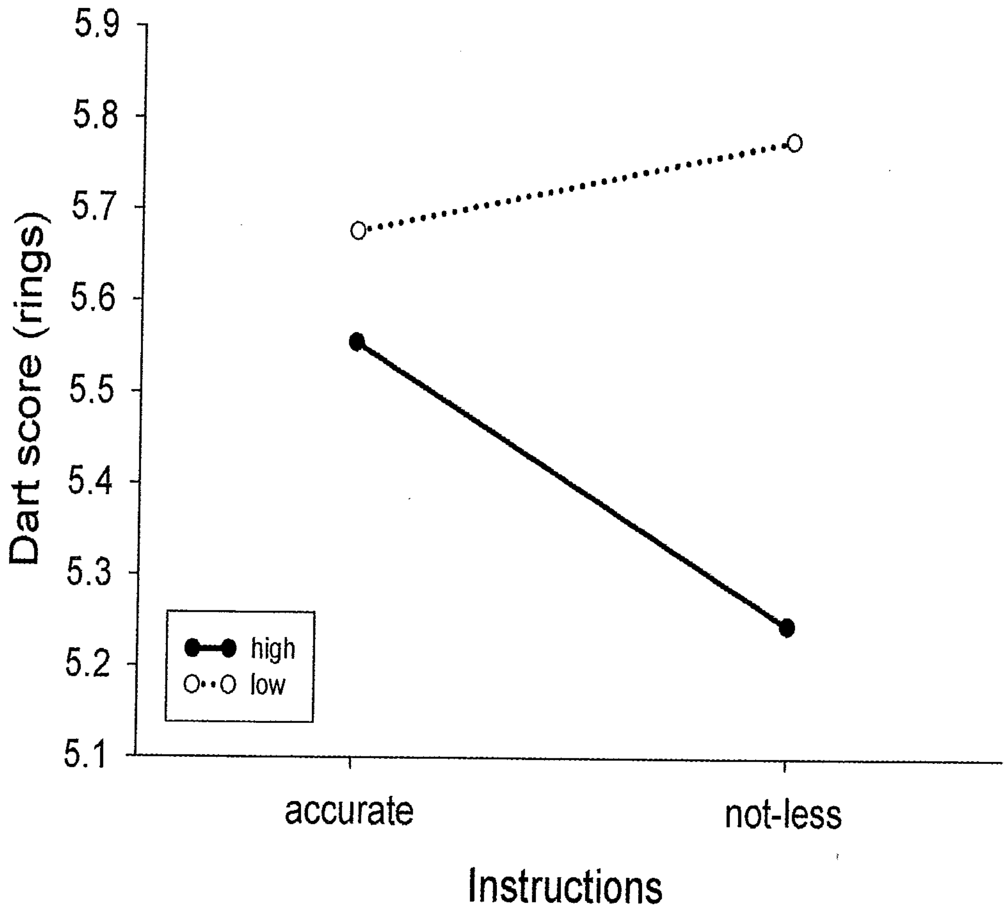

Figure 3. Average dart scores high and low on the wall and following the accurate and not-less instruction conditions.

did not negatively affect performance, $p = .25$, 95% CI [-0.27, 0.07]. Furthermore, with the accurate instruction a similar level of performance was reached high and low on the wall, $p = .24$, 95% CI [-0.33, 0.09].

Discussion

The main purpose of this study was to gain more insight into the combined effects of anxiety and negative instructions on perceptual-motor performance. It appeared that performance was affected by the not-less instruction, but only high on the climbing wall, thus, with anxiety. This is in line with Wegner's theory of ironic processes (1994), which predicts ironic effects following negative instructions particularly when combined with conditions of increased load, in this case induced with anxiety. With our instruction not to score less than X we effectively created two (concentric) areas on the board, one to which the participant should throw (i.e., rings X to bulls-eye) and one area that should be avoided (i.e., the outer rings yielding less than X points; see Figure 1). As a consequence, with the not less instruction (visual) attention may have been drawn (more) to the outer rings, despite the instruction (also in this case) to aim at bulls-eye. When anxiety was present, the operating process may have failed to restore visual attention on bulls-eye leading participants to ironically throw closer to the second (outer) area rather than further away from it (closer to bulls-eye), an ironic effect. Apparently, without anxiety (low on the wall) the not-less instruction did not lead to a negative effect on performance. Possibly without their attentional resources being taxed by anxiety, participants managed to restore attention (using the operating process) and to throw as they would normally do. Although speculative at this stage as we did not measure (visual) attention in the current study, our results are entirely in line with earlier findings on ironic processes in penalty shooting (Binsch, Oudejans, Bakker, & Savelsbergh, 2010) Binsch et al. found that participants looked longer at and shot closer to the keeper following the instruction not to shoot close to the keeper. The negative instruction not to shoot close to the keeper had resulted in longer looking at the keeper at the cost of looking at the open goal space.

The fact that anxiety alone (i.e., combined with the accurate instruction) did not affect performance is in line with recent findings by Nibbeling et al. (2012) who investigated dart throwing and gaze behavior high and low on the climbing wall with and without a cognitively taxing dual-task. Just as in the current study, Nibbeling et al. only found worse performance for novices when anxiety and the dual-task were combined. These results are consistent with Attentional Control Theory (ACT; Eysenck, Derakshan, Santos, & Calvo, 2007), an over-riding framework for the effects of anxiety on attention and performance (for an update of this theory for perceptual-motor performance see Nieuwenhuys & Oudejans, 2012). In contrast to several other theories that describe the underlying mechanisms of the effects of anxiety on performance ACT also describes how negative effects of anxiety may be countered by investing extra mental effort in performance. Several recent studies have shown that additional mental effort may indeed help in maintaining performance with anxiety (Nieuwenhuys & Oudejans, 2011; Oudejans & Pijpers, 2009, 2010). Unfortunately, mental effort scores were not obtained in the current study, but the results of Nibbeling et al. confirm that high on the wall more mental effort is invested in dart throwing, possibly explaining why performance was maintained with anxiety alone. Interestingly, there are striking resemblances between the self-regulatory mechanisms proposed in the ACT and Wegner's (1994) theory of ironic mental processes (cf. Wilson, Wood, & Vine, 2009), as both theories are dual-process theories in which automatic and controlled processes in working memory are proposed to interact, and in which the interaction may be affected by emotional load leading to suboptimal performance. It is a challenge for future research to develop one theoretical framework to explain effects of anxiety as well as ironic instructions on performance (cf. Nieuwenhuys & Oudejans, 2012). As mentioned in the introduction, it can be argued that in the perceptual-motor domain, an ironic effect that occurs under high pressure and anxiety can be considered a special case of choking with ironic mental processes as catalyst for choking under these particular circumstances.

In contrast to Woodman and Davis (2008) the present study found ironic effects averaged over all participants, thus, irrespective of individual differences in anxiety coping style (individual analyses of anxiety scores and heart rates, indicated that participants represented a mix of coping styles). Apparently, when the anxiety level and hence the cognitive load is high enough general ironic effects may be found following negative instructions. There is empirical evidence that state anxiety provides a more crucial measure for determining differences in, for instance, processing efficiency than is trait anxiety (Murray & Janelle, 2003, 2007). Nevertheless, it is a limitation of the current study that individual differences in coping with anxiety could not be taken into account. Future examination of the role of specific dispositions that are related to the vulnerability to ironic effects and choking, such as regulatory focus (Higgins, 1997, 1998; Plessner, Unkelbach, Memmert, Baltes, & Kolb, 2009), action-control (Jostmann & Koole, 2007; Kuhl, 1994), or repression (Woodman & Davis, 2008), is warranted. A positive development in that regard is provided by the recent work by Geukes, Mesagno, Hanrahan, and Kellman (2012) on the interactionist perspective that focuses on the interaction between specific personality traits and situational demands. They show that different types of pressure (e.g., public versus private) may activate different traits leading to predictable performance drops for specific athletes in specific circumstances (see also Binsch et al., 2009; Mesagno & Marchant, 2013).

Another limitation of the current study is that anxiety induced by the climbing wall (fear of falling) is of course not identical to anxiety resulting from increased pressure to perform well. However, following the definition of anxiety as an aversive emotional and motivational state in threatening circumstances, any threat, from a real or alleged danger, will result in anxiety and may interfere with reaching the current goal (see Spielberger, 1966, for a discussion about differences and similarities between fear and anxiety). As such, anxiety induced by the climbing wall also forms a threat to performing the darts task well. In addition, although anxiety in a sports competition environment may not be identical to anxiety on the climbing wall, a large part of the symptoms are the same (e.g., cognitive: worries and distracting thoughts; somatic: increased heart rate), providing a justification for the current manipulation and inspiring confidence in the relevance of the current findings. Still, future studies are necessary to determine the generalizability of our findings to actual sports competition, hereby also taking into account the different types of pressure and personality traits (e.g., Geukes et al., 2012).

Furthermore, participants were no experts but inexperienced dart throwers, who may show inconsistent levels of performance that should not be referred to as choking. However, following several definitions of choking (e.g., Baumeister, 1984; Hill, Hanton, Matthews, & Fleming, 2010; Mesagno & Hill, 2013) novices are not excluded from the possibility to choke; even novices can perform worse than expected when put under pressure, provided that their score is not zero to begin with. In the current study average scores were between 5 and 6, allowing for choking to occur. Still, it is possible that inconsistency in performance may have played a role in our findings, yet, given the counterbalanced design of a total of four conditions resulting from two within-subjects factors, namely, anxiety and instruction, it is unlikely that our findings are the result of such inconsistency. In fact, the statistics show that it is likely that the worse performance in the high-anxiety and not-less instruction condition is related to these independent variables and not inconsistency in performance.

One point of debate in the choking literature is whether a relatively small drop in performance should be considered choking or just underperformance (see Mesagno & Hill, 2013). Our stance in that debate is that there is a difference, whether we want it or not, between actual sports, involving phenomena such as choking and ironic effects, and scientific research into these phenomena. In most experimental studies, we deal with multiple participants, average performance, and experimental control over factors that we do not wish to investigate. This automatically means a distancing from the full choking phenomenon in actual sports competition even if we strive for representative designs (for discussion on representative design see Dicks, Davids, & Button, 2009). In experimental studies into choking there are two essential ingredients that are necessary to refer to choking: anxiety and a statistically significant drop in performance relative to conditions with less anxiety (see also Mesagno & Hill, 2013). Even if that drop is small in magnitude, it may still have catastrophic effects in actual sports. The drop in performance in the current study was within one ring on the dart board (2 cm). However small, in actual darts, winning or losing may be determined by differences of one or two millimeters (i.e., the width of the iron on the board determining in which section the dart has landed). As such, in experimental studies performance drops that are small in magnitude may be considered choking and not just underperformance. This does not imply that studies reporting such drops in performance capture all crucial elements of actual choking in sports (Hill, Hanton, Matthews, & Fleming, 2010; Mesagno & Hill, 2013).

In conclusion, the present findings make clear that particularly the combination of high anxiety and negative (self-)instructions (e.g., don't aim at the keeper, don't miss, don't score lower than score X) provide the most dangerous combination for performance, possibly yielding ironic effects and, thus, choking. Ironically this combination is often encountered in high-pressure situations as found in the sporting arena or in police work or fire fighting (e.g., Oudejans, 2008). In such high-pressure situations it is essential that task-relevant attention is maintained, and that attention is not drawn away by task-irrelevant (threat-related) matters, such as worrying thoughts, negative instructions, or external elements in the (visual) environment (Nieuwenhuys & Oudejans, 2012). There are three empirically supported methods to achieve and maintain such a task-related focus under high pressure. First, recent studies have shown that several sessions of training with increased levels of anxiety may help in getting used to the high-pressure circumstances and maintaining the appropriate focus (Nieuwenhuys & Oudejans, 2011; Oudejans, 2008; Oudejans & Pijpers, 2009; 2010). Second, Vine and colleagues have shown that in aiming tasks visual attention training (called Quiet Eye training) emphasizing athletes to fixate the target prior to and during the aiming action may indeed lead to sufficiently long visual attention on the target also under pressure circumstances (Vine & Wilson, 2010, 2011;

Vine, Moore, & Wilson, in press). Third, several studies by Binsch and colleagues (Bakker et al., 2006; Binsch, Oudejans, Bakker, & Savelsbergh, 2010; Binsch, Oudejans, Bakker, Hoozemans, & Savelsbergh, 2010) have shown that negative instructions involving the to-be-avoided area (e.g., the goal keeper; the outer rings) should be avoided in favor of positive instructions involving the target area, such as bulls-eye, the rim in basketball, or the hole in golf. All three methods are promising in helping to prevent choking under pressure. In all three cases athletes learn to maintain task-focused (visual) attention under stressful circumstances.

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