

Coping Under Pressure: Employing Emotion Regulation Strategies to Enhance Performance Under Pressure

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Performing under high pressure is an emotional experience. Hence, the use of emotion regulation strategies may prove to be highly effective in preventing choking under pressure. Using a golf putting task, we investigated the role of arousal on declined sport performance under pressure (pilot study) and the effectiveness of emotion regulation strategies in alleviating choking under pressure (main study). The pilot study showed that pressure resulted in decreased performance and this effect was partially mediated by increased arousal. The main study, a field study, showed that whereas the choking effect was observed in the control condition, reappraisal and, particularly, distraction were effective emotion regulation strategies in helping people to *cope* instead of *choke* under pressure. These findings suggest that interventions that aim to prevent choking under pressure could benefit from including emotion regulation strategies.

Keywords: choking, arousal, emotion regulation, sport, golf

The year was 1995, and the scene was the first game of the NBA Finals between the defending champion Houston Rockets and the Orlando Magic. With less than 8 s to play and with the Orlando Magic up by 3 points, Orlando Magic player Nick Anderson was sent to the free throw line. Anderson, normally a 70% free throw shooter, missed four consecutive free throws, thereby failing to seal the victory for Orlando. With less than 2 s to play, Kenny Smith hit a three-pointer at the other end for Houston, tying the game and sending it to overtime. The Houston Rockets eventually won the game in overtime. The question that everyone asked afterward was: how could Anderson have missed four free throws?

It is likely that the pressure on Anderson played an important role when he missed four shots in a row. Under such conditions of increased pressure, people, not just athletes, often suffer from what is called *choking under pressure* (Baumeister, 1984). When a person chokes, they fail “to perform up to whatever level of skill and ability the person has at the time” (Baumeister, 1984, p. 610). This is especially true for highly practiced performances, such as free throws, which over many years of practice have become highly *automatic* (i.e., they require little conscious attention; Beilock & Carr, 2001).

As this kind of choking under pressure is obviously disadvantageous and unwanted, it has been frequently studied to elucidate the mechanisms underlying this

phenomenon, and to find ways to prevent choking from occurring (Beilock & Gray, 2007). In this article, we investigate the effectiveness of the emotion regulation strategies that have been found to alleviate arousal as a promising alternative type of intervention for choking under pressure.

Theories of Choking Under Pressure

Baumeister and Showers (1986) identified two groups of theories that can explain the choking under pressure phenomenon: attentional theories and drive theories. Attentional theories describe how pressure changes the attentional mechanisms and memory structures supporting performance (Beilock & Gray, 2007). Most strategies that have been proposed to alleviate choking in sports are derived from these attentional theories and focus on adapting individuals to the types of attentional monitoring that are thought to be prompted by pressure situations (Beilock & Gray, 2007). A second group of theories that have been proposed to explain choking under pressure, but that have been less extensively investigated recently, are drive theories (Baumeister & Showers, 1986).

Drive theories state that performance depends on the level of arousal and specifically that an optimum level of arousal benefits performance (Baumeister & Showers, 1986). For example, one of the major drive theories, inverted-U theory (Yerkes & Dodson, 1908), states that as arousal increases, performance is enhanced but only up to a certain threshold (Easterbrook, 1959; Humphreys & Revelle, 1984; cf. Hanin, 1995). Beyond this threshold, performance will suffer. That is, on the

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one hand, high levels of arousal can enhance performance on simple physical tasks by increasing anaerobic power (i.e., in short, but powerful movement such as running a 100-m sprint; Parfitt, Hardy, & Pates, 1995; Parfitt, Jones, & Hardy, 1990). On the other hand, high levels of arousal can lead to poorer performance on fine motor tasks by increasing muscular tension (Parfitt et al., 1990). Examples of fine motor skills involve high levels of hand–eye coordination, such as making a free throw, playing a tennis shot, or putting a golf ball. For Nick Anderson, extreme levels of arousal thus may have negatively influenced his ability to successfully hit a free throw, as would be predicted by drive theories.

While the notion that pressure leads to increased arousal has been empirically demonstrated previously (Cooke, Kavussanu, McIntyre, & Ring, 2010; Tanaka & Sekiya, 2010; Veldhuijzen van Zanten, De Boer, Harrison, Ring, Carroll, et al., 2002), to the best of our knowledge to date only one study exists that empirically supports the assumption that arousal mediates the effect of pressure on performance (Cooke, Kavussanu, McIntyre, Boardley, & Ring, 2011). However, this study showed that increased arousal due to increased pressure was associated with improved rather than declined performance, which is in contrast with predictions made by drive theories. We aim to further investigate the mediating role of arousal in the present studies, by focusing on effective strategies to alleviate problems associated with increased arousal and its effects on subsequent performance. To this end, the effectiveness of two different strategies in regulating arousal will be compared: cognitive reappraisal and distraction. We selected these two major emotion regulation strategies as previous research has revealed that they are successful in downregulating emotions (Gross, 2002; see also Levine, Schmidt, Kang & Tinti, 2012).

Emotion Regulation Strategies

The first strategy we aim to test as a way to alleviate choking under pressure is *cognitive reappraisal*, which involves reinterpreting the emotion-invoking stimulus in a way that alters its emotional impact (Gross, 2002). Participants are, for example, instructed to think about the positive aspects of what they are experiencing (Shiota & Levenson, 2009). Reappraisal has been used to successfully downregulate all kinds of distress and negative emotions (e.g., Gross, 2002) and importantly, has been proven to be effective in downregulating emotional arousal (Hofmann, Heering, Sawyer, & Asnaani, 2009). However, it has not yet been tested in the domain of choking under pressure.

The second emotion regulation strategy we aim to test is *distraction*, which refers to engaging in another neutral thought (Nolen-Hoeksema, 1991), or taking thoughts or memories in mind that are unrelated to the experienced emotional state (Watts, 2007). The use of distraction has been linked to decreased self-reported arousal when viewing emotional images (Thiruchselvam, Blechert, Sheppes, RYdstrom, & Gross, 2011) and is associated

with lower physiological arousal such as blood pressure and heart rate arising from emotional arousal (Gerin, Davidson, Christenfeld, Goyal, & Schwartz, 2006). In addition, Terry (2004) describes the use of music as a precompetition routine to regulate mood, arousal, and concentration. Pates, Karageorghis, Fryer, and Maynard (2003) showed that listening to a music intervention before performing netball shooting enhanced accuracy and also triggered positive emotions and cognitions. When using distraction in relation to choking, Mesagno, Marchant, and Morris (2009) provided preliminary evidence that listening to music through headphones improved performance under pressure for three female basketball players. Although this research suggests that distraction is an effective strategy to alleviate choking, it may be not feasible to let athletes wear headphones during an actual game. Furthermore, in the study by Mesagno et al. there was no measurement of arousal, so as of yet it remains unclear whether distraction indeed improved performance by means of reducing arousal.

The present research will examine whether two major emotion regulation strategies, reappraisal and distraction, are effective in helping people cope under pressure when engaging in a golf putting task. As we first wanted to test whether arousal (as manipulated in the current design) is indeed related to choking and whether subjectively measured arousal is indeed a reflection of objectively measured arousal, we first performed a pilot study. We hypothesized that our pressure manipulation would lead to increased levels of arousal—as indicated by increased heart rate and subjective experiences of arousal—and that this increased arousal would result in performance decrements (pilot study). In our main study, we investigated whether both distraction and reappraisal positively influenced performance under pressure in a sample of experienced golfers. As prior research has consistently shown that both reappraisal and distraction are effective in downregulating arousal (Hofmann et al., 2009; Thiruchselvam et al., 2011), we expected that both emotion regulation strategies would be effective in preventing participants from choking.

Pilot Study

A pilot study was conducted to test whether arousal, as manipulated in the current design, is indeed related to choking and whether the objectively measured arousal level is correlated with subjectively measured arousal level, as these are basic premises for conducting the main study. In the pilot study, participants engaged in a golf putting task under low and high pressure. The number of successfully holed putts was used as a measure of performance. We used heart rate and self-reports of arousal and anxiety as measures of both physiological and psychological arousal. These variables have frequently been used in choking research (Cooke et al., 2010, 2011; Tanaka & Sekiya, 2010, 2011) and allowed for empirically testing the hypothesized mediating role of arousal in the relation between pressure and performance.

Method

Participants

Fifty university students (36 women, 14 men) who did not have experience with playing golf participated for either money (€3) or course credit. Five participants were excluded from data analysis because of missing values on one or more of the dependent variables (e.g., heart rate monitor failure), five participants were excluded from data analysis because they failed to manage the task properly (i.e., they were not able to successfully keep the golf ball on the putting mat during all putting phases), and one participant was excluded because of an outlier ($> 3 SD$) on one of the dependent variables. The final sample consisted of 39 participants (27 women, 12 men) with a mean age of 22.23 years ($SD = 4.22$). Before participating, informed consent was obtained from all participants.

Design and Procedure

This pilot study employed a within-subjects design with pressure (low pressure vs. high pressure) as the independent variable and heart rate, self-reported arousal, and anxiety as dependent variables. Upon arriving at the laboratory, participants were told that we were testing the usefulness of a new heart rate monitor for scientific research. Therefore, they had to fill out questionnaires and engage in a golf putting task. We used an artificial putting mat (length: 270 cm, width: 60 cm) for this task. A heart rate transmitter belt was worn continuously during the experiment by the participant. Putts were made using a regular putter and using regular-size golf balls (diameter, 4.26 cm).

In both the low- and high-pressure phases, putts were made from two distances to reduce familiarity with one particular distance (see Cooke et al., 2010; Wilson, Smith, & Holmes, 2007). Participants made their putts from different distances by using different holes. In this manner, participants did not have to move throughout the experiment, which helps to reduce the potential confounding effects of physical activity on heart rate (Jorna, 1992). The same counterbalanced order of putting distances was fixed for each block: 2×1.8 m, 2×2.1 m, 2×2.1 m, and 2×1.8 m. After explaining the exact procedure, participants completed three blocks of eight putts. The use of eight putts is in line with existing literature on choking (Gucciardi & Dimmock, 2008; Wilson et al., 2007). Block 1 helped participants to become familiar with the task demands and procedure. The following block was similar to the first and represented the low-pressure phase. Before the third and final, high-pressure phase, the pressure manipulation took place. This manipulation involved the use of a video camera and a financial incentive to induce pressure (see the next subsection, *Manipulation*). When high pressure precedes low pressure, participants may experience reduced motivation (Beilock & Carr, 2001); therefore, the order of the high- and low-pressure phases was fixed. Participants were instructed to make

one stroke for every putt, and not to keep putting the golf ball until it was holed. After each putt, the golf ball was retrieved by the experimenter and placed at the correct position. Only in Block 3 did participants receive feedback regarding their performance and the related reward as part of the pressure manipulation. Participants filled out the questionnaires to obtain self-report measures of arousal and anxiety right before putting in the low- and high-pressure phases. The procedure as outlined above followed the guidelines of Utrecht University. At the end of the experiment, participants were debriefed, thanked, and paid for their participation.

Manipulation

To induce pressure, participants were videotaped during the high-pressure phase of the experiment. They were led to believe that researchers from the Physiology department were interested in video footage of people that are putting. Videotaping participants has been shown to be effective in inducing pressure (Beilock & Carr, 2005; Lewis & Linder, 1997). Participants had the choice to agree or disagree with their putting session being videotaped. All participants agreed. To further increase pressure, they were told that they would receive a reward depending on their performance. This meant that they would receive a €1 reward for every putt within 10 cm of the hole and a 50-cent punishment for every putt further away. Financial incentives have also shown to induce pressure (Cooke et al., 2010, 2011; Wilson et al., 2007).

Measures

Arousal (Heart Rate). Heart rate in beats per minute (bpm) was monitored throughout each block of putting using a short-range telemetry method (Polar RS300X, cf. Wilson et al., 2007). This comprised a transmitter attached around the chest and a receiver that was operated by the experimenter to reduce the salience of the measurement and to keep up the cover story (see *Procedure*). Heart rate during the actual putting sequences was recorded by the experimenter by using the heart rate transmitter's "lap" function. The experimenter used this function to indicate when a certain period started (i.e., the low- or high-pressure putting phase). The heart rate transmitter calculates an average over this time period. This number was noted down and used in our analyses.

Arousal (Self-Reports). In addition to heart rate, self-reports of arousal and anxiety were obtained through scales devised by Warr (Warr, 1990; Fisk & Warr, 1996). Participants were presented with 12 expressions: 6 concerning arousal and 6 concerning anxiety. For each expression, participants were asked to circle the response that best described their present state on a 7-point Likert scale (e.g., "I feel tense"; 1 = *not at all*, 7 = *extremely*). The items covering arousal were alert, full of energy, lively, lifeless, tired, and fatigued, with the last three being recoded as they were reverse scored. The items covering anxiety were tense, uneasy, worried, calm, contented,

and relaxed, also with the last three being recoded as they were reverse scored. Alpha coefficients of internal reliability were .78 for arousal and .77 for anxiety.

Performance. The frequency of successfully holed putts was recorded as a measure of performance. This could range from 0 to 8. In addition, the distance left between the golf ball and the hole was recorded after each putt. Since we were unable to discriminate adequately between good and bad performance among participants using this measure, which is in accordance with earlier studies using the same measure (Cooke et al., 2010; Wilson et al., 2007), we left it out of our analyses.

Pressure Check. To check whether the experimental manipulation was successful in increasing perceived pressure, participants completed the five-item pressure/tension subscale from the Intrinsic Motivation Inventory (Ryan, 1982). Items were answered on 7-point Likert scales (e.g., “I felt pressured”; 1 = *totally disagree*, 7 = *totally agree*) immediately after the second series (low pressure) and third series (high pressure) of putts. The item responses were averaged to provide one pressure/tension scale (Cronbach’s $\alpha = .77$). Unfortunately, owing to computer failure, data concerning this manipulation check was only saved for approximately 50% of the participants.

In addition, participants rated on 7-point Likert scales how important, engaging, difficult, and exciting they judged the task to be to assess competitiveness (e.g., “I found the task to be difficult”; 1 = *not at all*, 7 =

extremely, cf. Veldhuijzen van Zanten et al., 2002). The item responses were averaged to provide one competitiveness scale (Cronbach’s $\alpha = .70$). Both pressure checks were administered after putting in the low-pressure phase and after putting in the high-pressure phase.

Results

Pressure Check

A repeated-measures ANOVA with pressure phase as a within-subjects variable and perceived pressure as the dependent variable showed a significant increase in perceived pressure from the low-pressure ($M = 2.94$, $SD = 0.87$) to the high-pressure phase ($M = 3.81$, $SD = 1.03$), $F(1, 17) = 11.63$, $p = .003$, $\eta^2 = .40$. A similar analysis for competitiveness showed that participants judged the task to be more competitive during the high-pressure ($M = 4.61$, $SD = 0.90$) compared with the low-pressure phase ($M = 4.26$, $SD = 0.86$), $F(1, 38) = 7.45$, $p = .010$, $\eta^2 = .16$, confirming that the pressure manipulation was effective.

Performance

A repeated-measures ANOVA to test the effect of pressure on performance showed that performance declined significantly from the low-pressure ($M = 1.15$, $SD = 1.16$) to the high-pressure phase ($M = 0.72$, $SD = 0.89$), $F(1, 38) = 5.26$, $p = .028$, $\eta^2 = .12$; see Figure 1.

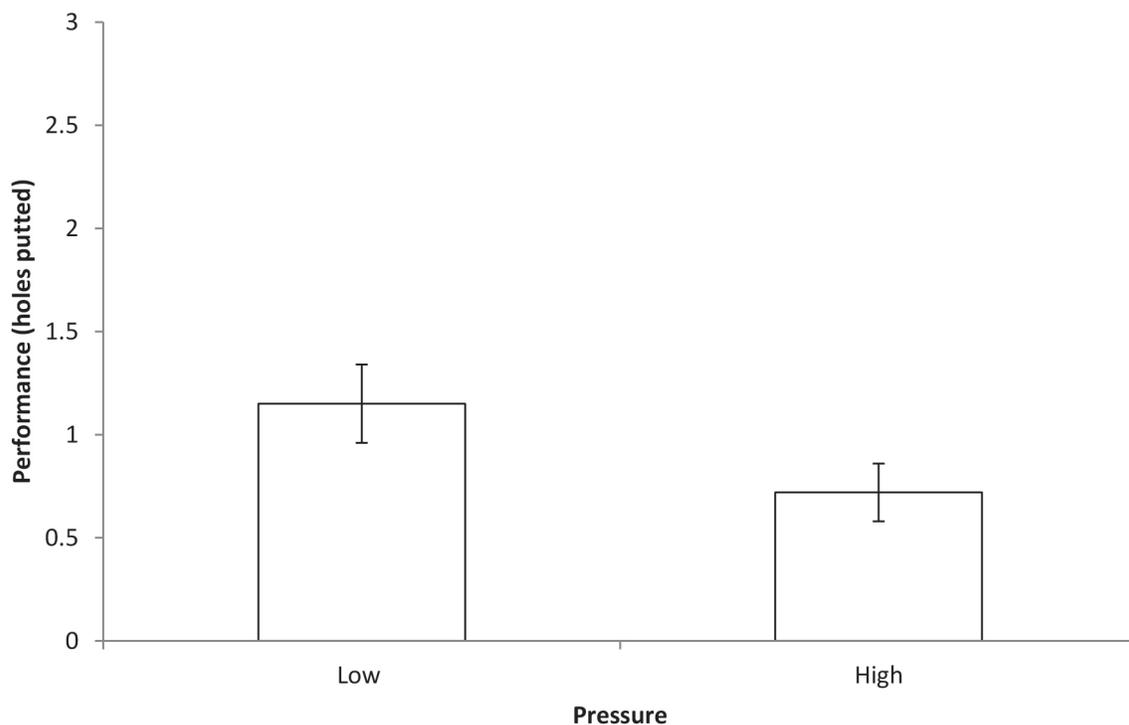


Figure 1 — Mean (SE) performance during low and high pressure (pilot study).

Arousal

Heart Rate. A repeated-measures ANOVA to test for the effects of pressure on heart rate showed a main effect of pressure, $F(1, 38) = 14.84, p < .001, \eta^2 = .28$. Heart rate increased from the low-pressure ($M = 87.87, SD = 13.13$) to the high-pressure phase ($M = 90.72, SD = 14.86$).

Self-Reports. Similar repeated-measures ANOVAs for self-reported arousal and anxiety showed that self-reported arousal increased from the low-pressure ($M = 2.90, SD = 0.81$) to the high-pressure phase ($M = 3.53, SD = 0.98$), $F(1, 38) = 32.42, p < .001, \eta^2 = .46$. In a similar vein, anxiety increased from the low-pressure ($M = 5.06, SD = 0.79$) to the high-pressure phase ($M = 5.18, SD = 0.85$), $F(1, 38) = 7.97, p = .008, \eta^2 = .17$.

Mediation of Arousal. Mediation analyses were employed to test whether heart rate and self-reports of arousal and anxiety mediated the significant decline in putting performance. Following the approach used by Cooke et al. (2010), we conducted a repeated-measures ANCOVA with each potential mediator variable as the changing covariate, pressure phase as a within-subjects factor, and performance as the dependent variable. The change in η^2 associated with the pressure phase when each variable is used as a covariate indicates the importance of that variable in explaining the effects of pressure phase on putting performance (Tabachnick & Fidell, 2007). As outlined above, the repeated-measures ANOVA for performance indicated that 12% of the variance in number of balls holed could be explained by pressure phase (i.e., $\eta^2 = .12$). This effect of pressure on performance decreased when heart rate was used as a covariate $F(1, 37) = 1.60, p = .214, \eta^2 = .03$, when self-reported arousal was used as a covariate $F(1, 37) = 0.36, p = .551, \eta^2 = .01$, and when self-reported anxiety was used as a covariate $F(1, 37) = 3.77, p = .06, \eta^2 = .09$, indicating that these variables partially mediated the effect of pressure on performance as a small-to-medium effect size remained.

Discussion

In this pilot study, we replicated the classic choking under pressure effect: performance declined when pressure was high compared with when pressure was low. In addition, our results show that our pressure manipulation also resulted in increased arousal. This was not only the case for arousal measured by heart rate but also for subjective measures of arousal. We also showed that the decline in performance under pressure was partially explained by heart rate and self-reports of arousal and—to a lesser extent—anxiety. It is important to note, however, that the findings of this pilot study are not necessarily in line with drive theories, as they would predict that only an optimum arousal level benefits performance. As we only measured two arousal levels, it remains unclear whether the obtained arousal levels actually exceeded this optimal level. Nevertheless, this pilot study provides preliminary evidence that arousal may underlie choking under pres-

sure, which gives credit to the hypothesis that is tested in the main study that emotion regulation strategies aimed at decreasing arousal may help to prevent choking.

Main Study

Having established in the pilot study that our pressure manipulation was successful in inducing arousal and that subjective measures of arousals were a reflection of objective arousal levels, the main study was designed to investigate the effects of using distraction and reappraisal—two emotion regulation strategies that have been shown to reduce arousal—on performance under pressure. The main advantage of the use of emotion regulation strategies over other strategies that have been used to counteract the choking effect (e.g., counting backward; Lewis & Linder, 1997) is that research has revealed that if instructions can be provided before the stressful situation arises (Gross, 2002), everybody can easily apply the instructions (Gross, 1998), and applying the strategy does not involve any costs (Ray, McRae, Ochsner, & Gross, 2010).

To overcome problems associated with the low variance in performance among novice golfers, as was evident in our pilot study, the main study included only experienced golfers. Furthermore, to increase ecological validity, this study was conducted outside the laboratory and included only self-reports of arousal and anxiety. That is, monitoring heart rate was expected to significantly hinder participants in their normal routine and to instill an increased overall sense of pressure and anxiety. As the subjective arousal measures reflected objective arousal measures, using only self-report arousal measures was not expected to reduce the validity of our findings.

Method

Participants

Forty participants (12 women, 28 men) participated in this study. Participants were recruited at a Dutch golf club. All participants agreed to take part in the study in exchange for a chance to win a €10 coupon for the golf shop. Two participants did not finish the experiment as a result of time constraints. The final sample consisted of 38 participants (12 women, 26 men) with a mean age of 59.60 years ($SD = 12.42$). On average, participants had been playing golf for 21.75 years ($SD = 8.78$) and had an average handicap of 14.51 ($SD = 10.42$). Before participating, informed consent was obtained from all participants.

Design and Procedure

The study employed a 3 (condition: reappraisal, distraction, control; between subjects) \times 2 (pressure: low vs. high; within subjects) mixed design. Participants were randomly assigned to one of the three conditions. Upon arriving at the putting green, participants were told that

we were testing cognitive capacities of people while they are concentrating. As in the pilot study, participants completed three blocks of putts in a fixed order of low pressure and high pressure. In the main study, participants made 10 putts during every block (e.g., Gucciardi & Dimmock, 2008; Wilson et al., 2007). After each putt, the participants themselves placed a new golf ball at the appropriate position.

To maximize ecological validity and the potential to apply this strategy in real sport settings, participants received instructions to engage in either reappraisal, distraction, or they received instructions to feel their emotions naturally (see *Manipulations*), after the acquisition phase, but before the low- and high-pressure phases took place. The main advantage of this approach is that participants are able to start regulating before a specific (negative) emotion arises. Specifically, as pressure often arises suddenly and without anticipation, coaches should be able to equip their players with strategies to counteract choking in advance of the game. For example, the free throw awarded with only a few seconds left to play is often not anticipated and feelings of pressure may be fully developed before one is able to cope with them successfully. Related to this, a coach often cannot intervene and administer an emotion regulation strategy in the middle of the game when a pressure situation has just arisen. In addition, previous research has shown that reappraisal initiated in advance is effective in reducing negative emotions, whereas applying an emotion regulation strategy once the emotion has fully arisen is much more difficult (Gross, 2002). Therefore, instructions were provided well before pressure increased.

The pressure manipulation was analogous to the pilot study in that it used the videotaping of participants and providing them with a financial incentive to induce pressure. Self-reports of arousal and anxiety were obtained by administering questionnaires right before putting in the low- and high-pressure phases. The procedure as outlined above followed guidelines of Utrecht University. At the end of the experiment, participants were debriefed, thanked, and paid for their participation.

Manipulations

Pressure. Pressure was manipulated by notifying participants that the next series of putts was to be videotaped (similar to the pilot study) and that their performance was going to be published on a public sheet in the clubhouse. In addition, participants read that the five best players (i.e., the ones who successfully holed the greatest number of golf balls in 10 putts) would receive a golf shop coupon, which served as a financial incentive to induce pressure (Cooke et al., 2010, 2011; Wilson et al., 2007).

Emotion Regulation Strategy. Participants were instructed to engage in either distraction or reappraisal, or they received instructions to feel their emotions freely (control condition), based on previous work by Sheppes and Meiran (2007). In the cognitive reappraisal condition, the instructions were as follows.

“We would like to see to what extent you can control the way you experience things. Therefore, it is very important to us that you try your best to adopt a positive attitude towards putting the golf ball. For example, keep reminding yourself that putting the golf ball is just a game.”

In the distraction condition, the instructions were as follows.

“We would like to see to what extent you are able to think of other things while putting the golf ball. Therefore, it is very important that you try your best to think about something else that is not related to golfing during the putting phase. In order to do so, we ask that you take a song in your mind that you know by heart. Take your time to think of such a song.”

To reduce the chance that the golfers would use their own strategies to deal with pressure, participants in the control condition were instructed to experience the emotions arising from the situation naturally:

“We ask you to freely experience your emotions whenever they arise. In other words, when putting the golf ball leads to joy, anger or fear, please try to experience this emotion naturally.”

After reading the instructions, participants immediately started with the next series of putts. Therefore, we did not include a manipulation check to test to what extent participants followed the instructions, which is in line with other emotion regulation literature using this approach (e.g., Kuehner, Huffziger, & Liebsch, 2009; Sheppes & Meiran, 2007, 2008).

Measures

Arousal. Self-reports of arousal (Cronbach's $\alpha = .67$) and anxiety (Cronbach's $\alpha = .73$) were obtained by using the same scales as in the pilot study.

Performance. The number of successfully holed putts (range 0–10) during the low- and high-pressure phases served as the measure of performance. Similar to the pilot study, putts were made from two distances to reduce familiarity with one particular distance and the same counterbalanced order of putting distances was fixed for each block: 2×1.8 m, 2×2.1 m, 2×2.1 m, 2×1.8 m. Successful putts were recorded on a sheet by the experimenter.

Pressure Check. Checks for perceived pressure (Cronbach's $\alpha = .70$) and competitiveness (Cronbach's $\alpha = .75$) were the same as in the pilot study.

Results

Randomization Check

Separate ANOVAs were conducted with condition (reappraisal, distraction, and control) as the independent

variable and age, handicap, and years of golf experience as dependent variables. There were no significant differences between the three conditions, all $ps > .416$, indicating that randomization was successful. A chi-square analysis confirmed that gender was equally distributed across conditions, $\chi^2(2, N = 38) = 0.737, p = .692$.

Pressure Check

A repeated-measures ANOVA with pressure phase as a within-subjects variable, condition as a between-subjects variable, and perceived pressure as the dependent variable showed a main effect of pressure $F(1, 35) = 5.76, p = .022, \eta^2 = .13$. Participants showed a significant increase in perceived pressure from the low-pressure ($M = 2.64, SD = 1.18$) to the high-pressure phase ($M = 3.16, SD = 1.17$). There was no main effect of condition, $p = .329$, and no interaction between pressure and condition, $p = .523$. A similar analysis with competitiveness as the dependent variable showed a main effect of pressure, $F(1, 35) = 5.50, p = .025, \eta^2 = .10$, indicating that participants judged the task to be more competitive during the high-pressure ($M = 4.73, SD = 1.03$) compared with the low-pressure phase ($M = 4.35, SD = 1.13$). There was no main effect of condition, $p = .568$, and no interaction between pressure and condition, $p = .651$. These analyses confirmed that our pressure manipulation, as intended, was equally effective across all conditions.

Performance

A repeated-measures ANOVA was conducted to test for the effects of pressure phase and condition on

performance. There was no main effect of pressure on performance, $p = .428$, and no main effect of condition, $p = .589$. However, there was a significant interaction between pressure and condition, $F(2, 35) = 7.76, p = .002, \eta^2 = .30$. As shown in Figure 2, decomposing this interaction effect showed that participants in the control condition showed a decline in performance from the low-pressure ($M = 6.31, SD = 1.57$) to the high-pressure phase ($M = 5.00, SD = 1.47$), $F(1, 12) = 6.24, p = .028, \eta^2 = .34$. For participants in the reappraisal condition, pressure did not significantly affect performance, $p = .239$ ($M_{\text{low pressure}} = 5.42, SD = 1.73$; $M_{\text{high pressure}} = 4.83, SD = 1.99$). For participants using distraction, performance increased from the low-pressure ($M = 5.00, SD = 1.41$) to the high-pressure phase ($M = 6.23, SD = 1.83$), $F(1, 12) = 8.35, p = .014, \eta^2 = .41$.

Arousal

A repeated-measures ANOVA with self-reported arousal as dependent variable and pressure phase and condition as independent variables showed no main effects for pressure, $p = .204$, and condition, $p = .962$. However, there was a marginally significant interaction effect, $F(2, 35) = 3.18, p = .054, \eta^2 = .15$. Decomposing this interaction showed that for participants in the reappraisal condition, self-reported arousal significantly decreased from the low-pressure ($M = 3.13, SD = 1.12$) to the high-pressure phase ($M = 2.44, SD = 1.11$), $F(1, 11) = 5.90, p = .033, \eta^2 = .34$. For participants in the control ($M_{\text{low pressure}} = 2.96, SD = 1.38$; $M_{\text{high pressure}} = 2.67, SD = 1.38$) and distraction condition ($M_{\text{low pressure}} = 2.54, SD = 0.74$; $M_{\text{high pressure}} = 2.87, SD = 1.01$), self-reported arousal did not change, $ps > .250$.

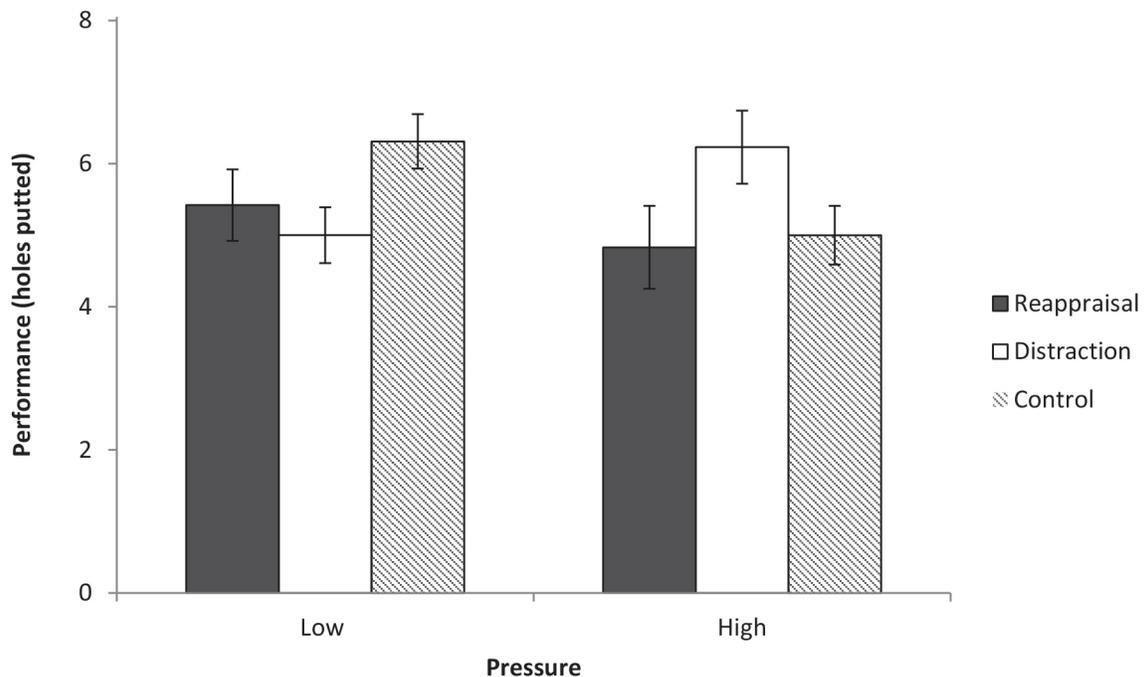


Figure 2 — Mean (SE) performance during low and high pressure for all experimental conditions (main study).

A repeated-measures ANOVA with self-reported anxiety as dependent variable and condition and pressure phases as independent variables showed a main effect of pressure phase $F(1, 35) = 8.94, p = .005, \eta^2 = .20$. Across conditions, participants showed an increase in anxiety from the low-pressure ($M = 5.60, SD = 0.80$) to the high-pressure phase ($M = 5.86, SD = 0.78$). There was no main effect of condition, $p = .755$, and no interaction effect, $p = .183$.

Discussion

This study revealed the classic choking effect for participants in the control condition. The use of distraction, however, had profound effects on performance under pressure, as the classic choking effect was reversed and participants *improved* their performance under pressure. Using reappraisal also prevented participants from choking, since performance did not decline. These results thus show that applying emotion regulation strategies can prevent choking from occurring. Performance, however, could not be attributed to changes in arousal. That is, impaired performance was not related to increased arousal, as participants in the control condition performed worse under pressure in the absence of increased arousal. In addition, improved performance was not related to decreased arousal, as the distraction condition improved under pressure in the absence of decreased arousal, whereas the reappraisal condition did not change under pressure despite decreased arousal.

General Discussion

In the present research we investigated the role of emotion regulation strategies in the prevention of choking under pressure. Specifically, we tested whether emotion regulation strategies would decrease arousal, which would in turn lead to the absence of choking. We found that emotion regulation strategies indeed contribute to the prevention of choking, although the assumed role of decreased arousal was not supported by the empirical evidence.

The pilot study showed that arousal, as measured by heart rate and self-reports, increased under pressure. In addition, participants showed the classic choking effect as they performed worse under high pressure compared with low pressure. We also showed that increased arousal partially mediated the effects of pressure on performance decrements. This finding should be treated with care, however, as we manipulated only two levels of arousal and accordingly it remains unknown what level of arousal would be optimal for performance. That is, according to the inverted-U theory, only a moderate level of arousal can be beneficial. Thus, to test this theory, at least three levels of arousal would be needed. The finding that arousal partially mediated the effect of pressure on performance *decrements* has not been demonstrated previously. Although Cooke and colleagues (2011) also found that

increased arousal mediated performance under pressure, they found that arousal mediated the effects of pressure on *improved* performance. It is important to note, however, that the study by Cooke and colleagues investigated experienced golfers. Similar work of these authors among novice golfers did not show mediation of heart rate on performance (Cooke et al., 2010). Although this topic is obviously in need of more research, it nevertheless shows that arousal, and specifically heart rate, increases from low to high pressure, and that it can be an important underlying component of performing under pressure.

In the main study, a field experiment was conducted to test whether reappraising the pressure situation in a positive manner or distracting oneself by taking a song in mind would positively influence performance under pressure in a sample of experienced golfers. We replicated the classic choking effect in the control condition but, most importantly, we also found that both reappraisal and distraction were effective in preventing golfers from choking under pressure. Noticeably, performance even improved under pressure for participants using distraction. To our knowledge, this is the first study to empirically test and demonstrate the beneficial use of emotion regulation strategies in choking. Although more research is needed on the use of these strategies in the domain of choking, the present findings suggest that emotion regulation strategies may be a promising tool in helping people to successfully cope with pressure.

Surprisingly, in the main study, the results for arousal were not in line with the effects obtained for performance. Specifically, whereas participants in the control condition showed the classic choking effect, self-reported arousal remained stable, and the mediation effect of arousal was not replicated. Also for the experimental conditions, the results for arousal were not entirely in line with the performance: Participants using distraction improved under pressure in the absence of decreased arousal, whereas participants using reappraisal did not change, but also did not choke, under pressure despite decreased arousal. A possible reason for the results for arousal not matching the results for performance is that only subjective arousal was assessed. Even though in the pilot study the results for objective and subjective arousal were similar, previous research has indicated that there is not necessarily coherence between self-reported arousal and physiological indicators of arousal (Katkin, 1985; Pennebaker, 1982; Rimé, Philippot & Cisamolo, 1990). Physiological indicators of arousal are obviously better tuned to capture small physiological changes that may not even enter subjective awareness, but that may still affect performance. In addition, other factors associated with choking, such as autonomic and kinematic factors (see Cooke et al., 2010, 2011; Tanaka & Sekiya, 2010) may potentially explain the inconsistency between results for arousal and performance.

Another possible explanation is that reappraisal, and especially distraction, prevented choking from occurring via attentional processes rather than via decreased arousal. This suggestion is corroborated by previous

studies based on attentional (e.g., Lewis & Linder, 1997) rather than drive theories. These distraction studies have used other types of distraction (e.g., counting backward) to successfully alleviate choking and claim that changes in attentional focus underlie the beneficial effects of distraction on performance (Beilock & Carr, 2001; Lewis & Linder, 1997). It should be noted, though, that empirical evidence for the presumed mediating role of attention is generally lacking, as the underlying processes have not been investigated in depth. That is, as of yet it has not been empirically demonstrated that attentional focus increases naturally when athletes perform under pressure (Oudejans, Kuijpers, Kooijman, & Bakker, 2011). On the other hand, from general emotion research it is evident that due to reappraisal and particularly distraction the attention is effectively drawn away from the pressure or the emotional event, leading to a successful decrease of the stress (and the arousal) at hand (e.g., Sheppes & Meiran, 2007). In other words, it seems likely that attention plays a substantial role; however, to what extent it is increased attention toward the needed skills or decreased attention for the experienced pressure, or both, needs further examination. Yet another possibility is that both attention and arousal may interact in promoting performance under pressure (Fenigstein & Carver, 1978). Wegner and Giuliano (1980), for example, suggested that increases in arousal prompt individuals to turn their attention on themselves and their current task performance in an attempt to seek out an explanation for their aroused state. Taken together, it thus remains to be investigated in future research whether arousal, attention, or both processes are responsible for the effectiveness of emotion regulation strategies in helping people to cope, instead of choke, under pressure.

The present studies are not without limitations. A limitation of the main study is that no objective arousal measures were taken. As stated earlier, we chose to do so to increase ecological validity and not to hinder participants in their normal routine. Nonetheless, the association between heart rate and subjective arousal as established in the pilot study is not necessarily generalizable to the main study. Therefore, as stated above, objective measures of arousal should be included in future studies to gain a better understanding of the underlying processes. Second and related to this, self-reported anxiety increased from low to high pressure across all conditions. We suspect that the role of anxiety in choking involves a different process, as anxiety proved to be a relatively weak mediator of the effect of pressure on performance (i.e., a small to medium effect size remained) and apparently was unaffected by the use of emotion regulation strategies. A third limitation of this study is that we used a golf putting task in both studies. To generalize our findings to other sport disciplines, the role of arousal could be investigated using other tasks from different types of sports. For example, sports that involve running or jumping and rely less on fine motor movements (e.g., running a 100-m sprint), may suffer to a lesser extent from increased arousal (Parfitt et al., 1995), so it remains to be investigated whether

reappraisal and distraction are equally effective for these types of sports as well.

Another issue that needs to be addressed in future research concerns the duration of the observed effects of emotion regulation strategies. We instructed participants well before the pressure manipulation and measured subsequent performance under pressure. It is possible that the effects of downregulating pressure disappear, or even show rebound effects, after a longer period of time. Future research could try to identify the duration of interventions aimed at alleviating choking, including both strategies we used in this study. Another interesting avenue for future research is to investigate whether other forms of reappraisal and distraction are equally effective to counteract choking. For example, it remains to be explored whether all forms of distraction (e.g., a loud horn) are equally helpful in preventing choking under pressure, or whether participants need to apply, for example, a distracting technique that needs conscious deliberation (e.g., taking a song in mind).

As we wanted to test the effect of emotion regulation strategies on arousal, and subsequently performance, the present studies have focused primarily on arousal as an underlying mechanism of choking. We are aware that arousal is most likely not the only mechanism underlying choking, and that choking concerns an interplay of several psychological, autonomic, and kinematic factors (cf. Cooke et al., 2010, 2011; Tanaka & Sekiya, 2010). More research is needed that aims to incorporate more and different measurements of the potentially involved factors and their interaction.

Notwithstanding these limitations, results from the present studies clearly demonstrated that using distraction or reappraisal can prevent choking under pressure among experienced golfers. We based our expectations in explaining the positive effects of distraction and reappraisal on literature that has convincingly shown that both emotion regulation strategies are effective in regulating anxious arousal (Hofmann et al., 2009), physiological arousal (Gerin et al., 2006; Gross, 1998), and self-reported arousal (Thiruchselvam et al., 2011). However, we cannot draw any firm conclusions about the role of arousal as the results are mixed at best. It is likely that other processes account for our finding that both strategies are effective in alleviating choking.

The present findings have important implications for research on choking under pressure, as the present work underscores the role of emotion regulation strategies as an intervention to prevent choking under pressure from occurring, as using reappraisal or distraction was effective in alleviating the choking effect. In addition to being effective, emotion regulation strategies such as cognitive reappraisal and distraction may also prove to be more convenient compared with currently used strategies aimed at alleviating choking, such as counting backward, which can be considered a more intrusive way to deal with pressure. The present findings also have implications for emotion regulation literature by extending its applicability to the field of choking under pressure, as this is the first

study to use emotion regulation strategies directly aimed at preventing choking from occurring. Taken together, these main findings provide a basis for emotion regulation strategies such as reappraisal and distraction to be employed when athletes are performing under pressure.

Consequently, after Nick Anderson had been awarded the first free throw by the referee, and had walked up to and stood at the free throw line, he might have scored at least one of the four free throws, sealing the victory for the Orlando Magic, if only he had appraised the situation in a positive manner or had taken a song in his mind.

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