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Is Choking under Pressure a Consequence of Skill-Focus or Increased Distractibility? Results from a Tennis Serve Task

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Abstract

It has been repeatedly demonstrated that athletes often choke in high pressure situations because anxiety can affect attention regulation and in turn performance. There are two competing theoretical approaches to explain the negative anxiety-performance relationship. According to skill-focus theories, anxious athletes' attention is directed at how to execute the sport-specific movements which interrupts execution of already automatized movements in expert performers. According to distraction theories, anxious athletes are distractible and focus less on the relevant stimuli. We tested these competing assumptions in a between-subject design, as semi-professional tennis players were either assigned to an anxiety group (n = 25) or a neutral group (n = 28), and performed a series of second tennis serves into predefined target areas. As expected, anxiety was negatively related to serve accuracy. However, mediation analyses with the bootstrapping method revealed that this relationship was fully mediated by self-reported distraction and not by skill-focus.

Keywords

Choking, Distraction, Skill-Focus, Self-Focus, Sport

1. Introduction

In high pressure situations athletes are not always capable of displaying their optimum level of performance: This finding is termed choking under pressure (Baumeister, 1984). In research on this matter state anxiety serves

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as an indicator for perceived pressure in a given situation (cf. Mullen, Hardy, & Tattersall, 2005). For instance, higher levels of state anxiety have been found to be associated with a decrease in handgun shooting accuracy (e.g., Nieuwenhuys & Oudejans, 2010), impaired dart performance (e.g., Nibbeling, Oudejans, & Daanen, 2012; Vickers, Rodrigues, & Edworthy, 2000), and a lower basketball free-throw success rate (e.g., Wilson, Vine, & Wood, 2009).

Although this negative relationship between anxiety and perceptual-motor performance has been replicated numerous times, there are different theoretical approaches trying to explain this relationship. Performance decrements in high pressure contexts can be explained by two competing groups of theories: Skill-focus theories (e.g., Baumeister, 1984; Beilock & Carr, 2001; Masters, 1992) and distraction theories (e.g., Eysenck & Calvo, 1992; Eysenck, Derakshan, Santos, & Calvo, 2007; Wine, 1971). In both theoretical approaches it is assumed that anxiety has an influence on an athlete's attention regulation (Beilock & Gray, 2007). However, the specific assumptions on how one's attention is affected diverge.

According to skill-focus theories, anxious individuals have a tendency to shift their attention inwards as one's level of self-consciousness increases. The attentional focus can either be directed on the separate steps of a proper skill execution, termed explicit monitoring (Beilock & Carr, 2001), or individuals attempt to consciously regulate the specific skill execution in a step-by-step manner, termed conscious processing or reinvestment (e.g., Hardy, Mullen, & Jones, 1996; Masters, 1992; Masters & Maxwell, 2008). In the case of expert performers, this attentional shift leads to a disruption of well-elaborated automatized skills which actually do not require conscious processing which in turn can be associated with performance decrements in the respective movement execution (e.g., Beilock & Carr, 2001). The assumptions of skill-focus theories have been empirically supported in several studies (e.g., Beilock & Carr, 2001; Gray, 2004; Gucciardi & Dimmock, 2008; Jackson, Ashford, & Norsworthy, 2006; Mullen & Hardy, 2000; Mullen et al., 2005). In most studies on that matter the attentional focus has been experimentally manipulated as one half of the sample is instructed to explicitly focus on the execution of the movement (i.e., internal focus) while the other half of the sample is instructed to apply an external focus and to rather focus on the effects of the respective movement (e.g., Beilock & Carr, 2001; Beilock, Carr, MacMahon, & Starkes, 2002; Jackson et al., 2006). Although these results are compelling the question arises if such an adaption of skill-focus also occurs naturally in high pressure contexts or if it is simply the result of an experimental manipulation (Hill, Hanton, Matthews, & Fleming, 2010).

In contrast, distraction theories propose that anxiety consumes limited attentional resources of an individual leaving less attentional capacity for the actual sports task at hand (e.g., Carver & Scheier, 1981; Lewis & Linder, 1997; Wine, 1971). In line with the assumptions of processing efficiency theory (PET; Eysenck & Calvo, 1992) and attentional control theory (ACT; Eysenck et al., 2007) it is proposed that anxious individual's attention is shifted away from the actual task and directed towards task-irrelevant stimuli which can either be internal stimuli (e.g., worries) or external stimuli (e.g., the crowd). This attentional drift leads to impairments in the efficiency and the effectiveness of task execution which has been demonstrated in several empirical studies (e.g., Behan & Wilson, 2008; Causer, Holmes, Smith, & Williams, 2011; Nieuwenhuys & Oudejans, 2011; Nieuwenhuys, Pijpers, Oudejans, & Bakker, 2008; Vickers & Williams, 2007; Wilson et al., 2009).

Skill-focus theories (e.g., Baumeister, 1984; Beilock & Carr, 2001; Masters, 1992) and distraction theories (e.g., Eysenck & Calvo, 1992; Eysenck et al., 2007; Nieuwenhuys & Oudejans, 2012; Wine, 1971) are taking different approaches in trying to explain why athletes often cannot perform up to their capabilities in high pressure contexts, and both theories have received plenty of empirical support (e.g., Behan & Wilson, 2008; Beilock & Carr, 2001; Causer et al., 2011; Gray, 2004; Gucciardi & Dimmock, 2008; Mullen & Hardy, 2000; Mullen et al., 2005; Nieuwenhuys & Oudejans, 2011; Nieuwenhuys et al., 2008; Vickers & Williams, 2007; Wilson et al., 2009). However, in our view thus far it has not been sufficiently investigated which theory is more suitable in explaining performance decrements in high pressure situations. As previously mentioned, in the case of skill-focus theories the attentional focus is experimentally manipulated in most studies by inducing either an internal or an external focus of attention (e.g., Beilock & Carr, 2001; Beilock et al., 2002; Jackson et al., 2006). Also in studies testing the assumptions of distraction theories the level of distraction is often experimentally manipulated as participants are for instance receiving an external distracting stimulus while performing a perceptual-motor task (e.g., Beilock et al., 2002; Jackson et al., 2006). These experimental approaches however do not clarify which focus is actually automatically activated in a high pressure situation.

Previous qualitative research on that matter has been rather inconsistent as Mesagno and colleagues (Mesagno, Marchant, & Morris, 2008) found support for the assumptions of the distraction theories in bowlers while bas-

ketball players reported higher levels of skill-focused attention in high pressure contexts (Mesagno, Marchant, & Morris, 2009). Gucciardi and colleagues (Gucciardi, Longbottom, Jackson, & Dimmock, 2010) report that golfers experience distracting thoughts and worries in high pressure contexts. Oudejans and colleagues (Oudejans, Kuijpers, Kooijman, & Bakker, 2011) assessed elite athlete's focus of attention by applying retrospective verbal reports and found that high pressure situations led to higher levels of distractibility rather than an explicit monitoring of the sequential steps of a movement execution.

In the present paper we not only want to address the question which attentional focus is automatically activated in a high pressure situation, which has been the subject of vigorous qualitative research (e.g., Mesagno et al., 2008, 2009; Gucciardi et al., 2010; Oudejans et al., 2011), but also how strongly the automatically activated attentional focus predicts actual performance in a high pressure situation. In doing so we wish to avoid an experimental manipulation of attentional focus as it has been done in previous research (e.g., Beilock & Carr, 2001; Beilock et al., 2002). We conducted an experiment with semi-professional tennis players who performed a series of second tennis serves in either a high pressure context (i.e., anxiety group) or a neutral context (i.e., neutral group), and assessed their level of distraction (i.e., as an indicator for the assumptions of distraction theories) and their attentional focus (i.e., as an indicator for the assumptions of skill-focus theories) retrospectively. We chose the accuracy of second tennis serves as our dependent variable because the quality of a serve can have an important impact on a player's confidence level and on the outcome of the tennis match as a whole (Lees, 2003). Additionally, Terry and colleagues demonstrated that the accuracy of second tennis serves can be hampered by higher anxiety levels (Terry, Cox, Lane, & Karageorghis, 1996). In line with these findings, we assumed that state anxiety predicts tennis serve accuracy. We further wanted to analyze if this expected relationship is mediated by distraction, skill-focus, or the interaction of both.

2. Method

2.1. Participants

N = 53 semi-professional German tennis players participated in the current study (M_{age} = 29.90, SD_{age} = 9.00; 19 females; 4 left-handed; Playing experience: M = 21.45 years, SD = 7.07). The athletes were ranked between the first and ninth highest levels of the German tennis federation (German: Leistungsklassen), and can be considered expert performers. After signing written informed consent participants were randomly assigned to the anxiety group (n = 25) or the neutral group (n = 28). The study was carried out in accordance with the Helsinki Declaration of 1975.

2.2. Materials and Procedure

We conducted the study on professional outdoor clay courts on the training facilities of the athletes' respective tennis club. Each assessment was carried out by the same experimenter, during the same time of day, and only under similar weather and wind conditions. Furthermore, players always served with the sun. Each session lasted approximately 30 minutes. Participants first reported demographic information (age, sex, serving hand, years of playing experience, and level of play).

Next, participants worked on the German sports anxiety scale (WAI-T; Brand, Ehrlenspiel, & Graf, 2009) which contains 12 items to assess dispositional sports anxiety. Participants answered each item on Likert-type scales ranging from 1 (*not at all*) to 4 (*very much*) with regard to how they generally feel before or during sporting competitions. Each item can be assigned to one of the following three subscales: Worry (e.g., "I worry that I will not play well"; α = .82), somatic (e.g., "I feel tense in my stomach"; α = .84), and concentration (e.g., "I lose focus on the game"; α = .68). Each subscale consists of four items. We calculated overall scores by averaging each participant's answers on the corresponding scale, meaning that higher scores always indicated higher values of the particular variable.

After an individual warm-up phase (approximately 5 minutes), participants performed a series of 10 second tennis serves (five per diagonal) with their own racket. We adopted a scoring system which has previously been applied successfully (e.g., Desliens, Guillot, & Rogowski, 2011; Guillot, Desliens, Rouyer, & Rogowski, 2013; Guillot, Genevois, Desliens, Saieb, & Rogowski, 2012). The ball had to be served into predefined areas within the opponents' serve box (**Figure 1**). We separated the serve box into three target areas by drawing lines between the serve box lines and the center line: a small area (.5 × .5 m), a medium area (1 × 1 m), and the remainder of the normal serve box. We assigned five points if the serve rebounded in the small area, three points if

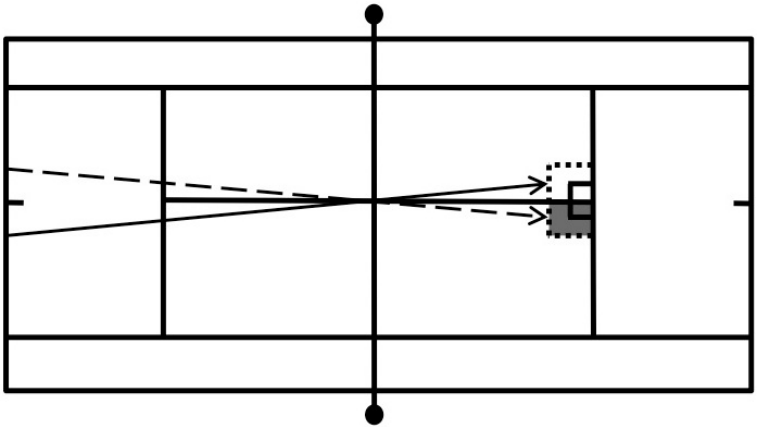

Figure 1. Tennis court setup (for this procedure see also, Desliens et al., 2011; Guillot et al., 2012, 2013). The black arrow represents the serve ball trajectory on the deuce diagonal, while the dashed arrow the serve ball trajectory on the advantage diagonal. The small squares correspond to the small area and the large-dot line to the medium area of the target zone.

it landed in the medium area, and participants were rewarded one point if the ball rebounded in the proper serve box. If the ball was not served into any of these three target areas or hit the net, participants did not receive a point. We recorded the points for each serve, and calculated the average score per serve, which served as our baseline measure for serve accuracy. By that we wanted to assure that the experimental groups did not differ in their general serve competence before any experimental manipulation took place.

Afterwards, participants were informed that they would be performing a second round of 10 second tennis serve (five per diagonal), and that we would apply the same scoring system as in the first series of tennis serves (e.g., Desliens et al., 2011; Guillot et al., 2012, 2013). The type of instruction served as our manipulation of state anxiety. While participants from the neutral group were simply instructed how to perform the task participants from the anxiety group received additional information. They were told that their performance would be evaluated by tennis experts, that their performance would be compared to other athletes' performance, and that they would receive a personal face-to-face feedback from a professional tennis instructor at the end of the experiment. Previous research has shown that this procedure is suitable to manipulate state anxiety (e.g., Behan & Wilson, 2008; Englert & Bertrams, 2012; Wilson et al., 2009).

Before starting the second round of tennis serves, we measured the success of the anxiety manipulation by applying an anxiety thermometer (Houtman & Bakker, 1989). The anxiety thermometer is a 10-cm continuous scale ranging from 0 (*not anxious at all*) to 10 (*extremely anxious*). Participants placed a small line on the scale that represented their actual level of state anxiety. State anxiety was assessed by measuring the distance from zero to the line the participants drew.

Then, participants actually performed the 10 tennis serves, and we recorded the points for each serve. The average score per serve was again our indicator for serve accuracy and our dependent variable.

In a next step, we assessed the level of skill-focussed attention as well as the level of distraction while performing the second round of tennis serves. As it is difficult to measure attention allocation and distraction directly this was done retrospectively (see also, Gucciardi et al., 2010). For this purpose, we specifically wanted to apply items which are externally valid and are representing states that are actually frequently experienced by athletes in high pressure situations. However, we are not aware of specific measures to assess athlete's attentional focus and level of distraction, as in most studies on that matter attentional focus and distraction were experimentally manipulated (Hill et al., 2010). Therefore, we focused on the results of a qualitative study by Oudejans and colleagues (Oudejans et al., 2011), in which the authors asked a large population of professional athletes about their actual thoughts and attention allocation in high pressure contexts by applying a verbal report questionnaire (for this procedure see also, Beilock, Kulp, Holt, & Carr, 2004) and concept mapping (Jackson & Trochim, 2002). In contrast to studies in which attention has been experimentally manipulated (e.g., Beilock, & Carr, 2001; Beilock et al., 2002; Jackson et al., 2006) the study of Oudejans and colleagues revealed on which certain aspects attention of athletes is actually automatically directed when under pressure. Based on these findings

we picked two representative statements to assess the level of skill-focus ("I was focussing on the proper technique while executing the tennis serves"; "I was focussing on my movement execution") and two representative statements to assess the level of distraction ("I was worrying about my performance"; "I was distracted by task-irrelevant thoughts"). Participants indicated how strongly each of these four statements applied to them while performing the second round of tennis serves on Likert-type scales ranging from 1 (*not at all*) to 4 (*very much*). We calculated an overall score for level of distraction and for skill-focus by averaging each participant's answers on the respective items.

After finishing the experimental procedure we thanked each participant for their partaking and debriefed them.

3. Results

3.1. Preliminary Analyses

As expected, the anxiety group and the neutral group did not differ in any of the three subscales of the WAI-T (see **Table 1** for descriptive statistics), as indicated by the results of a one-way between-groups analysis of variance (worry: $F(1, 51) = .87$, $p = .36$, $\eta^2_{\text{partial}} = .02$; somatic: $F(1, 51) = .86$, $p = .36$, $\eta^2_{\text{partial}} = .02$; concentration: $F(1, 51) = .04$, $p = .86$, $\eta^2_{\text{partial}} = .00$).

Furthermore, a one-way between-groups ANOVA demonstrated that there were no statistically significant mean differences in tennis serves accuracy at Time 1, $F(1, 51) = .80$, $p = .38$, $\eta^2_{\text{partial}} = .02$.

Finally, the anxiety manipulation was successful in the present study as a one-way between-groups ANOVA revealed that participants from the anxiety group had higher mean scores on the anxiety thermometer compared to participants from the neutral group, $F(1, 51) = 3.87$, $p = .05$, $\eta^2_{\text{partial}} = .07$. The mean scores on the anxiety thermometer for the anxiety and the neutral group were similar to previous studies (e.g., Englert & Bertrams, 2012).

3.2. Main Analyses

We tested whether the assumed relationship between anxiety and serve accuracy at Time 2 was either mediated by distraction, by skill-focus or both. We followed the recommendations from Preacher and Hayes and included both potential mediators simultaneously in a single multiple mediation model (**Figure 2**) which is a superior method compared to the Sobel test and is better suited for small sample sizes (Preacher & Hayes, 2004, 2008). This procedure allows one to test competing theories against each other within a single model (Preacher & Hayes, 2008). Via bootstrapping procedures we calculated direct and indirect effects of our independent variable (i.e., anxiety group) on our dependent variable (i.e., tennis serve at Time 2) with distraction and skill-focus as our multiple mediating variables. Based on this analyses the total effect of anxiety on serve accuracy at Time 2

Table 1. Descriptive statistics: Means and standard deviations.

Variable	Experimental condition			
	Anxiety		Neutral	
	M	*SD*	*M*	*SD*
WAI-T somatic	1.92	.64	2.10	.75
WAI-T worry	2.29	.76	2.25	.64
WAI-T concentration	1.98	.68	2.14	.59
Anxiety thermometer	2.44	2.07	1.55	1.13
Tennis serve T1	1.28	.48	1.39	.44
Tennis serve T2	1.16	.52	1.40	.31

Note: $n = 25$ in anxiety group, $n = 28$ in neutral group. Overall scores of a psychometric scale were obtained by averaging the responses to the scale items. WAI-T = Wettkampfängstlichkeitsinventar (German version of the Sports Anxiety Scale, SAS-2). Tennis serve T1 = average tennis serve performance out of 10 serves at first time of measurement. Tennis serve T2 = average tennis serve performance out of 10 serves at second time of measurement.

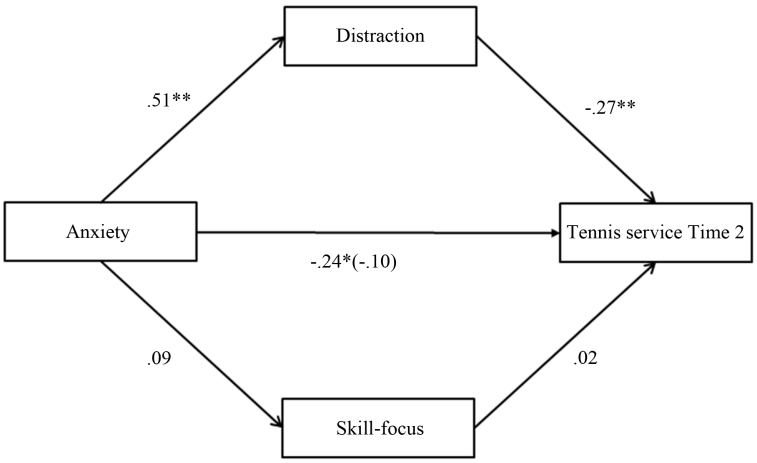

Figure 2. Path model for anxiety as a predictor of tennis serve performance at Time 2, including paths to represent possible mediation by distraction and skill-focus. Path values represent unstandardized regression coefficients. The value outside of the parentheses represents the direct effect, from bootstrapping analyses, of anxiety on tennis serve performance at Time 2 after the mediators are included. Coding of anxiety: 1 = Neutral group, 2 = Anxiety group. Statistics for overall model: $F(3,49) = 5.79$, $p < .01$, $R^2 = .26$. $^{*}p < .05$. $^{**}p < .01$.

($B = -.24$, $p = .04$) became non-significant ($B = -.10$, $p = .38$) when including the mediators into the model (i.e., direct effect of anxiety).

The total indirect effect of distraction and skill-focus was statistically significant, as the 95% BCa (bias-corrected and accelerated; see Efron, 1987) bootstrap confidence interval did not include zero (95% CI = .37 - .31). Analyses of the specific indirect effects for each of the two mediators indicated that only distraction was a unique mediator because the 95% BCa CI did not include zero (95% CI = .04 - .30). However, the 95% BCa CI for skill-focus included zero (95% CI = −.02 - .05) and thus did not significantly contribute to the total indirect effect above and beyond distraction. Therefore, the effect of anxiety on tennis serve accuracy was fully mediated by distraction.

4. General Discussion

In previous research it has been repeatedly demonstrated that higher levels of anxiety are associated with impaired performance in perceptual-motor tasks from several sports domains (e.g., Behan & Wilson, 2008; Beilock & Carr, 2001; Causer et al., 2011; Gray, 2004; Gucciardi & Dimmock, 2008; Mullen & Hardy, 2000; Mullen et al., 2005; Nieuwenhuys & Oudejans, 2011; Nieuwenhuys et al., 2008; Vickers & Williams, 2007; Wilson et al., 2009). There is compelling evidence for skill-focus theories (e.g., Beilock & Carr, 2001; Gray, 2004; Gucciardi & Dimmock, 2008; Jackson et al., 2006; Mullen & Hardy, 2000; Mullen et al., 2005) as well as for distraction theories (e.g., Behan & Wilson, 2008; Causer et al., 2011; Nieuwenhuys & Oudejans, 2011; Nieuwenhuys et al., 2008; Vickers & Williams, 2007; Wilson et al., 2009) as possible explanations for this finding. However, in most studies the attentional focus and distraction have been experimentally manipulated (e.g., Beilock & Carr, 2001; Beilock et al., 2002; Jackson et al., 2006) which makes it impossible to draw causal conclusions which theoretical approach is more suitable to explain choking under pressure effects (Hill et al., 2010). Qualitative studies testing the conflicting proposed mechanisms are also delivering inconsistent results (e.g., Gucciardi et al., 2010; Mesagno et al., 2008, 2009; Oudejans et al., 2011). That is why in the present study we not only tested which focus of attention participants apply and how distracted they are in high pressure situations but also how the respective focus and level of distraction are predicting actual performance in a tennis serve task under high pressure conditions. Our analyses revealed a statistically significant negative relation between anxiety and serve accuracy. Furthermore, this relationship was fully mediated by reported level of distraction while performing these serves, while level of self-reported skill-focus did not mediate the anxiety-performance relationship. Therefore, the current results are in line with distraction models of choking in sports.

However, there are several limitations that need to be considered. First, we applied retrospective measures to assess the attentional focus and level of distraction. Retrospective self-reports may not be accurate and can be suspect to retrospective biases which makes it possible that the current pattern of results are not solely accounted for by attentional drifts (e.g., Oudejans et al., 2011). Although there are ways to test the assumptions of distraction theories objectively by assessing one's gaze behaviour as an indicator for attention regulation (e.g., Behan & Wilson, 2008; Nieuwenhuys & Oudejans, 2011; Nieuwenhuys et al., 2008; Wilson et al., 2009), it is impossible to test the assumptions of skill-focus theories directly in a given situation. That is why in most studies on skill-focus attentional focus has been experimentally manipulated (e.g., Beilock & Carr, 2001; Beilock et al., 2002; Jackson et al., 2006). In the present study we wanted to avoid an experimental manipulation of attentional focus and distraction. Instead we wanted to investigate which focus is automatically activated and furthermore which theoretical approach is more suitable to explain actual behaviour in sports. That is why we think a retrospective assessment was the appropriate approach to address our research question.

Second, we conducted our study on outdoor clay courts. There are several external factors that could have had an influence on our results, as it is impossible for instance to assure identical weather conditions for all participants. We tried to control for these external factors (e.g., by conducting the study on the same time of day, by always serving with the sun). However, this is a common issue in field experiments and is a trade-off that needs to be considered before conducting an experiment: The internal validity may have been impacted by external stimuli in the current study, while at the same time the external validity was higher compared to a laboratory experiment (e.g., Gratton & Jones, 2010).

Finally, the situational characteristics of a pressure situation may determine if individuals are focussing on proper skill execution or are prone to be distracted by irrelevant stimuli while performing a perceptual-motor task (DeCaro, Thomas, Albert, & Beilock, 2011; Geukes, Mesagno, Hanrahan, & Kellmann, 2013). According to DeCaro and colleagues an external evaluation of one's performance by others (i.e., monitoring pressure) may result in a stronger focus on a proper skill execution, while on the other hand, outcome pressure (i.e., performance-contingent incentives) may lead to a higher level of distractibility, as one is focussing on the situation and the consequences of one's behaviour rather than on the task at hand. The characteristics of the pressure situation we generated in the current study seem to be more in line with monitoring pressure, as we told participants that their performance will be compared with other participants and that they will receive a feedback. As DeCaro stated this should have led to a higher level of skill-focus. However, in our study distraction instead of skill-focus mediated the anxiety-performance relationship.

Nieuwenhuys and Oudejans (2012) propose that although skill-focus theories and distraction theories seem to take opposite paths to explain choking under pressure effects, they are actually based on the same core assumption, namely that increased distractibility is responsible for performance impairments under pressure. According to distraction theories higher levels of anxiety are associated with increased distractibility (i.e., paying attention to task-irrelevant stimuli) leaving less attention for the actual task at hand (e.g., Eysenck & Calvo, 1992; Eysenck et al., 2007; Nieuwenhuys & Oudejans, 2012; Wine, 1971). One could argue that focussing on the execution of a skill is also a product of increased distractibility as such a skill focus is task-irrelevant for expert performers and can negatively affect expert performance (e.g., Baumeister, 1984; Beilock & Carr, 2001; Masters, 1992). This finding delivers additional support for the assumptions of distraction theories.

The current study deals with the important research question which processes are responsible for performance impairments in high pressure contexts in sports. The anxiety-performance relationship in our study was fully mediated by distraction which supports the assumptions of distraction theories. This study is, as far as we know, the first one that compared the two competing assumptions of skill-focus theories and distraction theories directly against each other without an experimental manipulation of attentional focus and level of distraction.

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