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Choking under pressure in externally-paced skill anticipation: The role of distraction and self-focus

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German Abstract

Ziel der Studie: ‚Choking under pressure' ist ein psychologisches Phänomen, das sich auf das Auftreten suboptimaler Leistungen von Sportler*innen in Druck-Situationen bezieht. Die choking-Forschung hat sich bislang stark auf selbstgesteuerte Fertigkeiten (Fertigkeiten, bei denen die Sportler*innen selbst entscheiden können, wann sie diese einleiten) beschränkt. Diese Studie ist die erste, die die Rolle der choking-Mechanismen bei selbstgesteuerten Fertigkeiten (Selbstfokussierung und Ablenkung) auf fremdgesteuerte Fertigkeiten (Fertigkeiten, bei denen die Sportler*innen nicht entscheiden können, wann sie diese einleiten) beleuchtet, indem sie die choking-Mechanismen auf den Schlüsselmechanismus fremdgesteuerter Fertigkeiten, die antizipatorische Leistung, überträgt.

Methode: In dieser Studie wurde ein Pretest-Posttest-Design verwendet, bei der 80 Teilnehmer*innen zufällig einer Kontroll-, Selbstfokus-, Ablenkungs- oder Kombinationsgruppe (Selbstfokus und Ablenkung) zugewiesen wurden. Die Teilnehmer*innen durchliefen einen antizipatorischen Leistungstest zweimal, wobei die Teilnehmer*innen der Versuchsgruppen im Posttest entweder selbstfokussiert (durch einen Spiegel) oder abgelenkt (durch das Hören von besorgniserregenden, häufig in Stresssituationen erlebten Gedanken) oder beides (Kombigruppe) waren. Mithilfe des Designs wurde die Hypothese, dass abgelenkte Teilnehmer*innen (Ablenkungs- und Kombigruppe) im Posttest eine schlechtere antizipatorische Leistung erbringen als nicht abgelenkte Teilnehmer*innen (Selbstfokus- und Kontrollgruppe), getestet.

Ergebnisse: Die Ergebnisse stützen die Hypothesen nicht. Abgelenkte Teilnehmer*innen zeigten im Posttest keine signifikant schlechtere antizipatorische Leistung als die Teilnehmer*innen der Kontrollgruppe (Hypothese 1) und auch nicht als die selbstfokussierten Teilnehmer*innen (Hypothese 2). Die Studie weist mehrere Limitationen auf, die eine korrekte Interpretation der Ergebnisse erschweren.

Schlussfolgerungen: Diese Ergebnisse deuten darauf hin, dass Ablenkung keinen negativen Einfluss auf die antizipatorische Leistung hat und dass daher bei fremdgesteuerten Fertigkeiten andere choking-Mechanismen zugrunde liegen könnten als bei selbstgesteuerten Fertigkeiten.

Abstract

Objective: Choking under pressure is a psychological phenomenon which refers to the occurrence of athletes' suboptimal performance in high-pressure situations. Research on choking has been heavily focused on self-paced skills (skills where athletes can decide when to initiate action). This study is the first to illuminate the role of self-paced skills' choking mechanisms (self-focus and distraction) on externally-paced skills (skills where athletes cannot decide when to initiate action) by applying them to the key mechanism of externally-paced skills: anticipatory performance.

Method: In this study, a pretest-posttest design was applied; 80 participants were randomly assigned to a control, self-focus, distraction or combi group (self-focus and distraction). Participants performed an anticipatory performance test twice. In the posttest, experimental group participants where either self-focused (applied via a mirror) or distracted (listening to worrisome, frequently in high-pressure scenarios experienced thoughts) or both (combi group). We assumed that distracted participants (distraction and combi group) have a worse anticipatory performance than non-distracted participants (self-focus and control participants) in the posttest.

Results: Results do not support the hypotheses, as the distracted participants did not show significantly worse anticipatory performance in the posttest than the participants in the control group (hypothesis 1), nor than the self-focused participants (hypothesis 2). However, this study exhibits several limitations, which makes it somewhat difficult to properly interpret the results.

Conclusions: These results indicate that distraction does not have a diminishing effect on anticipatory performance and therefore externally-paced skills may have different underlying choking mechanisms than self-paced skills.

key words: choking under pressure, self-focus, distraction, anticipatory performance, externally-paced skills

Contents

Introduction

Soccer players must score goals of immense value in a penalty-shoot-out, gymnasts must demonstrate their best performance in competitions, track and field athletes must perform in knock-out-stages. In all these scenarios described is the pressure high and the consequences of a failure severe. Every athlete will eventually experience pressure in important moments. In such situations, athletes often perform sub-optimally and are not able to display their best performance. The psychological phenomenon of suboptimal performance in high-pressure situations is referred to as *choking under pressure*, firstly named by Baumeister (1984), which was the starting point for a new field of sports psychology research (e.g. Masters, 1992; Beilock & Carr, 2001; Singer, 2000). Research postulates different causes of *choking*, which conflate to two kinds of theories. Self-focus theories state that perceived pressure will hinder motor skill execution of athletes due to conscious control in automated processes, which leads to suboptimal performance (Beilock & Carr, 2001). On the other hand, distraction theories postulate that pressure leads athletes to use part of their attentional resources for task-irrelevant cues (e.g. worrying about the performance outcome and its consequences), which results in a lack of task-relevant attention and therefore prevent successful execution of motor skills (Roberts et al, 2017). Although both theories are well-researched, choking studies especially focus on self-paced-skills, skills, where athletes can decide freely when to initiate action (Singer, 2000). Choking under pressure research lacks studies of externally-paced-skills, skills where athletes must respond to a certain stimulus (Jackson, 2003). This thesis addressed this research gap and attempted to narrow it.

Choking under pressure

Definition(s) and general research about choking

Choking under pressure is a psychological phenomenon described by the occurrence of suboptimal performance despite individual abilities which normally lead to superior performance (Baumeister, 1984). Baumeister was the first who used the term and defined pressure as a factor or multiple factors which increase the significance of performing well in specific situations. Baumeister describes choking as a decrease of performance which occurs under pressure, mostly used in the context of competitions, although the term is not limited to that specific area. A first extension of Baumeister's choking hypothesis was made by Masters

(1992): learning a motor skill is either explicit or implicit, and he suggested that the method by which a skill was learnt affects the ability to retrieve and 'reinvest' the explicit knowledge acquired. For example, if a particular skill was learnt explicitly, one may reinvest that explicit knowledge in the execution of the skill even after the skill has been fully automated. Moreover, Masters suggested that choking occurs as a result of trying to control processing in automatic processes (more on this, see chapter of self-focus theories).

In the following years, researchers altered and extended the definition of choking under pressure: Gucciardi and Dimmock (2008) stated that the term choking should only be used if inferior performance of the athlete is a significant deterioration of normal performance. Hill et al. (2010) noted that numerous researchers had already deviated (more or less) from Baumeister's (1984) definition and hence refer to choking as an acute performance decrease while under pressure. While there is no full consensus regarding a definition of choking under pressure, most research has followed Baumeister's definition (Hill et al., 2010). However, a few additions (accepted by the broader literature) to Baumeister's definition were made. For example, Clark et al. (2005) stated that choking differs from other forms of performance failure as the athlete is still able to make rational decisions when choking and knows the 'plan of action'. The impairment that leads to a decline in performance has psychological factors. Hill and Shaw (2012) mentioned that although the amount of research regarding choking in sport is constantly increasing, its definition still lacks clarity regarding the cause, mechanisms and its moderators (more of this below).

As science does not agree on a uniform definition, there is no universal definition of choking. The most accepted definition of choking was formulated by Mesagno and Hill (2013). They defined choking as 'an acute and considerable decrease in skill execution and performance when self-expected standards are normally achievable, which is the result of increased anxiety under perceived pressure' (p. 273).

Studies have investigated the presence of choking in athletes in different sports (e.g. Jordet & Hartman, 2008; Oudejans et al., 2011; Englert & Oudejans, 2014): Jordet and Hartman (2008) investigated soccer player's behaviour in penalty shootouts and found that soccer players exhibited more avoidance behaviour in negative valance situations. Oudejans et al. (2011) found that while athletes (the sample included several sports) are under pressure, their attention was often focused on worries and on external factors which lead them to positive monitoring in attempt to maintain performance. Englert and Oudejans (2014) investigated

tennis serve accuracy in choking athletes and found that perceived anxiety in a tennis serve task correlates negatively with serve accuracy; players had a worse serve accuracy while being anxious. These are just examples of the numerous studies on the presence of choking. Effects of choking can vary between athletes (e.g. they can be defamed, embarrassed or even ostracized from the sporting community; Mesagno et al., 2015); although in general, the presence of choking leads to maladaptive responses by the athletes.

Factors related to choking

Murayama and Sekiya (2015) investigated factors related to choking under pressure via a questionnaire survey which was distributed among university students who were in sports-orientated school-clubs. Their exploratory factor analysis extracted eleven different factors, of which nine of them were used as latent variables in an analytical model: changes in motor control and vicious circles (1), abnormal physical sensations (2), perceptual and cognitive confusion (3), introversion (4), self-consciousness (5), feelings of physical heaviness and weakness (6), conscious processing (7), passivity (8) and safety-oriented strategies (9).

Existing research proposed different psychological mechanisms which may foster choking. These theories can be categorized as either drive or attentional models of choking.

Mechanisms of choking

Choking is either explained in drive or attentional models/theories (of choking), this study will focus on the latter and therefore will discuss them in more detail (see self-focus and distraction). Drive theories of choking assume that choking occurs due to an increased level of arousal ("drive") which emerges from the athletes' desire to perform well under pressure (Spence & Spence, 1966). But how drive affects performance remained the source of discussion: A first proposal was based on Yerkes and Dodson's Inverted U Model (1908), which proposes that intermediate levels of arousal lead to optimal performance; whereas low and high states of arousal will cause performance to deteriorate. After a few other propositions, Baumeister and Showers (1986) concluded that although drive theories can offer 'plausible explanations' for choking, they fail to account for all cases of choking. Beilock and Gray (2007) later also criticized that drive theories lack an explanation of a full process that may lead to choking. Research therefore moved towards an attentional explanation of choking.

Research on attentional models of choking formulated two different attention-based models to explain choking under pressure (self-focus and distraction, Baumeister, 1984; Wine, 1971), which were already mentioned in the introduction of this master's thesis. As both are important for this study, we will now discuss them into more detail.

Self-focus theories

Approaches towards a self-focused view of choking largely comes from Baumeister's (1984) automatic execution hypothesis. Because controlled and automatic processes are contrary to each other, needed mental resources for carrying out a skill differ: while controlled processes need great mental and conscious resources (Singer, 2002), automatic processes are capable of being carried out without these resources. Motor skill learning involves a transition from controlled processing to automatic processing (Roberts et al., 2017). Baumeister's hypothesis states that choking occurs because the athlete directs his or her conscious attention to the execution of an automatic skill as they become increasingly anxious.

Research (e.g. Baumeister, 1984; Beilock & Carr, 2001; Masters, 1992) proposed two different theories of interferences in automatic processing: explicit monitoring hypothesis and conscious processing hypothesis, also named reinvestment theory.

Explicit Monitoring Hypothesis. Both hypotheses are derived from Baumeister's definition (1984) of choking. Beilock and Carr (2001) found that experts encode knowledge of a learnt skill in a procedural form which enables them to perform the skill without the need of constant attention. In their explicit monitoring hypothesis, they claim that anxiety in sensorimotor skills triggers athletes to consciously control complex procedural knowledge which already exists outside their working memory. While under pressure, performers increase their attention to step-by-step execution of a well-learned skill. In other words, perceived pressure increases athlete's self-consciousness about performing correctly and therefore leads them to focus their attention on skill execution, which disrupts athlete's execution of an already proceduralized skills (skills that can be executed without conscious awareness; DeCaro et al., 2011).

Conscious Processing Hypothesis/Reinvestment Theory. Masters (1992) extended Baumeister's definition by suggesting that it may make a difference how a particular skill is learnt, which may later affect the ability of one to 'reinvest' in the explicit knowledge acquired. He differentiated between explicit (e.g. through specific instructions on body position and movement) and implicit (e.g. with help of an analogy) motor skill acquisition. If a skill was learned explicitly, the performer may 'reinvest' in their rule-based knowledge even after skill execution becomes fully automated. On the other hand, by learning skill execution implicitly, performers will not and/or cannot "fall back" on rule-based knowledge. As Masters's conscious processing hypothesis (later called reinvestment theory; Masters & Maxwell, 2008) proposed that choking occurs because the performer's attention may shift toward (explicit) rule-based knowledge when under pressure and therefore will hinder the already automated skill execution; implicit motor learners perform more automatically than explicit learners when under pressure - due to the lack of rule-based knowledge (Master & Maxwell, 2008; Mesagno & Beckmann, 2017).

Although these theories have a different focus on how choking is caused, both approaches share that choking is triggered by anxiety-provoked introspection, which leads to interference in normally automatically carried out skills (Roberts et al., 2017). The explicit monitoring hypothesis differs (slightly) from the reinvestment theory in that it assumes that choking occurs when the athlete monitors the explicit components of the skill, whereas the reinvestment theory holds that choking is due to the athlete's conscious control of the components.

Studies on self-focus mechanisms. Generally, advocates of self-focus theories believe that choking athletes diminish their performance by monitoring and/or controlling their performance (Beilock & Carr, 2001; Masters, 1992).

Evidence that pressure leads to a more self-focused attention can be found in studies. In Gray's experiment (2004), expert baseball players had to swing at a simulated pitch while either low- or high frequency tones were played. After each swing, participants had to either discriminate a tone's frequency as high or low ('extraneous tone judgement') or identify their bat as moving up or down when the tone was played ('self-focused tone judgement'). Gray found that when pressure was applied, players self-focused judgement increased while extraneous judgement was unaffected. Gray and Cañal-Bruland (2015) could replicate that

effect in a golf-putting-task: only self-focused judgement improved when players were under pressure.

Experimental studies, in which participants experienced choking after performing a step-by-step execution of a motor task (e.g. Liao & Masters 2002; Snyder & Logan, 2013) also support the self-focus model of choking.

Liao and Masters (2002) were one of the first who assumed that pressure would evoke self-focus. They conducted two experiments, results of their first experiment showed that a higher level of self-focused attention (measured via a self-focussed attention scale) lead to increased anxiety in the buildup to competition. In their second experiment, some of their participants were told to focus on mechanics of the ball-shooting process during practice. These participants performed significantly worse in an afterwards stressful test phase than the participants who did not receive such instructions for their practice. Hence, Liao and Masters concluded that self-focused attention may increase when under psychological stress (experiment 1) and that the negative effect of self-focused attention on performance is increased when learning under self-focused attention (experiment 2).

Snyder and Logan (2013) conducted four experiments in which skilled typists had to type four-letter target words. Since the participants then had to report the hand sequence of the keystrokes, they were asked to pay attention to which hand they used to make each stroke (and therefore were manipulated towards a self-focussed attention). With that design, Snyder and Logan could investigate the conditions under which monitoring a skill interferes with practiced performance. The results were consistent with their implicit-explicit hypothesis, which states that performance interference is caused by cognitively executed, monitoring-induced interference. Thus, they suggest that monitoring costs arise when implicit performance details must be made explicit.

But not all individuals are equally prone to choke while being self-focused. Gröpel (2016) found that action-orientation moderates the performance-impairing effect of self-focused attention on motor skill failure: basketball players performed free throws under normal conditions (baseline) and under self-focused attention. Gröpel manipulated participants by telling them that their shooting technique is videotaped and evaluated. Moreover, players were requested to recall their shooting technique and were also given a detailed information on how an optimal shooting process should look. Thus, participants in the self-focused attention

condition were thoroughly nudged towards a more self-focused attention. Results show that state-oriented participants decreased the accuracy of their free throws, whereas action-oriented participants showed stable performance.

However, there are other ways of directing participants' attention to themselves. When manipulating participants to self-focus attention, Carver and Scheier demonstrated the manipulative aspects of a mirror leading to greater self-focused attention as early as 1978. Lundh and Öst (1996) and Silvia (2013) are further examples of studies in which the presence of a mirror (in which participants can see at least parts of themselves) increased self-focused attention. An audience can also increase self-focused attention: Carver and Schleier (1978) replaced the mirror with an audience in their second experiment and reached the same results; spectators can therefore also increase self-focused attention. Not only Carver and Schleier found the influence of an audience on participants; Wallace et al. (2005) results also indicated that the presence of an audience leads to an increased self-focus.

Distraction theories

Besides self-focus, there is another postulated mechanism of choking that can be explained by the attention-based model: distraction. Distraction theories are based on studies by Wine (1971), who postulated that people divide their attention between their task and preoccupation with themselves in ego-threatening situations, which leads to impairment of their performance. In sports, distraction is explained generally by an attention diversion caused by perceived pressure of an athlete, which leads to a split attention between relevant task-information and non-task information (e.g. worrying) and thus hinder successful task execution (Roberts et al., 2017). Causes of distraction could either be internal or external. An example of an internal distraction could be worrying about the outcome of a close game and therefore diminishing task-relevant attention. External distraction, on the other hand, is based on an external shift of attention toward task-irrelevant cues (e.g. loud crowd; Gröpel & Mesagno, 2019). A study by Hill and Shaw (2013) is an example of support for the distraction hypothesis; they worked with athletes who regularly choked under pressure and found that choking can indeed be caused by distraction, which in turn leads to poorer performance by the athlete. Nieuwenhuys and Oudejans (2017) postulated an integrated model of anxiety and perceptual-motor performance that aims to explain perceptual-motor behaviour across a broad spectrum of not only psychological but also neurobiological responses triggered by the perception of high pressure or by anxiety. It states that (most) real-life situations mostly take place in dynamic

environments, thus goal-directed movements also require situational awareness. Furthermore, Nieuwenhuys and Oudejans (2017) note that although literature on anxiety-performance exclusively focuses on the execution of movement, anxiety also influences different levels of operational control and therefore has more implications for movement behaviour.

Studies on distraction mechanisms. Generally, distraction can either be caused by external (e.g. crowd-noises) or internal (e.g. worrying thoughts) mechanisms (Wine, 1971). Two categories of evidence support a distraction-based explanation of choking in sport: the first one being qualitative studies which show that athletes usually attribute their choking to their dysfunctional thinking caused by distraction factors such as worries and negative thoughts (Hill & Shaw, 2013; Oudejans et al., 2011). Oudejans et al. asked athletes to recall their thought processes when they were under pressure and found that 26% of interviewees' thoughts were associated with worries and 5% were related to external factors. Secondly, studies on visual attention provide a more precise support for distraction. When under pressure, individuals tend to change their gaze behaviour, which leads to shorter final eye fixation towards the target ('Quiet Eye'). Nibbeling et al. (2012) found that while anxious, expert and novice darts players collected visual information less efficiently, yet only novice performance declined. In addition, Englert et al. (2015b) found that depleting inexperienced dart players' self-control prior to throwing resulted in shorter final fixations and decreased performance (only when) under high anxiety. Studies on visual attention furthermore suggests that anxiety (and pressure) reduces attentional efficiency, biases attention off-target (including towards threat) and can impair perceptual–motor performance (Roberts et al., 2017).

Distraction manipulation in studies generally contains a dual-task condition, where participants are requested to fulfil another task in addition to the primary one (e.g. Gray, 2004). Gray also found that different distraction tasks have varying effects on novices and experts: skill-related dual tasks lead to poorer performance in experts and have no significant effects on novices, whereas dual tasks that are not related to the skill performed lead to poorer performance in novices but have no significant effects on highly skilled individuals. Another example of a distraction manipulation can be found in a study by Englert et al. (2015a), in which basketball players took a certain number of free throws while listening to statements representing worrying thoughts through headphones. These statements contained worrying thoughts that are common in high-pressure situations for athletes (e.g. "I was worried about

my performance"). A similar approach was used in Furley et al.'s (2013) study where participants had to listen to distracting auditory messages during a decision-making task.

Closing on the two attention-based models of choking (self-focus and distraction), it can be said that both are supported by literature. In general, support for self-focus models is found in tasks that place little demand on working memory (e.g. motor skills such as golf putting), while support for the distraction hypothesis can be found in tasks that require a high capacity of working memory (e.g. mathematical calculations; Gucciardi, 2008).

Moderators of choking under pressure

Not every athlete is equally prone to choke under ego-threatening situations. The occurrence of choking is moderated by different traits. Hill et al. (2010) list potential moderators of choking found in previous studies. Moderators include self-consciousness and -confidence, trait anxiety, the presence of an audience, stereotype threat, public status, coping style, skill level, dispositional reinvestment and task properties. Mesagno et al. (2015) also named narcissism as a correlate of choking. Some of the listed moderators will be discussed in more detail.

Self-confidence and trait anxiety

Research on the influence of self-confidence and trait anxiety on choking indicate that athletes with low confidence and high in trait anxiety are at risk to choke (Baumeister & Showers, 1986; Baumeister et al., 1985). Poolton et al. (2004) stated that high trait anxious athletes tend to choke more because of their self-focus mechanisms. On the other hand, individuals with low self-confidence do not tend to adopt effortful strategies that could compensate for their processing inefficiency (Wilson et al., 2007), which they experience due to the overload of their working memory triggered by the anxiety reactions they experience when under pressure. Concludingly, both low confidence and high trait anxiety lead athletes to being more vulnerable to choking.

Presence of an audience and stereotype threat

Other moderators of choking are the presence of an audience and stereotype threat. Although the presence of an audience is usually considered to be a cause of choking (Wallace et al., 2005), Hill et al. (2010) described it as a moderator of choking. There is contradicting

evidence regarding the presence of other individuals in general (see social facilitation; Zajonc, 1965). Studies with athletes found that the presence of others can lead to self-focus and therefore may foster choking (Wallace et al., 2005), other research found positive effects on athlete's performance when the audience is supportive ('home advantage'; e.g. Thomas et al., 2008). However, a supportive audience can also have a detrimental effect on performance: Butler and Baumeister (1998) found that while a supportive audience has a calming effect on the individual (e.g., feeling better), better performance only occurs when the task presented is of low complexity; performance on more difficult tasks causes the individual to perform worse, despite the presence of a supportive audience. Therefore, Hill et al. (2010) mentions that the influence of an audience on the performance of athletes should be investigated further in future work.

Stereotype threat has been thoroughly investigated in academic and cognitive testing but has received little attention in the sport context (Beilock & McConnell, 2004). Stone et al. (1999) were among the first to examine stereotype threat in the sport context and found that Black participants performed worse on a golf putting task when it was framed as a sport intelligence test than Black participants who received no prior framing. On the other hand, white participants performed worse when the task was formulated as a test of "natural athletic ability" than white participants who did not receive any information. Therefore, the mere framing of a sports task can deteriorate the performance of members of the negatively stereotyped group ('Black individuals are not athletically intelligent but are naturally athletic and vice versa for white individuals'). However, Hill et al. (2010) points out that more research is necessary to fully understand the process of stereotype threat and its influence on choking.

Narcissism

Narcissism is a personality trait that is related to self-confidence, making narcissists more likely to perform well under pressure as overcoming difficult situations supports their perceived grandiosity (Mesagno et al., 2015). Wallace and Baumeister (2002) were the first who found a positive association between the character trait and performance under pressure – high narcissists performed better than low narcissists in dart-throwing when under pressure. Moreover, participants who scored higher in narcissism were more accurate in a ball-throwing task when put under pressure by and audience (Geukes et al., 2012; 2013). These results suggest a possible safeguarding role of the character trait narcissism and choking under pressure.

Nevertheless, athletes regularly choke under pressure, regardless of whether their personality traits make them choking-susceptible or not. As research postulated attentional choking models which can explain mechanisms of choking and found moderators of choking, sport psychological interventions have been developed and used for choking-susceptible athletes or to generally improve athletes' performance (Mesagno & Beckmann, 2017).

Sports psychological interventions based on attentional models of choking

Sports psychological interventions based on attentional models of choking can be split into two different branches: self-focus- and distraction-based interventions (e.g. Gröpel & Mesagno, 2019).

Self-focus-based interventions

Self-focus interventions aim to divert attention away from self-focused attention or to minimize explicit knowledge during skill acquisition (Mesagno & Beckmann, 2017). In their systematic review, Gröpel and Mesagno (2019) categorized literature of self-focus-based interventions. Contents of self-focus-based interventions range from dual-tasks, analogy or implicit training, left-hand contractions, fluency cues, task-irrelevant cues, process goal, neurofeedback training and Quiet Eye training.

In dual-task conditions athletes have to not only perform the primary task but also have to execute skills which are not task-relevant for the primary task (e.g. primary task: dribbling with their dominant food, secondary task: repeating a target word that appears once every three words; Jackson et al., 2006). Analogy or implicit trainings aim to stabilize performance under pressure due to different methods of learning (implicit learning). Although analogy learning groups tend to report fewer technical instructions, Schücker et al. (2013) found no significant difference between analogy learning and explicit learning groups in golf putting accuracy when under pressure. Quiet Eye interventions aim for a longer period of final eye fixation of the athlete towards the target just before action is initiated (Roberts et al., 2017). They found that a longer quiet eye period can reduce the occurrence of choking in athletes. Left-hand contractions are often used as an element in a pre-performance routine (e.g. Gröpel & Beckmann, 2017). Contractions of the left hand lead to a reduced state of cortical activity, which can aid the performance of the subsequent behaviour (Cross-Villasana et al., 2015).

Distraction-based interventions

The goal of distraction-based interventions is to reduce internal or external distractions and facilitate task-relevant concentration of attention while executing the skill (Gröpel & Mesagno, 2019). The most common intervention for avoiding distractions in crucial situations is a pre-performance routine (PPR). PPRs are a sequence of task-relevant actions performed by the athlete prior engaging a sport skill (Mesagno & Beckmann, 2017) and are applied for attentional and emotional control of athletes prior engaging (Moran, 1996). Examples of contents of a PPR are mental imagery, quiet eye (see above), dynamic handgrip (see above), relaxing, cue words, external focus and temporal consistency (Rupprecht et al., 2024; Gröpel & Mesagno, 2019). Roberts et al. (2017) also include cognitive strategies (e.g. thought stopping, self-talk and cognitive restructuring) as elements that are often part of PPR.

Gröpel and Mesagno's (2019) systematic review found that athletes who performed a PPR before task engagement performed either the same or better under pressure than before the PPR was implemented. Rupprecht et al. (2024) conducted a meta-analysis to determine effects of different PPR interventions on performance. Their findings indicate that using a PPR intervention prior engaging in a certain skill benefits the performer not only while under pressure, but in general as well. They also found that comprehensive PPRs containing multiple preparatory elements are just as effective as stand-alone PPRs and that it therefore does not matter how complex or simple a PPR is when it comes to performance.

Before athletes apply any sports psychological choking intervention, it is essential to educate and convince athletes of the mechanisms and benefits of the intervention, as some interventions seem illogical to use (Gröpel & Mesagno, 2019). Gröpel and Mesagno named dual-task interventions as an example, since in a dual-task intervention, athletes are asked to divert their attention away from task-relevant thoughts for optimal performance.

Choking under pressure in differently paced events/skills

In cognitive psychology and sport psychology, skill learning and performing optimally have been a topic of research for years (e.g. Singer, 2000). What to think about before task engagement, during and even after can have great consequences on performance. Such tasks (skills) can be categorized as self-paced (closed) or externally-paced (open). Research on the phenomenon of choking under pressure can be conducted with self-paced (e.g. golf putting) as well as with externally-paced (e.g. baseball batting) skills.

Self-paced skills

Self-paced skills (e.g. basketball free-throws) are categorized by athletes' own decision when to initiate action (Singer, 2000). Therefore, in self-paced events, athletes have a self-chosen amount of time before execution. Since one's allowed to choose when to act, self-paced situations are stable and predictable for athletes (Singer, 2000). However, self-paced skills are associated with challenges: Athletes experience effort by staying on task and ignoring task-irrelevant thoughts before initiating an action (Roberts et al., 2017). PPRs pose a well-researched and frequently used intervention for choking athletes in self-paced skills, as it prevents them from experiencing task-irrelevant thoughts before initiating action (Roberts et al., 2017). In Mesagno's and Mullane-Grant's (2010) study, PPR-intervention groups performed better during high-pressure situations and experienced less choking. Prior mentioned cognitive strategies like thought-stopping, self-talk and cognitive restructuring are often included in pre-performance routines and are also used as choking-prevention in self-paced skills (Roberts et al., 2017).

Externally-paced skills

Externally-paced skills, contrary to self-paced skills, do not allow the athletes the choice to determine the time at which the action is initiated. Externally-paced acts (e.g. batter hitting a baseball) involve the recognition of meaningful cues offered by the opponent(s), rapid decision making and anticipating the opponent's behaviour (Singer, 2000). In Castaneda and Gray's study (2007), participants of different skill level (high-skilled vs. less-skilled) had to focus on different cues (depending on in which condition they were) in a baseball batting simulation. Results indicate that for an optimal performance, high-skilled players should focus their attention onto the ball leaving the bat to achieve optimal performance (as focussing on the ball does not interfere with their proceduralized knowledge), whereas novices should direct their attention towards any aspect of skill execution for optimal performance. A previous study also revealed similar results: Beilock and colleagues (2002) found that novice soccer players performed the best when directing their attention to skill-based execution, whereas high-skilled soccer players performed better in a dual-task condition. These results can be seen as evidence for differences in focus of attention in novice and high-skilled players. Therefore, in externally-paced skills, anticipation (directing one's attention) differs greatly between novices and experts, although losing attentional resources to worrying can impact experts in their anticipation, which leads to novice-like behaviour (e.g. focusing on skill-execution; Roberts et

al., 2017). As anticipatory performance is the most important skill underlining performance in externally paced skills, the concept of anticipation will be addressed more thoroughly.

Anticipation

As anticipation is one of the main factors responsible for performance differences in novices and experts (Roberts et al., 2017), literature thoroughly investigated causes of differences in anticipatory performance between novices and experts (e.g. Abernethy, 1990; Rowe et al., 2009). Anticipation means that the future appears in the causal chain as a non-negligible factor (Williams & Jackson, 2019); therefore, in sports, future actions can be foreseen ("anticipated"). Anticipatory performance is usually measured by spatial (Mann et al., 2010) or temporal (Farrow & Abernethy, 2003) occlusion tests, which reveal differences in e.g. gaze behaviour between experts and novices. Studies have shown that experts are superior to novices in using provided information to predict an event outcome and only the experts are capable of picking up information from the early part of an opponent's action (Abernethy, 1990). Experts are generally better in picking up perceptual cues, use fewer fixations of longer duration (longer quiet eye periods), have a better response accuracy and a faster response time (Mann et al., 2007). Furthermore, experts are superior in using task relevant cues, cues which are important for successful task performance (Hardy et al., 2001). Luke et al. (2022) found that eye-gazing behaviour in expert and novice surfers differs; expert surfers spent more time looking at areas-of-interest regions (predefined regions which may or may not be relevant for performance), whereas novices generally spend more time on looking at irrelevant cues. Expertise is associated with more optimal visual attention to task-relevant cues; moreover, Mann et al. (2007) assume that experts have qualitatively different cognitive mechanisms and strategies that aid anticipation and make it possible to shorten response times and increase response accuracy. Farrow and Abernethy (2001) investigated anticipation regarding its trainability and found that junior tennis players significantly improved their anticipatory skills with implicit perceptual training.

Roberts et al. (2017) postulated in their model of choking in externally-paced skills that impaired anticipation (which means loss of preparation time) leads experts to novice-like performance, since they are reliant on later cues (which then leads to choking). Based on their model, it can be concluded that anticipatory performance is one of the most important measurement tools for researching choking under pressure in externally-paced skills.

Research on choking under pressure with self-paced and externally-paced skills

Mentioned studies in this chapter provide a definition of self-paced and externally-paced skills (Singer, 2000), found differences between novices and experts (Castaneda & Gray, 2007; Beilock et al., 2002) and could indicate which underlying mechanisms are important in externally-paced skills (anticipation being the most salient skill; Roberts et al., 2017).

However, research on choking is focused heavily on self-paced skills: Studies were conducted with basketball free throws (e.g. Englert et al., 2015a; Gröpel, 2016), darts throwing tasks (e.g. Nibbeling et al., 2012; Englert et al., 2015b) and golf-putting tasks (e.g. Gray & Cañal-Bruland; 2015). After an extensive literature search, no studies that examined choking under pressure in externally-paced skills or anticipatory performance were found.

Hypotheses

As mentioned, there is no research investigating the relationship between externally paced skills and the postulated triggers of choking (distraction and self-focus). Therefore, this study addressed this research gap and tried to shed light on choking under pressure in externally-paced skills and anticipatory performance. Because previous studies (e.g. Gröpel & Mesagno, 2019) have identified self-focus and distraction as interfering factors of performance in self-paced skills, they were also considered as possible triggers for choking in externally-paced skills in this study. Roberts et al. (2017) assumed that self-focus should have no effect on externally-paced skills, but that distraction should. As this study did not investigate an externally-paced skill itself but tested anticipatory performance of participants (as anticipation is postulated as the most important underlining factor of successful performance in externally-paced skills; Roberts et al., 2017), the hypotheses are formulated as follows:

(H1) Participants in distracted groups (distraction-group and combi-group) have worse anticipatory performance compared to control-group participants.

(H2) Participants which are distracted (distraction-group and combi-group) have worse anticipatory performance compared to self-focus-group participants.

As there is no evidence or postulated model in existing research regarding the influence of self-focus on anticipatory performance, there is no hypothesis postulating an effect. Moreover, although a control group is included in this study (study design is explained below), there is no hypothesis stating an influence on anticipatory performance regarding that group

(which is the intention in an experimental setting). However, as this study is based on a pre-post design, we expected a general increase in anticipatory performance in the post-measurement as likely due to learning effects (e.g. McClelland, 1987; Wesnes & Pincock, 2002). McClelland conducted performance measurements and found a statistically significant straight-line improvement across 10 sessions and therefore concluded that practice effects are found in performance measurements, therefore, similar results were expected in this study.

Methods

Study design

The study design consisted of two phases (pre- and post-test) and four different groups (conditions), which were assigned to participants randomly before their pre-test:

(1) control group,

(2) self-focus manipulation group,

(3) distraction manipulation group,

(4) self-focus and distraction manipulation group (also referred to as “combi-group”)

Procedure

In the pretest, participants completed a test of anticipatory performance. Next, depending on the experimental condition, they were either distracted or exposed to a self-focus manipulation or both, whereas control participants completed an unrelated task. All participants then completed the anticipation test for the second time. Finally, all participants were debriefed, given their incentive, thanked and dismissed.

Participants

The study was conducted in the sports psychology laboratory of the University of Vienna. Upon arrival, every participant signed an informed consent formular before taking part in the study. All participants were then introduced to the study procedure.

The sample was recruited via social media (e.g. WhatsApp, Instagram). Due to the limited resources of the author, a convenience sampling (snowball-sampling) was used

additionally to reach the proposed sample size of $N = 80$. A more detailed description of the sample can be found in the chapter on the results.

Each participant who completed the study received €20 as a financial incentive; the money was drawn from two different pots: €1300 came from the University of Vienna funding scholarship and €300 was provided by the Division of Sport Psychology of the Institute of Sport and Human Movement Science. The sum (€1600) was divided between the required number of participants ($N = 80$), whereby each participant received the above-mentioned €20 for carrying out the study.

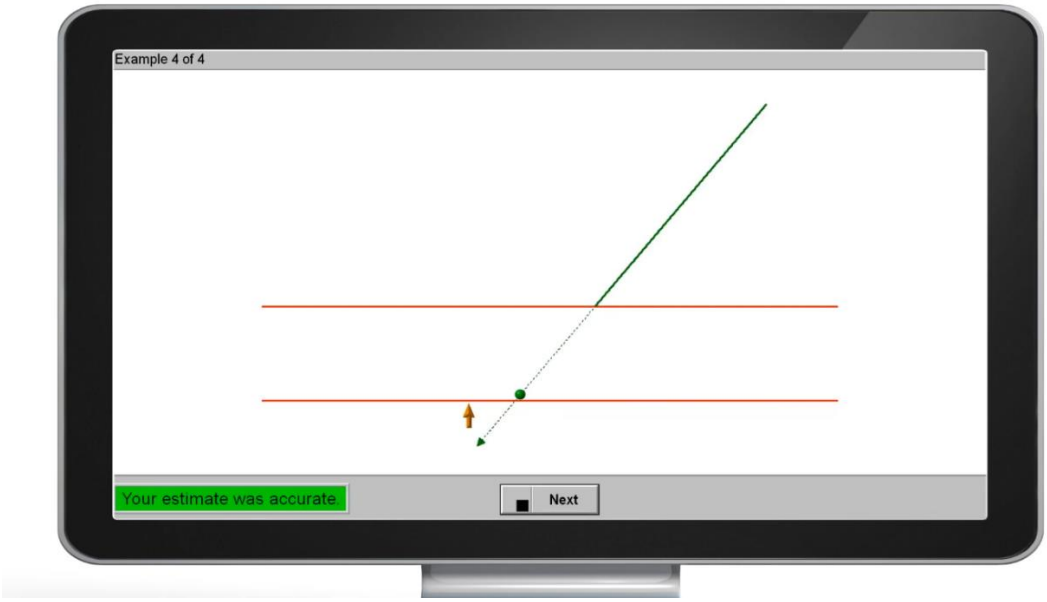
Operationalization of the constructs

Anticipation

Anticipatory performance of participants in this study was measured using the "Zeit- und Bewegungsantizipationstest" (ZBA). The ZBA is part of the SFTEAM (Success Factors Teamsport) test battery by Schuhfried (2018). The test quantifies the participants' anticipation of time and movement.

In the ZBA, participants were presented with a green ball that moves in any direction. At an unpredictable moment, the ball disappeared from the screen and two different red lines appeared. The first red line was drawn where the ball was before it disappeared, the second line was where the ball will pass later on. The test subjects' task was to anticipate when the green ball will pass the second red line (without being able to see it again after it has disappeared). After the test subjects have decided by pressing a button when they think the ball will pass the second red line (time anticipation), they had to use two other buttons to determine (with the help of an arrow) where on the line they think the ball passed it (movement anticipation). To give the participants a better understanding of the test, they were given eight practice trials in which they received feedback after each trial as to where the ball actually was after they have estimated it. An example of a trial task of the ZBA is shown in Figure 1.

Figure 1:
Depiction of a ZBA trial



Note. This figure demonstrates a ZBA trial, screenshot retrieved from a YouTube video (SCHUHFRIED VTS, 2012).

The ZBA provided two different values for participants' anticipatory performance: time and movement anticipation. Time anticipation performance is measured by the time a deviation score which reflects the median of the deviations (= registered amounts of time deviation) for each item between the anticipated time at which the ball crosses the second line and the true time at which it actually does so. This deviation is calculated in seconds, with higher values representing a worse time anticipatory performance. The movement anticipation deviation score is defined as the median of the deviations for each item between the anticipated point at which the green ball crosses the second line and the true point at which it actually does so. This deviation, on the other hand, is measured in pixels (image points), with higher values representing a worse movement anticipatory performance.

In general, the green ball had three different kinds on how it moves across the screen: linear pattern, sinusoidal pattern and complex pattern. For each pattern, raw variables were provided - however, only the total value for time and movement anticipation across all three patterns was used for the analysis in this study.

As time and movement anticipation of the test participants was measured separately and a raw value is obtained for each, both values of the pre-test were compared with the raw

scores from the posttest to identify differences between the two test measurement points. The ZBA lasted around 25 minutes, with the participants carrying it out twice.

Manipulation

As this study was structured as a pre-post-test, the second ZBA measurement (posttest) was conducted with participants being assigned to four different conditions, three of which had a manipulation that is explained below.

Control group

Participants in the control group were not faced with an altered setting in the posttest, however, a BFSI-personality questionnaire (Big Five Structure Inventory, included in the SFTEAM test battery) was given to participants between the first and the second ZBA measurement. It provided participants of the control group a cognitive break; participants' results of the BFSI were not included in the later data analysis. In the personality questionnaire, participants were asked to self-assess themselves. To do so, they were confronted with statements regarding character traits (e.g. "bei Problemen weitermachen" – "keep going if problems occur"), whereby they had to assess themselves to what extent this character trait applies to them (on a Likert scale from 1 to 4; 1 = *untypisch für mich* (*untypical for me*) to 4 = *typisch für mich* (*typical for me*); larger numbers stand for greater agreement of the displayed trait with participants' self-perceived personality. After the personality test, the ZBA was presented a second time.

Self-focus manipulation

Self-focus was induced using the procedure adapted from Carver and Scheier (1978). They used a mirror to get their participants to a more self-focused attention. Since anticipatory performance is measured with a computerized test (ZBA) in this study, we induced self-focus by placing a mirror (22cm x 39xm) under the participants' monitor so that they could observe their hand movements through the mirror in their second anticipatory measurement phase (posttest).

Distraction manipulation

As Englert et al. (2015a) successfully manipulated their participants by distracting them with audio messages containing worrying thoughts, this study used a similar approach to distract participants. Since the sample of this study did not only include athletes but was based on convenience sampling, Englert et al.'s manipulation was adjusted. Their statements are tailored to basketball athletes; therefore, these statements were redefined to a more general frame of reference before use. By doing so, the audio messages then contained statements which are relevant not only for (basketball) athletes but also for non-athletes. Statements implied struggling with their anticipatory performance and not their free-throws (like in Englert et al.'s paper). Participants were instructed to ignore these worrying thoughts and focus solely on the anticipation tasks.

For example, we redefined of Englert et al.' manipulation statement "Wie ist das möglich, dass ich so viele Würfe nicht getroffen habe?" (How is it possible, that I missed that many free throws?) to "Wie is es möglich, dass ich mich so oft verschätze?" ("How is it possible, that I misjudge that often?"). All 17 statements which were used by Englert et al. were redefined and used in this studies distraction manipulation. All redefinitions can be found in appendix B. Since the time it takes to display the worrying thoughts does not last around 25 minutes (as the ZBA does), a 10-second interlude was inserted between each statement in which noise (low frequency, deep bass sounds; Exoplanet, 2022) can be heard. The process of compiling the distracting thoughts and the noise was carried out using version 3.4 of Audacity (Audacity®, 2023).

Combi-group manipulation

In the 4th group of this study (self-focus + distraction manipulation) both manipulations took place. Thus, participants in the combination group were stimulated to self-focus by the mirror (22cm x 39xm) placed under their computer screen and were distracted by our redefinition of the distraction statements of Englert et al. (2015a) as well as by interposed noise (Exoplanet, 2022).

Power analysis

As no previous study had investigated the relationship between distraction and self-focus and anticipatory performance, there was no statistical comparative values. Therefore, a statistical approach was conventional. The subsequent power analysis was carried out using G*Power (Faul et al., 2009). The power analysis (f = 0.25; α = .05, 1 – ß = .95) revealed a required sample size of N = 76. To take potential dropouts into account, the sample sized aimed at was N = 80.

Analysis strategy

Since this study consisted of four different conditions and two measurement points of the same sample in which anticipatory performance is measured, the statistical approach for the master's thesis framework was a repeated measures ANOVA. The main advantage of it is that participants serve as their own controls, which increases the statistical power of the test. A repeated measures group design can meet or exceed the level of statistical power of a between-subjects design, but with far fewer participants (Ellis, 1999).

In this theoretical framework, group membership functioned as the independent variable and anticipatory performance (in both times: pre- and posttest) of the participants as the dependent variable. We conducted two repeated measures ANOVAs, on time and movement anticipation separately. To find out if participants' performance changed from pretest to posttest among the study groups, separate 4 (Group) × 2 (Phase) repeated measures ANOVAs were conducted on the time anticipation score and movement anticipation score. To test the study's hypotheses, we conducted two contrast-coded analyses through the specification of L (the test matrix) and M matrix (the transformation matrix). For hypothesis 1, we conducted a contrast-coded analysis (LMATRIX -2, 0, +1, +1 for the control, self-focus, distraction and combi-group, respectively) to test if the distraction intervention groups would have a significantly better anticipatory performance than the control group. For our second hypothesis, we conducted a contrast coded analysis (LMATRIX 0, −2, +1, 1 for the control, self-focus, distraction and combi-group, respectively) to test if the distraction intervention groups would have a significantly better anticipatory performance than the self-focus group. The M matrix was specified as MMATRIX 1, -1 for the respective pretest and posttest for time anticipatory scores and -1, +1 for movement anticipatory scores. All analyses were performed with SPSS 21.0 (IBM Corp.; Armonk, NY, United States). For the contrast coded tests, we

used the Bonferroni-adjusted *p-value* of .0125. The significance level for all other analyses was set at $p < .05$ (two tailed).

As the study by Gröpel and Altermann (2024) has a similar study design, the writing structure of this section was inspired by their paper.

Results

Description of the sample

A total of 80 participants took part in the study. No subject was excluded for data analysis. 70% of the study participants were women, 30% of the participants were men. The sample did not include participants who identified themselves as diverse or other (0%). The mean age of participants was 21.23, whereas the deviation (*SD*) was 4.4. The youngest participants were aged 18, the oldest was 55. The average age of male participants was 22.7 years with a *SD* of 7.23 years. The average age of female participants was 20.61 years with a *SD* of 2.15 years.

The most frequently mentioned educational qualification was Matura (high-school diploma) or a comparable qualification: 63 people (78.8%) stated this level of education. A bachelor's degree was the second most frequently mentioned qualification with 10 responses (12.5%). 6 participants (7.5%) completed compulsory schooling and 1.3% had an apprenticeship qualification. Consequently, 91.3% of the respondents had a high-school diploma (Matura or a comparable qualification) or a higher qualification.

A vast majority of participants were students (85%), the most often named degree programs were sport science (25% of all participants), different teaching degree programs (20%) and TFM (theater, film and media studies; 10%).

16 participants (20%) had experience in psychological tests prior the study, whereas the other 80% did not have experience taking part in a psychological study and/or had no psychological diagnostic background.

Time anticipation

Table 1 shows anticipation performance of the four study groups for both measurement points, Figures 2 and 3 provide a graphical overview of the change in anticipation performance from pretest to posttest.

Time anticipation worsened from pretest (M = 1.21, SD = 0.70) to posttest (M = 1.36, SD = 0.44) for the overall sample, as indicated by a significant Phase effect (F(1,76) = 7.05, p = .01, η_p^2 = .09), indicating a medium effect (f = .3; Cohen, 1988). There was no effect of Group (F(3,76) = 1.69, p = .18, η_p^2 = .06) and no significant interaction (F(3,76) = 1.04, p = .38, η_p^2 = .04), indicating that the groups worsened their time anticipation performance to a similar degree. We further conducted contrast analyses to test our hypotheses. The first hypothesis stated a significant difference in anticipatory performance between distraction groups (distracted and combi-group) and the control-group; however, the results revealed no significant results (F(1,76) = 2.36, p = .13, η_p^2= .03) for time anticipation. The second hypothesis stated that distracted participants will have a worse anticipatory performance than self-focus participants. Again, results were not significant (F(1,76) = 1.07, p = .31, η_p^2= .01), indicating that time anticipation performance did not differ significantly between self-focus and distracted participants.

Movement anticipation

There was no change in participants' movement anticipation between pretest and posttest (across all groups), as indicated by a non-significant Phase effect (F(1,76) = 1.70, p = .20, η_p^2= .022). The proportion of variance refers to a small effect (f = .15). There was no effect of Group (F(3,76) = 0.74, p = .53, η_p^2 = .03) and no significant interaction (F(3,76) = 1.31, p = .28, η_p^2 = .05). The first hypothesis found no significant difference in movement anticipatory performance between distraction groups (distracted and combi-group) and the control-group (F(1,76) = 1.03, p = .31, η_p^2= .01). Results for the second hypothesis were also not significant (F(1,76) = 0.03, p = .87, η_p^2 < .01), indicating that movement anticipation performance did not differ significantly between self-focus and distracted participants.

Figure 2:
Change in time anticipation performance between measurement points

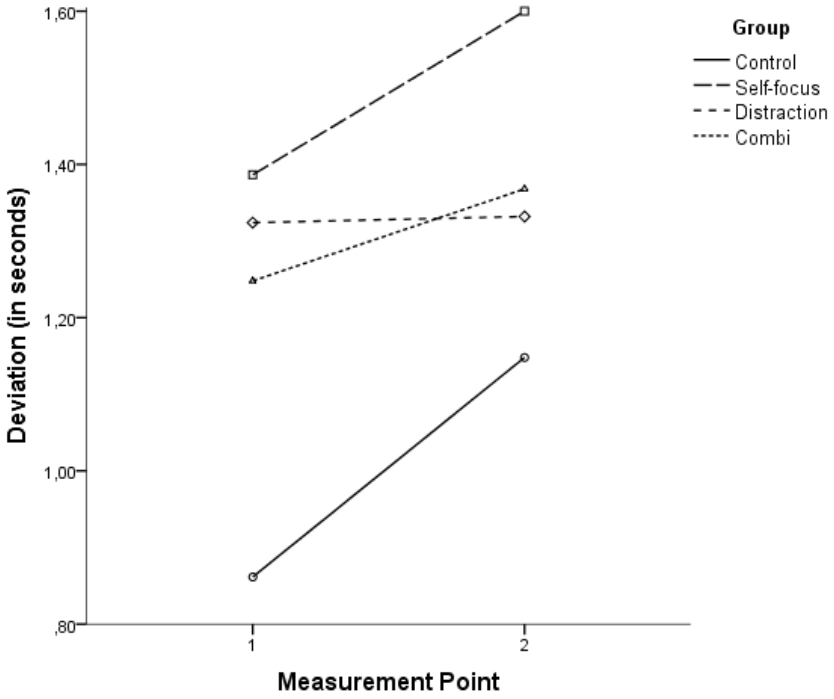


Figure 3:
Change in movement anticipation performance between measurement points

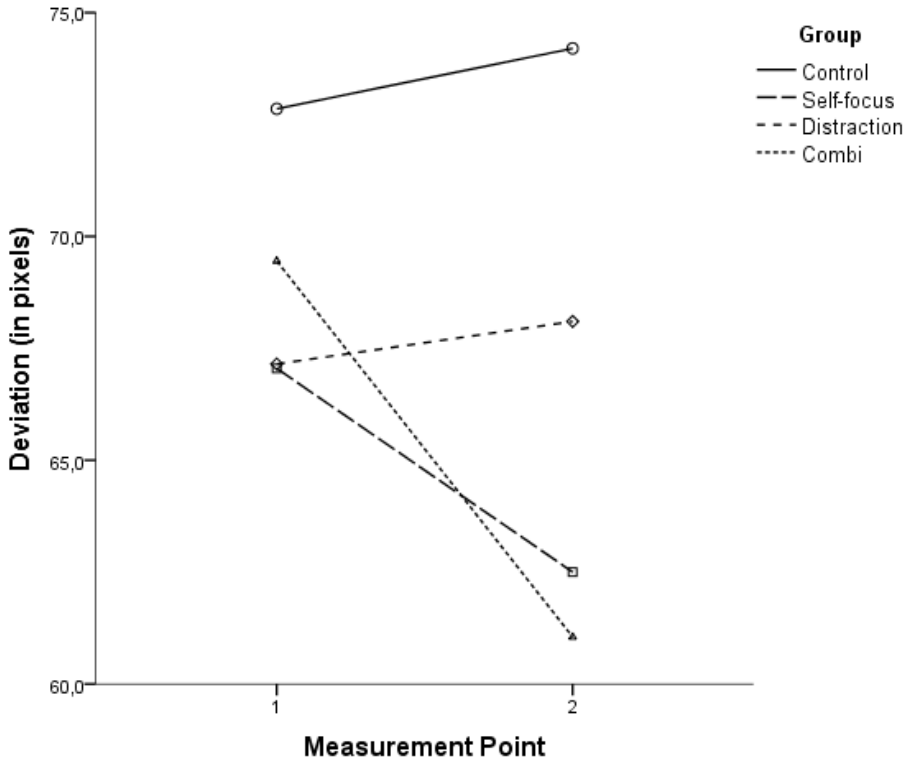


Table 1

Time and movement anticipation scores of the four study groups in the pretest and the posttest

	Time anticipation		Movement anticipation	
Group	Pretest (*SD*)	Posttest (*SD*)	Pretest (*SD*)	Posttest (*SD*)
Control	0.86 (0.44)	1.15 (0.61)	72.85 (23.55)	74.20 (22.03)
Self-focus	1.39 (0.75)	1.60 (0.92)	67.05 (24.69)	62.50 (23.99)
Distraction	1.32 (0.81)	1.33 (0.76)	67.15 (22.13)	68.10 (21.04)
Combi	1.25 (0.66)	1.37 (0.92)	69.13 (23.14)	66.46 (22.40)

Note. This table shows the respective group mean values of the pre-test and post-test of the ZBA. For time anticipation, the values represent the median of the deviations for each item between the anticipated time at which the ball crosses the second line and the actual time at which it does so (in seconds); higher values indicate worse time anticipation. For movement anticipation, the values represent the deviations for each item between the anticipated point at which the green ball crosses the second line and the actual point at which it does so (in pixels); higher values indicate worse movement anticipatory performance.

Discussion

The aim of this study was to illuminate the research gap of externally-paced skills and choking under pressure and to take a first step into this research gap by using anticipatory performance. According to Roberts et al.'s model (2017), anticipatory performance is one of the most important mechanisms underlying externally-paced skills. Roberts et al. proposed that people's anticipatory performance will deteriorate when they are distracted. However, we did not find support for this proposition; distracted participants were not worse in their anticipatory performance then self-focused or control participants.

The results of this study can be seen as a first insight into the topic of choking in externally-paced skills and are therefore not applicable across the board (for more on this, see in limitations).

Hypothesis 1 was rejected, as we found no significant difference in anticipatory performance between our two measurement points regarding control group participants and participants which were distracted (distraction group and combi-group). Differences in time and movement anticipation performance between these groups were not significant.

Our second hypothesis, which stated that distracted participants (distraction group and combi-group) have a worse anticipatory performance than self-focus participants, was also rejected, as we found no significant difference in anticipatory performance between these groups in time anticipation movement anticipation. This contrasts with Roberts et al. (2017), where they state that a distraction manipulation should have a weakening effect on anticipatory performance. The relationship between self-focus and distraction in externally-paced skills remains to be explored, despite the fact that our hypotheses in this study were rejected (more on this in Limitations).

Given the finding that distracted participants did not show poorer anticipatory performance, either the model of choking under pressure in externally paced skills proposed by Roberts et al. (2017) must be rejected or readjusted with respect to the operating mechanism of anticipation in externally-paced skills. Roberts et al.'s model of choking in externally-paced skills assumes that athletes who experience pressure suffer from impaired information processing and thus, in the case of externally-paced skills, athlete's anticipation is disturbed, which in turn leads to a novice-like performance, as the athlete can only react to later cues (choking). Either their model does not accurately reflect reality or the distraction manipulation in this study was not optimally chosen (see also under Limitations) and therefore this study's results cannot be implemented further.

An expected learning effect, which usually occurs in cognitive testing (e.g. Collie et al., 2003) was not found. The results only show better (movement) anticipatory performance in the posttest in the groups that were manipulated to self-focussed attention (self-focus group and combination group). We assumed that a learning effect will only occur in the control group, which, however, had poorer (time and movement) anticipatory performance in their posttest then in their pretest. Some participants in the control group stated that they were bored and

were less focused in the post-test, as they did not understand why they had to perform the anticipation test twice. Therefore, despite a reminder from the study supervisor that concentration should be maintained at both measurement points, several control participants were not able to do so. Some of them also mentioned that it was obvious that they were part of the control group, as the BFSI-personality test (which was intended to serve as a cognitive "break" that all other groups received in the form of a 5-minute break) was perceived as irrelevant for the study. These remarks may indicate why an expected learning effect could not be observed in this study.

As this study was the first investigating choking mechanisms and anticipatory performance, results cannot be related to previous literature and/or be incorporated in existing research. Nevertheless, this study has shed light on the beforementioned research gap for the first time, allowing future studies to take up these findings in order to investigate the relationship between anticipation in externally-paced skills in choking further. We will continue to outline limitations of this study, as we already mentioned some of them in passing.

Limitations regarding this study

Since this was the first study investigating a potential relationship between anticipatory performance (externally-paced skills) and proven interference factors which lead to choking under pressure (self-focus and distraction), there were no statistical reference values for an effect size. Therefore, a conventional effect size (f = 0.25) was used for the power analysis. Moreover, as there were no studies on choking and externally-skills yet, this study began investigating anticipation, which has been postulated to be a key mechanism of externally-paced skills (Roberts et al., 2017). Roberts et al. defined anticipation as an essential part of successful performance of an athlete in externally-paced skills, and as there is no further literature regarding the studies' topic, it cannot be said with certainty that anticipation is really an indispensable aspect of an externally-paced skill.

A further limitation arises from the fact that the sample consists almost exclusively of students at the University of Vienna and acquaintances of the author. More women (70%) than men (30%) took part in the study, the educational level of the sample is well above that of the general population (91.3% have a high-school-leaving certificate or a higher degree), the average age of 21.23 years (SD = 4.4 years) is below that of the general population and all the study participants live in Austria or Germany (one participant). However, as the study focuses

on choking, with potential findings that can be implemented as interventions for athletes (who represent an exclusive group of individuals), generalizability of the results is not primarily required. However, the generalizability of the results of this study to an "athlete sample" is also questionable and therefore represents a limitation of the study with regard to future interventions for choking in externally-paced skills.

In general, it can be said that the generalizability of such a uniform sample is considerably limited, which is why, strictly speaking, conclusions can only be drawn about the population represented in the sample (mostly students in Vienna).

Moving on to limitations regarding the study's groups: Control group participants complained that they lost their focus in the post-test, as nothing changed in comparison to the first measurement point and did not understand why they had to do the same task twice. Taking these statements into account, this could have been the reason why the participants in the control group showed the greatest decline in their time and movement anticipation performance compared to the pretest (time anticipation score increased from 0.86 seconds to 1.15 seconds, movement anticipation score from 72.85 pixels to 74.2 pixels). On the other hand, control group participants had the best performance in their time anticipation-pretest over all four groups (0.86, 1.39, 1.32, 1.25 seconds for the control, self-focus, distraction and combi-group, respectively) and thus had more "room" for poorer performance on the posttest.

Numerous participants mentioned that they did not feel stressed and/or no noticeable pressure on themselves in the distraction groups (distraction and combi group). Others mentioned that they were only motivated by the distraction as they assumed that the noise and thoughts which were displayed had the intention to distract them and therefore, they tried harder to focus on the task for better results. However, this should not actually be a limitation, as participants, although they try (more), should still be distracted if the hypotheses represent reality. Either the manipulation of the distracted groups was chosen incorrectly (see below for more), or distracted people are generally not limited in their anticipatory performance, as supported by the results. To summarize: most participants either stated that they did not feel distracted by the manipulation or were, but deliberately tried harder in the posttest as they knew that the manipulation should lead them to poorer results. Future studies investigating the topic of anticipatory performance and choking should therefore either use another distracting manipulation (e.g. an audience; Baumeister et al., 1985) or compliment this study's distraction manipulation. A few participants asked the study supervisor if he would watch them during the

posttest, to which he responded in the negative; based on this experience, we suggest that if the capacity exists, an audience will be one (of many) complementary adaptation(s) for future studies to apply real pressure on participants in similar scenarios.

Another limiting aspect regarding the distraction manipulation is that it was used in a study where participants had to perform basketball free-throws (a self-paced skill) and participants listened to these worrying thought prior (and while) throwing (Englert et al., 2015a). In our study, the manipulation lasts the whole ZBA-posttest (approximately 20-25min); Englert et al.'s thoughts therefore repeated itself – Englert et al.'s manipulation was not tailored to a longer lasting study design and therefore maybe is not fitting for this study's design. For future research, if a "worrying thoughts" distraction manipulation is used in a longer lasting study design, a different approach should be used. Moreover, some participants also stated that they used the rhythm of the distracting tones (low frequencies, low bass) between Englert et al.'s statements to better estimate the speed of the green ball. This also should be considered for future studies.

Building on the previous discussion of our distraction manipulation: this study did not perform a manipulation check, so it is not possible to say with certainty whether the self-focus manipulation led to more self-focused attention of participants or whether the distraction manipulation really did significantly distract participants - mentioned feedback from participants does not indicate this. However, without a manipulation check, it cannot be confirmed that participants were (un-)successfully manipulated. Future studies should take this into account and integrate a manipulation check in their study.

Implications for future research

Generally speaking, future research tackling the issue of choking under pressure in externally-paced skills and/or anticipatory performance should take few considerations into account: exert genuine pressure on the participants in the posttest (1) and therefore use the right manipulations (2; discussed in more detail above). To do so, convince participants in the control group into believing that they belong to an intervention group and/or get them to exert the same effort at both measurement points in a pre-post study design in order to be able to compare results with each other unbiasedly (3) and, in order to integrate findings into a broader sport psychology context, a sample consisting of athletes should be used (4). Finally, future research should include actual externally-paced skills in its study design (5), as we used anticipatory

performance in this study because this study was intended as an initial jumpstart into the research gap and we first aimed to investigate the relationship of anticipatory performance in choking as anticipatory performance is an essential component of successful externally-paced skill performance (Roberts et al., 2017).

Conclusion

This study's aim was to shed light on the research gap of choking under pressure and externally-paced skills (anticipatory performance). We found no significant difference in anticipatory performance (time and movement anticipation, measured by ZBA; Schuhfried, 2018) of distracted participants compared to control group participants (hypothesis 1) and participants in the self-focus intervention group (hypothesis 2) and therefore had to reject both hypotheses. This study had limitations, among others, its sample characteristics (e.g. a vast majority being students and female) and therefore the results cannot be generalized. A further limitation is a not perfectly chosen distraction manipulation (participants stated they were not distracted and/or under pressure). Future studies should therefore consider different, more fitting distraction manipulations (e.g. an audience watching), use a more diverse/fitting sample (consisting of athletes), try a different operationalisation of anticipatory performance or even operationalise externally-skill performance as a whole.

Although this study did not produce significant results, further research into this research gap is encouraged so that in the future a more comprehensive picture can be drawn of the relationship between choking under pressure not only in self-paced skills but also in externally-paced skills, allowing sport psychology interventions to be developed in that area.

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Appendix A - List of Figures

Appendix B - Played thoughts in distraction manipulation

1. Das wird nicht gut gehen.
2. Keiner mag mich.
3. Ich will so schnell wie möglich nach Hause.
4. Ich sollte nicht daneben schätzen.
5. Ich bemerke, dass ich einen Tunnelblick habe.
6. Bei dieser Aufgabe verschätze ich mich.
7. Diese Aufgabe muss ich richtig antizipieren.
8. Was mache ich hier eigentlich?
9. Das läuft nicht gut, ich muss es jetzt wirklich besser machen.
10. Ich denke an das letzte Mal, als ich unter Druck stand.
11. Wie ist es möglich, dass ich mich so oft verschätze?
12. Ich bemerke, dass ich Zweifel an meinen Entscheidungen habe.
13. Traue ich mich wirklich, das zu tun?
14. Ich muss besser antizipieren.
15. Ich denke an die Konsequenzen meiner Handlung.
16. Ich denke an die letzten Fehlschätzungen, als ich ein gutes Gefühl hatte.
17. Ich bemerke, dass ich mich zu früh auf die nächste Aufgabe konzentriere.

Appendix C – Use of AI

In the spirit of transparent research, I would like to report on the steps in the creation of this master's thesis in which artificial intelligence was used.

During the writing process, DeepL was used to translate some of my texts, originally written in German, into English. These translations were not directly adopted but served as a basic framework for the final version. However, it is possible that individual parts of the sentences came directly from the DeepLWrite program.