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REVIEW ARTICLE

# From Choke to Clutch: Using Neuroscience and Psychology to Understand Performance Breakdown in Athletes

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ABSTRACT: This article reviews the literature on performance breakdowns, commonly referred to as "choking", in high-stakes athletic situations. By integrating findings from sport psychology and neuroscience, it offers a more comprehensive understanding of choking. Sport psychology relies on experimental designs and psychological assessments, whereas neuroscientific studies explore brain activity patterns. The review finds that explicit attention to skill execution (self-focus) and distraction (performance worries) are seen as the major causes for choking, with emotional dysregulation (over-arousal) as an additional element. By combining insights from sport psychology and cognitive neuroscience, it explores which psychological levers can be adjusted to reduce choking behavior, highlighting both in-the-moment interventions and long-term strategies for sustaining peak performance. By identifying both short-term and long-term solutions tailored to different groups, this article contributes to the development of more effective mental training strategies for beginner athletes and high-pressure performers alike.

KEYWORDS: Neuroscience, Cognitive Neuroscience, Sports Psychology, High-Pressure, Perfectionism, Performance Anxiety, Choking.

## Introduction

One swing, one shot, one second, make or break. Rory McIlroy, after sinking 496 consecutive short putts in the 2024 season, missed two crucial ones at the 2024 U.S. Open, unraveling under the weight of pressure.[1] Whether it is a missed free throw in the final seconds of a championship game or a subpar routine in the Olympic finals, elite athletes are not immune to sudden and dramatic performance failures under intense pressure. These stressful moments expose a critical paradox at the heart of competitive sports, as even the most prepared and skilled athletes can unravel, or choke, when it matters most.

Choking, defined as a rapid and significant decline in performance despite high ability and preparation, has been widely documented across sports and acute stress situations.[2] This article will review the academic literature on why and how this happens and identify various interventions to overcome performance breakdowns. Early foundational work by Beilock and Carr supported the theory that pressure-filled situations can interfere with the automaticity of refined motor skills, specifically when athletes attempt to consciously control movements that typically run on autopilot or become overly self-conscious of their abilities.[3] Beilock further emphasizes that pressure causes performers to shift from procedural to declarative thinking, making even routine actions vulnerable to failure.[2]

Sport-related anxiety plays a critical role in this process. Martens, Vealey, and Burton introduced a multidimensional model of competitive anxiety and found that cognitive state anxiety (worrying thoughts) is negatively related to performance.[4] They also found that an increase in somatic state anxiety (physical arousal/activation) can facilitate performance up to an optimal level, but after that point, additional arousal/anxiety causes performance to decline. Ford *et al.* expanded this work by showing that elevated anxiety can impair attention and working memory, increasing the likelihood of performance errors.[5] Among the psychological traits that heighten vulnerability, perfectionism stands out. Athletes with perfectionistic tendencies often link their performance on a given day to their self-worth. The fear of letting themselves and those around them down, linked to perfectionistic ideals, often leads to overthinking, mental overload, and ultimately choking in high-pressure moments, such as championships or important matches.[6]

Research in the neuroscience field has supported findings that demonstrate how pressure alters brain activity in regions that are responsible for emotional regulation, motor control, and even cognitive processing.[7] In the contexts of sports such as golf, these mental setbacks often lead to motor breakdowns, known as the "yips", where anxiety from the moment impairs movement execution.[8,9]

Understanding why athletes choke under pressure is essential for improving performance, preventing psychological distress, and developing effective long-term training strategies. While research has shown that anxiety disrupts attention and working memory, and that the explicit attention to skill execution (skill focus) increases vulnerability to stress, few studies have examined how these factors interact to influence performance breakdowns.[4-6] Neuroscientific findings support the idea of pressure altering brain activity in areas linked to motor control and emotional regulation in specific brain regions, yet these insights are rarely integrated with sport psychology models.[7,9,10] This gap limits the development of targeted interventions.

This article combines perspectives from sport psychology and neuroscience on choking and discusses the efficacy of both short-term and long-term remedial interventions. The analysis



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unfolds in three parts. First, a review of literature synthesizes psychological and neuroscientific research on self-focus, distraction, and emotional dysregulation as the major causes of choking. Additionally, it analyzes how perfectionism and anxiety interact to increase the risk of choking by compounding stress that impairs performance. Second, the article introduces a temporal perspective on stress, drawing on temporal construal theory and stress physiology to examine how pressure builds or shifts over time, influencing athletes' cognitive and emotional responses. Finally, the article reviews evidence-based interventions, including short-term techniques like attentional control and cognitive reappraisal, which involve reframing moments into a neutral or positive light, as well as long-term approaches such as acceptance and commitment therapy and cognitive behavioral therapy to manage perfectionism and stress.

## Discussion

***Cognitive and Emotional Challenges as Major Causes of Choking:***

High-stakes performance environments place significant cognitive and emotional demands on athletes, and research shows that sport-related anxiety can contribute to performance breakdowns and undermine athletic performance.[3-5] This section identifies self-focus (centered on skill execution) and distraction (centered on performance worries) as the major theories for choking under pressure, and emotional dysregulation as an added factor. The goal is to synthesize key findings from sport psychology and neuroscience to show how these mechanisms contribute to choking, and to highlight the need for integrated models that bridge psychological theories with brain-based evidence.

In the self-focused attention theory of choking, pressure-related anxiety causes a shift in attention to internal matters that leads to a deterioration in performance. In athletes, explicit conscious attention to their fine motor skills or to the sequential steps of how the skill should be executed may interfere with normal task execution, which in turn affects their performance. This comes as the athlete's brain, especially the prefrontal cortex, which is in charge of decision making and focusing attention, is presented with more information or mental demands than it can effectively process at one time. This causes the working memory to be overwhelmed by internal and external demands or pressure, and to experience a cognitive overload. This leads to slower thinking, errors, and difficulty focusing or making decisions.[2,11]

| Self-focus | Distraction | Emotional dysregulation |
|---|---|---|
| performance pressure | performance pressure | performance pressure |
| ↓ | ↓ | ↓ |
| self-consciousness | anxiety, shortage of attention, focus on irrelevant information | awareness of importance of correct execution |
| ↓ | ↓ | ↓ |
| attention to control of previously learned skill execution | reduced working memory for task control or reduced task focus | overarousal by high incentives or social pressure |
| \| | \| | \| |
| enhanced prefrontal cortex activity | enhanced prefrontal cortex activity | overactive amygdala and increased midbrain activity |
| ↓ | ↓ | ↓ |
| cognitive overload | lack of executive control | excessive psychological pressure or stress |
| ↓ | ↓ | ↓ |
| disruption of automatic motor processes | imperfect execution of task control | impaired execution of complex or not well-practiced tasks |
| ↓ | ↓ | ↓ |
| choking | choking | choking |

Source: Author's visualization.

Note: Figure provides a visual comparison of the three main theories of choking in sport psychology and the various mechanisms involved, with the neurological correlates in red and sport psychological correlates in black.

**Figure 1:** Psychological factors and neural mechanisms in three theories of choking.

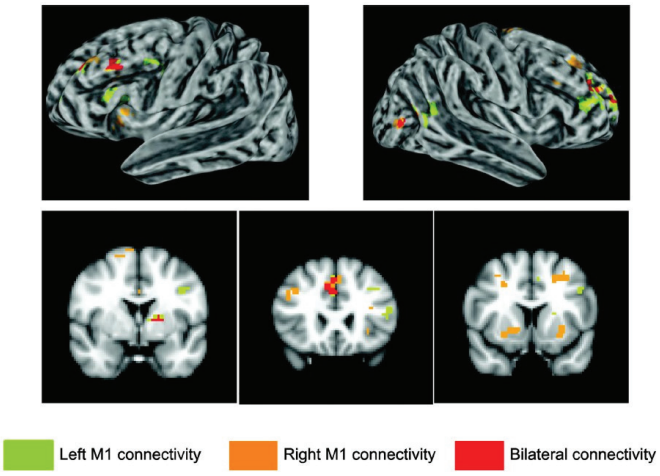
In distraction theories, on the other hand, pressure-related anxiety causes a shift in attention to thoughts and worries about performance.[12] These thoughts and worries draw attention away from primary task execution, causing the athlete's brain, especially the prefrontal cortex, to focus more on irrelevant stimuli or internal thoughts instead of their game. Disrupted attention reduces situational awareness and inhibits adaptive decision-making, both critical in competitive environments, thereby resulting in reduced performance.[5]

Anxiety and perfectionism increase emotional reactivity, which in turn disrupts physiological and cognitive functioning. Emotional dysregulation, projected through heightened arousal or rumination, can further hijack attentional resources and amplify performance anxiety.[9,13] The theory of emotional dysregulation (also called overarousal) posits that degraded performance is caused by excessive arousal induced by high incentives or social pressure. This manifests itself in increased activity of the athlete's ventral midbrain, which is associated with reward response.[14] Also, the amygdala, the small region of the brain located in the medial temporal lobe, is known to play a crucial role in processing emotions and has extensive connections to the midbrain and to the prefrontal cortex.[15]

Cognitive overload in the self-focus theory, attentional disruption in the distraction theory, and emotional dysregulation are interconnected (see Figure 1). Anxiety can overload working memory and disrupt attention, while perfectionistic tendencies intensify emotional responses. These mechanisms compound under pressure, creating a cycle of deteriorating performance and psychological strain when faced with challenges.[2,5]

In a review of the literature, Oudejans *et al.* and Roberts, Jackson, and Grundy found that in sport psychology studies, the self-focus theory of choking under pressure is more often favored over the distraction theory.[16,17] They attribute this to the focus on the brief moments of motor execution, the failure to take into consideration diverse preparatory cognitive activities, and the experimental design of many empirical studies. When this is taken into account, the evidence suggests that distraction alone or distraction in combination with self-fo-

cus may derail an expert motor skill under pressure. Moreover, sport psychology studies find that athletes with high levels of perfectionism are especially prone to emotional dysregulation, given their tendency to tie self-worth to achievement.[18,19]




Note: Figure shows that choking under pressure leads to increased functional connectivity between the motor cortex and regions important for cognitive control, action monitoring, and reward, pointing to over-activity in line with the self-focus theory. Reprinted from NeuroImage, Vol. 105, with permission from Elsevier, (c) 2015 Lee and Grafton.

**Figure 2:** Brain regions displaying increased functional connectivity with the motor cortex during choking.

Neuroimaging studies appear to confirm the validity of all three choking theories, although the results may be influenced by the test design. In studies with large financial rewards, enhanced prefrontal cortex activity –activity in the frontal region of the brain where complex cognitive processes take place– correlates with decreased motor performance (Figure 2). This pattern of functional connectivity results has been interpreted as weaker top-down control and hence a greater propensity to choke, in line with the distraction theory.[7,10] In addition, increased functional connectivity between different parts of the brain and the motor cortex was found to protect against choking in a high-reward state, whereas choking occurred in individuals with unchanged connectivity in the brain, thus validating the arousal theory. However, these studies do not entirely dismiss the self-focus theory since they note that participants may have implemented new, but ultimately ineffective, strategies, as opposed to failing to exert control. The latter observation is corroborated by Ogasawara *et al.*, who induced choking in a complex bimanual visuomotor task (not an actual sport) through a jackpot condition, an extremely high reward with a rare chance.[20] They found that choking can be attributed to overactivation in brain regions related to perception and motor control required for the task execution, and attention of the participants shifted towards self-action, in line with the self-focus theory. Similarly, Masaki *et al.* also rejected the distraction in favor of the self-focus theory in a comparison of low versus high sports anxiety athletes through a study of brain waves, although admittedly utilizing a rather simple task to elicit choking responses.[21] Other studies support the arousal theory, as they link stress-induced performance breakdowns to amygdala overactivation and reduced prefrontal modulation.[8,14]

Despite growing evidence from sport psychology and neuroscience, few studies integrate these findings into unified models, limiting their application to real-world performance interventions.[8,9] A deeper understanding of how cognitive and emotional processes interact under pressure will be essential for developing effective mental training strategies. The following section builds on this foundation by exploring the temporal dynamics of stress and how athletes' responses may evolve across performance phases.

***The Temporal Dynamics of Pressure and Stress Responses for Athletes:***

This section explores how pressure is experienced and evolves over time in competitive sport contexts, tapping into temporal construal theory, sport stress physiology, and performance phase research. It explores how stress responses differ before, during, and after high-stakes performances, and how these shifting psychological and physiological states can increase vulnerability to choking. Understanding these temporal patterns is essential for developing phase-specific interventions and resilience training for athletes.

Although current research has studied the immediate cognitive and emotional challenges athletes face under pressure, there is less focus on stress over a long period of time, such as the buildup to high-stakes competitions. Stress is not only a short-term feeling, but also builds upon itself and shifts over time, often in predictable phases.[22] Drawing on temporal construal theory, which explains how people think differently about near and distant future events, and the physiological stress response framework, this section explores how pressure accumulates and alters athletes' psychological states and performance capabilities.[9] It also considers how perfectionism and anxiety intensify across these timeframes, creating different points of vulnerability for choking to occur.

The first stage of stress, the anticipatory phase, occurs well before high-stakes moments. This phase is marked by rising physiological arousal, cognitive rumination, and distorted perceptions of future performance. These symptoms often are expressed through the body's physical response to stress (heart rate, adrenaline, etc.), unproductive and often negative overthinking, and unrealistic beliefs about future performance.[7] The temporal construal theory offers a framework for understanding stress buildup, explaining that distant events are often thought about abstractly, and not stressed about. However, as the moment draws closer, negative emotions become concrete, and stress levels rise, as illustrated in Figure 3. As athletes approach competitions, abstract goals such as winning a tournament shift to fears such as missing a shot, increasing their anxiety levels.[23]

Research has supported that anxiety from this phase already begins to interfere with the cognitive functioning of athletes. According to Ford *et al.*, anticipatory worry taxes working memory and attentional resources, leaving athletes less mentally prepared before performance even begins.[5] Similarly, Martens *et al.* conclude that both somatic/physical and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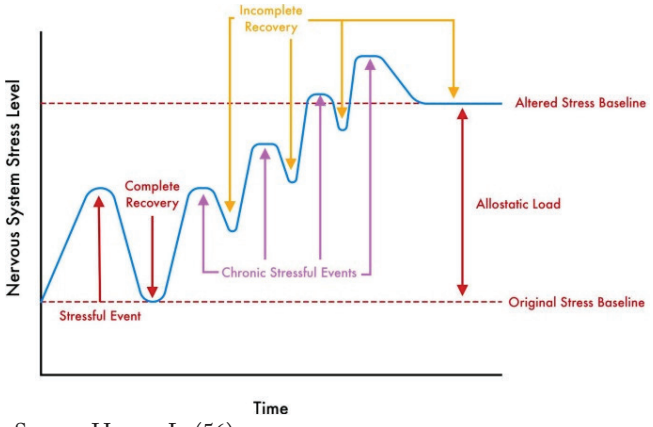
cognitive/mental components of anxiety peak as athletes approach competition, elevating stress levels that do not match performance needs.[4] For athletes with perfectionistic traits, the anticipatory phase becomes especially hazardous. Perfectionists often engage in pre-performance doubts, replaying imagined errors or rehearsing worst-case scenarios, which intensifies emotional stress and primes them for cognitive overload.[6]



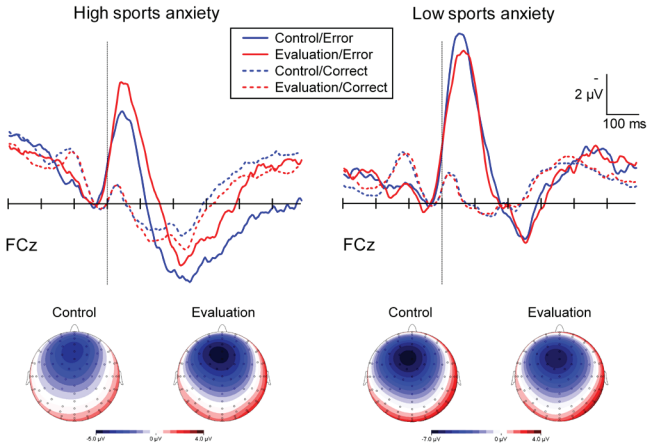

Source: Houge, L. (56)

Note: The figure shows that chronic stress can build up in the nervous system, leading to mental and physical health challenges.

**Figure 3:** The Buildup of chronic stress.

The moment of performance brings a sharp escalation in both cognitive and physiological demands. Under the already building pressure, athletes are expected to execute skills with precision, often in split-second conditions, such as in golf or football. However, performance anxiety disrupts attentional control, narrows focus to task-irrelevant thoughts, and triggers cognitive overload, especially when athletes begin consciously monitoring automatic actions.[2,3] This may lead to a struggle in the brain to process excess information or excess stress as its working memory is overwhelmed by a barrage of stimuli, leading to impaired decision-making and slower reaction times. This phenomenon can be explained by the reinvestment theory, which is an extension of the self-focus theory. This theory posits that athletes under pressure begin to think about their skill execution and use their knowledge for skill control learned at an earlier stage.[24,25] This "reinvestment" with unnecessary, conscious self-instruction consumes limited working memory resources, leading to cognitive overload and choking.

Neuroscientific research supports these behavioral findings. As mentioned before, functional imaging studies show that during high-pressure moments, the prefrontal cortex exhibits diminished activity, correlating with impaired motor execution, and amygdala overactivation disrupts the brain's regulatory balance, further weakening attentional control. Athletes with high levels of anxiety or perfectionism may be more likely to shift into this state, increasing the likelihood of choking. Additionally, time pressure during the performance phase plays a key role. In sports that require immediate decision-making, such as tennis, basketball, or gymnastics, athletes have limited time to process information, leaving little room to reframe or recover from intrusive thoughts. The combination of cognitive strain, physiological stress, and perceived time scarcity creates a perfect setup for breakdowns in motor performance and emotional regulation.[9] This is most aptly illustrated by Masaki *et al.*, finding that brain signals (waves) of high sports anxiety athletes in response to errors (error-related negativities or ERNs - the solid lines in the top panel of Figure 4) appear to peak higher during competition than during training.[21] This suggests an excessive focus on error monitoring, consistent with the self-focus theory. Also, in training, high sports anxiety athletes actually had significantly lower ERNs than low sports anxiety athletes, suggesting that they focus less on their errors when practicing and performing alone.




Note: The top panel shows the error-related and correct response negativity, measuring the strength of electrical patterns (waveforms) of brain activity measured by an electroencephalogram (EEG) for a test (the spatial Stroop task) that measures interference between a stimulus location on a screen and its spatial meaning for athletes with high and low sports anxiety, respectively. The vertical bars represent the response onset. The bottom panel shows scalp topographies in each condition (control: practice rounds, and evaluation: competition) for both groups of athletes. Reprinted under the Creative Commons license from Developmental Neuropsychology, Vol. 42, published by Taylor & Francis, © 2017 Masaki, Maruo, Meyer, and Hajcak.

**Figure 4:** Error-related and correct response negativity for nigh and low anxiety athletes.

Even after the event has ended, the psychological and emotional effects of stress often continue well into the post-performance phase. For athletes who choke, this period is frequently characterized by overthinking, self-criticism, and, in some cases, emotional exhaustion. The lingering impact of a failed performance can have heavy consequences, especially for athletes with perfectionistic tendencies. As noted by Martín-Rodríguez *et al.*, perfectionistic athletes often tie their self-worth to outcomes, making a poor performance feel like a personal failure.[19] This mindset reinforces cycles of shame, overanalysis, and self-doubt.

Over time, these patterns can contribute to burnout, a chronic state of emotional and physical exhaustion accompanied by reduced accomplishment and devaluation of the sport itself. Research has shown that unresolved post-performance stress, particularly when paired with ongoing perfectionism and high external or internal expectations, increases the risk of long-term disengagement and mental health issues.[18] This

makes the post-performance phase not only a time for reflection but also a critical period for recovery and psychological intervention to prevent burnout.

Despite its importance, the post-performance phase is often overlooked in performance psychology models, which tend to focus on pre-competition preparation or in-the-moment mental skills. However, sustained success in high-pressure environments depends not only on performing well but on recovering effectively from setbacks. It is extremely important to understand the lingering emotional effects of pressure and failure for supporting athletes' well-being and preventing future performance collapses. Otherwise, elite athletes may be at increased risk of poor mental health as they experience adversity and accumulate stress over the course of time, as documented in a study of 95 athletes by McLoughlin *et al.*[26]

***Tactics for Managing Choking: Short-Term Techniques and Long-Term Strategies:***

This section reviews tactics and strategies from sport psychology and clinical intervention studies aimed at preventing or reducing performance breakdowns under pressure. Overall, evidence from a meta-analysis by Lochbaum *et al.* suggests that sport psychology interventions have a significant impact on performance and may be of great practical value to athletes and coaches.[27] To be effective, interventions should have both short-term, in-the-moment, and long-term focus. Short-term techniques help athletes regulate attention and emotion during high-pressure scenarios, whereas long-term strategies help address the underlying cognitive patterns that increase vulnerability to breakdowns. Research also emphasizes the importance of individualized approaches that target both acute stress responses and chronic vulnerability factors because no one's anxiety is the same, calling for an eclectic approach.[28]

***Short-term techniques:***

When athletes are faced with split-second decisions or must perform under intense scrutiny, they need strategies that help them stay focused, composed, and task-oriented. Three of the most commonly used short-term interventions are attentional control training, cognitive reappraisal, and acclimatization interventions. They are designed to minimize the impact of anxiety and perfectionistic thinking in real-time. In this regard, Hill and Hemmings found that the likelihood of choking is moderated by the athlete's choice of coping strategy.[29]

Attentional control training helps athletes redirect their focus toward task-relevant cues and away from distractions or self-critical thoughts, in line with the distraction model of choking. Interventions aimed at preventing internal and external distractions may include the use of cognitive or behavioral pre-performance routines. Techniques such as "quiet eye" training, in which athletes train to fixate on key visual targets before executing a movement, have been shown to enhance performance by stabilizing gaze and reducing cognitive noise.[5] Additionally, athletes can use cue words, short, purposeful phrases like "breathe" or "follow through", to anchor their attention during performance. In golf, the famed player Jack Nicklaus is known to use mental imagery for every shot, saying he never hit a shot, even in practice, without having a sharp, in-focus picture of it in his head.[30] The effectiveness of pre-performance routines is corroborated by several studies, including meta-studies by Simonsmeier *et al.* and by Rupprecht, Tran, and Gröpel.[31,32]

Cognitive reappraisal involves reframing how an athlete interprets a pressure situation, in line with the self-focus model of choking. A central tenet of self-focus-based interventions is to minimize the reinvestment of explicit knowledge and conscious control of skill execution. Instead of viewing a moment as threatening, "If I miss, I've failed", athletes learn to perceive it as a challenge or opportunity, "This is a chance to perform my best". This shift in perspective or pattern-breaking reduces emotional reactivity and supports better decision-making under stress.[2] Complementary to this, positive or neutral intentional internal dialogue can counteract the perfectionistic and anxious thoughts that often lead up to choking. For instance, telling oneself, "I've practiced this a thousand times," helps maintain confidence and task focus. Generally, self-focus interventions are found to be less effective than other interventions, as confirmed by Gröpel and Mesagno's meta-study.[33] However, Hidayat *et al.* found that self-talk has a significant impact on badminton motor skills and self-confidence for beginner athletes.[34]

Acclimatization interventions focus on reducing the feelings of pressure that otherwise may lead to distraction or self-focus.[35] Acclimatization interventions may include practice under mild anxiety conditions to familiarize participants with pressure. Low *et al.* found from a study of sport psychologists and international-level athletes that pressure training benefits athlete performance through learning of coping skills, "changing the relationship" with pressure, and by increasing the quality of training, as it extends the reach of consequences and simulates the psychological demands of competition.[36]

***Long-term strategies:***

To overcome deeper issues that predispose athletes to performance breakdowns, long-term interventions are key to combat performance stressors such as perfectionistic thinking, chronic anxiety, and negative cognitive habits. As Collins and Winter's study of UK sport psychology students shows, different psychological models may be adopted, depending on the issue presented.[28] No single psychological model may be able to combat all performance stressors comprehensively, thus requiring an eclectic, or process-based approach.[37] That said, cognitive-behavioral approaches appear to be the most widely used in practice, followed by psychosocial models that integrate acceptance and mindfulness strategies.[38]

Cognitive behavioral therapy (CBT) is one of the most widely used and effective interventions for treating anxiety and perfectionism.[38] It works by identifying and restructuring irrational or dysfunctional (negative) thoughts and replacing them with more balanced beliefs. For athletes, CBT can help dismantle the high self-imposed expectations that contribute to choking, while also teaching coping strategies to manage competitive pressure and reduce fear of failure.[39] CBT has been implemented in training plans of many athletes and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sports teams, as it achieves improvements in cognitive skills such as motivation, mental concentration, and self-confidence (see Isorna-Folgar *et al.*, for a review and application to Spanish youth rowers in preparation for the European championships).[40]

Acceptance and commitment therapy (ACT) encourages athletes to accept difficult thoughts and emotions rather than fight them, while committing to behaviors aligned with their core values (see Hayes, Hofmann, and Ciarrochi for a general overview of ACT).[41] This seems particularly effective for athletes dealing with perfectionistic thinking, as ACT helps them focus less on outcomes and more on personal meaning and process. Athletes trained in ACT learn to observe anxious or critical thoughts without letting those thoughts dictate behavior, a skill that enhances emotional resilience and reduces performance anxiety over time. This is confirmed by recent studies, including Juncos *et al.*, who found ACT helpful in the treatment of music performance anxiety, and Ronkainen, who found that ACT intervention improved mental well-being, reduced stress, and increased cognitive flexibility among national-level athletes compared to a no-intervention control group.[42,43] Compared to CBT, which works through symptom reduction and changing negative thoughts, ACT mechanisms rely more on "acceptance" and "acting with awareness" as a natural part of life to mediate the athlete's performance outcome.[37,44]

Finally, mindfulness-based interventions (MBIs) aim to change a person's relationship to their experiences, especially by reducing emotional reactivity, rather than trying to change (CBT) or control (ACT) the content of their experiences. This has been shown to improve athletes' ability to regulate emotions and reduce cognitive overload.[45] Athletes who practice mindfulness report increased focus, reduced rumination, and enhanced ability to return attention to the task after distraction.[46] Emotional regulation skills, such as naming and accepting emotional states, rather than suppressing them, support performance consistency and prevent the emotional spiraling often seen in perfectionistic or anxious athletes.[13] Neurologically, MBI interventions may strengthen the prefrontal cortex and reduce the amygdala activity, resulting in better focus and executive function and better management of emotions, respectively.[47] A mini-review of 19 studies by Birrer, Röthlin, and Morgan found that different athlete populations can benefit from mindfulness-based approaches in terms of performance and well-being, even including sleep quality, confirming its usefulness in sport psychology interventions.[48]

## ■ Conclusion

Understanding how and why choking occurs is essential for athletes, their coaches, and sport psychologists. This will help to develop more targeted, evidence-based interventions to manage psychological and neurological pressures and sustain athletes' performance and mental well-being in high-stakes sports.

This article found that choking is caused by the interaction of psychological traits like perfectionism and sport-related anxiety with cognitive and somatic processes of self-focus, distraction, and emotional dysregulation. This article found that performance stress affects attention, working memory, and motor control, building on both sport psychology and neuroscientific evidence. It found that the risk of performance failure significantly increases when anxiety and perfectionism start interacting, by overloading cognitive systems and shifting focus away from task execution, or causing negative thoughts about their performance. It pointed out that pressure can build over time, particularly in perfectionistic athletes prone to overthinking and emotional dysregulation, eventually leading to choking.

To counteract these adverse effects on their performance, athletes can benefit from both in-the-moment strategies, such as attentional control and cognitive reappraisal, and long-term approaches like acceptance and commitment therapy, cognitive-behavioral therapy, and mindfulness-based interventions.

Future research could explore in more detail how personalized mental training, guided by psychological profiles and neuroscience, can help athletes regulate pressure more effectively. This could include the integration of biofeedback into coaching and the development of athlete-specific cognitive training programs.[7,49,50] In addition, a research area which has received much less attention is the study of clutch performance, the opposite of choking.[51,52] Such a study may complement the present review by showing which mechanisms, besides personality traits, contribute to athletes' ability to excel under pressure. Furthermore, given that there is no one-size-fits-all explanation of choking, more comparative research may be needed on the sensitivity to choking in different sports.[53] Finally, while this article focused on performance breakdowns of individual athletes, recent studies have also analyzed team choking—generally finding that it is more than the sum of individual choking of multiple players at the same time.[54,55] However, more research is needed to better understand the mechanisms involved in team choking.

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