Anxiety and Fear in Sport and Performance

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Summary and Keywords

Anxiety and fear are unpleasant emotions commonly experienced in sport and performance settings. While fear usually has an apparent cause, the source of anxiety is comparatively vague and complex. Anxiety has cognitive and somatic components and can be either a trait or a state. To assess the different aspects of anxiety, a variety of psychometric scales have been developed in sport and performance domains. Besides efforts to quantify anxiety, a major focus in the anxiety-performance literature has been to explore the impact of anxiety on performance and why such effects occur. Anxiety-performance theories and models have increased the understanding of how anxiety affects performance and have helped to explain why anxiety is widely considered a negative emotion that individuals typically seek to avoid in performance settings. Nonetheless, individuals approach anxiety-inducing or fear-provoking situations in different ways. For example, high-risk sport research shows that individuals can actively approach fear-inducing environments in order to glean intra- and interpersonal regulatory benefits. Such individual differences are particularly relevant to sport and performance researchers and practitioners, as those who actively approach competition to enjoy the fear-inducing environment (i.e., the "risk") are likely to have a performance advantage over those who compete while having to cope with their troublesome anxiety and fear. Future research would do well to: (1) examine the effects of anxiety on the processes that underpin performance rather than a sole focus on the performance outcomes, (2) test directly the different cognitive functions that are thought to be impaired when performing under anxiety, (3) unite the existing theories to understand a "whole picture" of how anxiety influences performance, and (4) explore the largely overlooked field of individual differences in the context of performance psychology.

Keywords: conscious processing, explicit monitoring, reinvestment, processing efficiency, attentional control, ironic processing, performance catastrophe, high-risk sports, individual differences

This chapter starts with definitions of anxiety and fear, providing a foundation for examining the two different terms in sport and performance. It is also worth noting that the discussions on anxiety and fear in this chapter are in relation to the normal population rather than clinical settings or patients with particular disorders (see American Psychiatric Association, 2013).

Distinguishing Anxiety From Fear

Fear was one of the critical themes in ancient Greek philosophy. The conceptualization of fear can be traced back to the era of the great thinkers such as Aristotle (384 BCE–322 BCE), Epicurus (341 BCE–270 BCE), and Galen (CE 129– CE 216). For example, Aristotle's *Theory of Contrariety* (Anton, 1957) stated that the complexities of the cosmos consist of basic pairs of opposites (e.g., hot versus cold). When using contrary pairs to conceptualize fear, Aristotle made fear the opposite to confidence, and he attributed one's fearfulness as connected to life events relating to poverty, loneliness, friendlessness, dishonor, pain, illness, and death (Bywater, 1894). After Aristotle, other great thinkers such as Epicurus and Galen also provided fruitful thoughts on fear (see Hall, 1974). Despite their different opinions on how to deal with fear, Epicurus and Galen agreed that fear is the specific effect of one's painful anticipation or imagination of unpleasant feelings (Irwin, 1947; Laërtius, 1925). These ancient viewpoints foresee some essential modern discussions on fear. In his *Theory of Psychoanalysis*, Freud (1920) argued that any fear has an apparent cause. That is, fear always has a specific source, and individuals detect threats and react to them accordingly (e.g., fight or flight).

Anxiety is different from fear. Whereas fear has a direct link to identifiable objects (e.g., a spider) or circumstances (e.g., darkness), the source of anxiety is comparatively vague. Freud suggested that anxiety is "the evolution of fear" (Freud, 1920, p. 345). That is, when experiencing anxiety, one perceives sensations that are similar to those experienced when fearful, but the anxiety experience appears more complex and vague compared to fear. Specifically, whereas people will fairly rapidly know how to avoid fear, they will less readily understand how to avoid anxiety. For example, a person who is fearful (scared) when seeing a spider will experience a decline in fear once he/she is away from the spider. Conversely, an athlete suffering from performance anxiety during an important competition will likely find it more difficult to reduce or overcome such unpleasant feelings. The distinction between anxiety and fear has also been supported at a neurobehavioral level (Perusini & Fanselow, 2015). In particular, a person who feels fearful tends to initiate post-encounter defense (i.e., react toward the existing dangerous situation), which is related to the activation of the subcortical forebrain (e.g., Price, 2005). However, a person who is anxious tends to initiate pre-encounter defense (i.e., respond toward the potentially dangerous environments where typical "threat" has yet to be encountered), which is related to the activation of the prefrontal cortex (e.g., Mobbs et al., 2009).

Anxiety is an unpleasant emotion. Apart from some discordant views (cf. Zajonc, 1980, 1984), most researchers (e.g., Eysenck & Calvo, 1992; Gray, 1982; Lazarus, 1982; Sarason, 1984) agree that anxiety is a primary emotion that that requires cognitive processing before being experienced (see also Woodman & Hardy, 2001). Early conceptualizations (e.g., Lévy-Valensi, 1948) suggested that anxiety is a distressing feeling that comprises both cognitive worrying and somatic symptoms such as dizziness, breathing difficulty, heart palpitations, tension, and trembling(see also Liebert & Morris, 1967).

Both cognitive and somatic anxiety can occur at either a trait or state level. While literature usually gives credit to either Cattell and Scheier (1960) or Spielberger (1966) in introducing the distinction between trait and state anxiety, this distinction has existed for more than two thousand years. The Latin philosopher Cicero (106 BCE–43 BCE), in his "Tusculan Disputations" (Cicero, 1927), clarified that *anxietas* (trait anxiety), one's temperament of being prone to anxiousness is different to *angor* (state anxiety), one's subjective feeling of tension and worry under certain circumstances. According to Cicero, the extent of one's state anxiety depends on the synergic effect of one's trait anxiety and perceived environmental threats. This interplay between trait anxiety and environmental threats contributes to the performance anxiety literature (e.g., Cheng, Hardy, & Markland, 2009).

Measuring Anxiety in Sport and Performance

To quantify one's perceived anxiety in performance settings, researchers have developed a variety of measurements. For trait anxiety in sport, Smith, Smoll, and Schutz (1990) developed the Sport Anxiety Scale (SAS). The SAS consists of three subcomponents: worry, somatic anxiety, and concentration disruption. Due to the inconsistency of the SAS's factor structure across adult and child samples, Smith, Smoll, Cumming, and Grossbard (2006) revised the SAS to create the SAS-2. In this revised measure, they retained the same subcomponents of trait anxiety and improved the items so that the measure demonstrated acceptable validity for adults and children.

To measure state anxiety in sport, Martens, Burton, Rivkin, and Simon (1980) first constructed the Competitive State Anxiety Inventory (CSAI). Martens, Burton, Vealey, Bump, and Smith (1990) later developed the 27-item CSAI-2 by specifying three relatively independent pre-competition subcomponents including cognitive anxiety, somatic anxiety, and self-confidence. The CSAI-2, later revised to the CSAI-2R to enhance the factor structure (Cox, Martens, & Russell, 2003), is the most widely used measure of competitive state anxiety in sport psychology research. Nonetheless, when researchers wish to measure these pre-competition constructs in a less time-consuming manner to capture participants' affect within a short timeframe, they often resort to administering single-item versions of the CSAI-2 (e.g., Hardy & Hutchinson, 2007) or the Mental Readiness Form (MRF) (e.g., Barlow, Woodman, Gorgulu, & Voyzey, 2016; Woodman, Barlow, & Gorgulu, 2015; Woodman & Davis, 2008). The MRF (Krane, 1994) comprises three single-item factors that measure worry/cognitive anxiety, tension/somatic anxiety, and self-confidence. The single-item format of the MRF is less intrusive and thus convenient for allowing researchers and practitioners to measure anxiety as close as possible to either the manipulative instructions or the subsequent performance. Furthermore, the use of the word "worry" in the MRF is a better description of state cognitive *anxiety* than the word "concern," which is used in both the CSAI-2 and the CSAI-2R. Indeed, the word *concern* is open to ambiguous interpretation because concern might reflect worry, but it might also reflect the perceived importance of an event (e.g., "I am concerned about this competition"; see Woodman & Hardy, 2001).

Work using the CSAI-2 or CSAI-2R only assesses the intensity of anxiety symptoms. However, in an attempt to incorporate individual interpretations of anxiety (i.e., viewing anxiety as either facilitative or debilitative), some researchers utilize an amended version of the CSAI-2, which includes a directional scale (CSAI-2D; see Jones & Swain, 1992). The CSAI-2D adds a facilitative-debilitative directional continuum scale to each of the items in the CSAI-2, thus allowing the assessment of both anxiety intensity and its interpretations. A wide range of research in sport and performance psychology has adopted such a directional approach of anxiety (see Wagstaff, Neil, Mellalieu, & Hanton, 2012). However, while some studies (e.g., Jones, Smith, & Holmes, 2004; Jones, Swain, & Hardy, 1993) demonstrated the association between anxiety interpretation and previous or predicted performance, most of the work investigating directional interpretations has focused on antecedents or mechanisms of anxiety interpretation as opposed to the relationship between anxiety interpretation and performance.

More recently, Cheng et al. (2009) developed the Three-Factor Anxiety Inventory (TFAI) comprising cognitive anxiety, physiological anxiety, and the regulatory function of anxiety. According to Cheng et al., anxious performers evaluate not only environmental and internal threats but also their capacity to control these threats, which results in voluntary coping (regulatory dimension). By acknowledging the regulatory dimension of anxiety, Cheng et al. argued that the TFAI would facilitate a better understanding of the complex anxiety-performance relationship. There is some support for this perspective (Cheng, Hardy, & Woodman, 2011; Otten, 2009).

Theories and Models of Anxiety and Performance

Skill-Focused Versus Distraction Theories

Skill-focused (or self-focused) theories and distraction theories are the two classes of theories that have received the most research attention in the anxiety-performance literature. Both theories focus on the detrimental effect of anxiety on cognitive processing as a critical mechanism but provide different explanations for how anxiety affects performance.

The Reinvestment Perspective

Skill-focused theories emphasize the role of self-consciousness in the skilled performance process. The explanation of how anxiety affects performance is closely linked to Fitts and Posner’s (1967) stages of skill learning. According to Fitts and Posner, people learn skills through explicit encoding of the required knowledge. That is, in the early stages of learning, people explicitly and consciously focus on how they should behave in order to perform a skill. Such an explicit and conscious focus on each component of the skill leads to an awkward and jagged performance. This is akin to a baby learning to feed itself. As we become more proficient with the skill, our specific knowledge base regarding what needs to be done in order to perform the skill becomes gradually more subconscious, and the skill becomes smooth and efficient. This is akin to an adult eating with a knife and fork (there is no conscious effort). According to the skill-focused account of anxiety-induced performance breakdown, a skilled performer has reached automaticity and is thus able to perform skills subconsciously and smoothly (Anderson, 1982; Masters, 1992). However, when skilled performers are anxious, they reinvest attention on (consciously monitor) their skill by using step-by-step “rules,” which regresses skilled performance to a novel level and leads to performance impairments.

The reinvestment effect as proposed in the skill-focused theories has been well tested. Masters (1992) first proposed the Conscious Processing Hypothesis (CPH), positing that performers, when experiencing anxiety, attempt to use explicit “rules” in task execution, rather than perform the task “automatically” as they would normally. According to the CPH, using explicit knowledge to break down well-established “automatic” task execution harms performance. To test the CPH, Masters assigned a sample of novice golfers to either an explicit learning group (i.e., who used detailed technical instructions when practicing putting) or an implicit learning group (i.e., to perform a random letter generation when practicing putting, without access to technical instructions). After an intensive practice session, both groups putted under a high-anxiety condition. In line with CPH, if the performance decrement under high anxiety is due to conscious processing, only the explicit learning group (i.e., those with access to detailed knowledge) would suffer impaired performance. Results showed that the implicit learning group continued to improve, but the explicit learning group failed to do so, supporting the notion that the use of explicit “rules” when feeling anxious is comparatively detrimental to performance (see also Hardy, Mullen, & Jones, 1996).

Another skill-focused perspective stems from Baumeister’s (1984) seminal work on testing the effect of explicit monitoring, the Explicit Monitoring Hypothesis (EMH; Beilock & Carr, 2001). Similar to the CPH, the EMH proposes that when performers experience anxiety, they tend to monitor their performance throughout task execution in an attempt to ensure excellent performance; such monitoring disrupts well-established routines and makes performance vulnerable. To test the EMH, Beilock and Carr trained a sample of novice golfers to a high skill level in either a single-task group, a distraction group (i.e., performing a secondary task when practicing putting), or a self-consciousness group (i.e., using video recording to induce self-monitoring when practicing putting). After intensive training, these golfers performed a putting transfer task in a high-anxiety condition. Anxiety harmed the performance of the control and distraction groups. Only the performance of the self-consciousness group did not suffer in the high anxiety condition. This maintenance in performance of the self-consciousness group was expected because explicit monitoring was present in both low- (i.e., manipulation-induced) and high-anxiety condition (i.e., anxiety-induced) for this group.

Considering that both conscious processing (i.e., the use of explicit rules) and explicit monitoring (i.e., the act of monitoring the process of performance) describe the reinvestment of attention during task execution, Masters and Maxwell (2008) united the CPH and the EMH under a single umbrella: the Theory of Reinvestment (TOR). Evidence for the TOR has emerged in different performance domains (e.g., Gray, 2004; Jackson, Ashford, & Norsworthy, 2006; Kinrade, Jackson, & Ashford, 2015). Psychophysiological research has also provided some neuroscientific evidence to support the TOR. For instance, in a pressurized putting task, Cooke et al. (2015) found that pre-movement electroencephalographic (EEG) high-alpha power reduced when a previous putt was missed compared to when it was holed, and this effect was greater in expert than in novice golfers. Since the reduced EEG high-alpha power reflects an increase in the resources allocated to adjust putting (Cooke et al., 2014), Cooke et al.'s (2015) findings show that experts, compared to novices, reinvested greater resources when there was a need to correct for previous errors (i.e., a missed putt), which is in line with the TOR prediction that experts have more resources (e.g., explicit knowledge) to reinvest. Further, Gallicchio, Cooke, and Ring (2016) identified the T7-Fz of lower left temporal-frontal connectivity as a neurophysiological marker of movement-specific conscious processing. Gallicchio et al. found that T7-Fz connectivity successfully distinguished missed and holed putts, supporting the key prediction of the TOR that conscious processing impairs performance (see also Dyke et al., 2014).

The Distraction Perspective

Distraction theories propose that worry will induce cognitive interference, which shifts the performer's attention from the task to task-irrelevant thoughts. Developed in cognitive psychology, the two main theories of distraction are Processing Efficiency Theory (PET; Eysenck & Calvo, 1992) and Attentional Control Theory (ACT; Eysenck, Derakshan, Santos, & Calvo, 2007).

PET incorporated the critical assumption of Cognitive Interference Theory (CIT; Sarason, 1984). That is, while creating high cognitive demands, anxiety in the form of worry pre-empts the resources of working memory thus leading to impaired performance. However, based on a collection of initial works (Eysenck, 1979; Eysenck & Eysenck, 1985; Eysenck, Macleod, & Mathews, 1987), Eysenck and colleagues argued that the CIT exaggerates the role that worry plays in impairing performance. Providing different evidence that increasing anxiety does not always undermine cognitive performance, Eysenck and Calvo (1992) proposed that worry serves two principal functions. On the one hand, worry distracts cognitive processing by pre-empting working memory, which shifts attention to task-irrelevant thoughts and is detrimental to performance. On the other hand, worry also serves a motivational function, whereby the worry about performing poorly may lead to the reallocation of additional cognitive resources (i.e., trying harder) and thus the maintenance of optimal performance when anxious.

The two principal roles of anxiety as proposed in the PET point to its two main predictions. First, the detrimental role of anxiety predicts that high trait anxious performers will be more vulnerable than low trait anxious performers to the adverse effect of anxiety, and these adverse performance effects will increase as the cognitive demands of the task increase. Second, anxiety impairs performance *efficiency* (e.g., longer processing time, greater effort) more than performance *effectiveness* (i.e., the quality of performance). As such, it is only when there are no extra resources available to buffer anxiety that performance decrements occur.

Although initial support for these predictions was from cognitive psychology (see Eysenck & Calvo, 1992), an impressive body of research within sport psychology has also evidenced these predictions. For example, Smith, Bellamy, Collins, and Newell (2001) followed a sample of elite volleyball players throughout a competitive season. These authors reported findings consistent with the PET that high trait anxious players reported higher anxiety and greater mental effort compared to low trait anxiety players when performance was equivalent to each other (see also Wilson & Smith, 2007).

The impairment in performance efficiency may also appear in the form of increased processing time (rather than simply in increased effort). For example, Murray and Janelle (2003) tested a sample of participants in the context of a dual-task racing simulation. The authors instructed participants that both the driving task and the secondary task were equally important for the purposes of competition. Results indicated that although driving performance was similar in the baseline and the competition, high trait anxious participants spent more time responding to the secondary task in the competition condition. There were no such differences at baseline (see also Wilson, Smith, & Holmes, 2007).

Evidence from eye gaze research has also supported anxiety-induced impairments in performance efficiency and effectiveness. Williams, Vickers, and Rodriguez (2002) asked a sample of experienced table tennis players to perform serves that require either a low cognitive demand (i.e., follow simple patterns) or a high cognitive demand (i.e., follow complex patterns) under low- and high-anxiety conditions. There was an increase in visual search rates with the use of foveal fixations rather than peripheral vision in both groups. The increase of visual search using foveal instead of peripheral fixations reflects a decrease in efficiency because foveal vision processes provide less task-relevant information compared to peripheral vision so more fixations are necessary to glean the same information. Also, although efficiency decreased (i.e., less efficient gaze behavior) under high anxiety in both low and high cognitively demanding tasks, decrements in performance effectiveness only occurred in the highly cognitively demanding task, thus supporting the predictions of the PET.

Despite support for PET, it is unclear in PET which function of working memory is impaired by anxiety, and why anxiety diverts attention from task-relevant to task-irrelevant stimuli. To bridge these limitations, Eysenck et al. (2007) modified PET to ACT. Adopting the predictions of PET, ACT proposes that the detrimental effects of anxiety on attentional processes are fundamental to how anxiety exerts its influence on performance. Specifically, Eysenck et al. suggested that when experiencing increasing anxiety in performance settings, performers will allocate resources to detect the source of related threats. Such acts divert resources from a goal-directed (top-down) attentional system to a stimulus-driven (bottom-up) attentional system, thus increasing task-irrelevant thoughts and disrupting attentional control. Moreover, Eysenck et al. also made a precise prediction regarding the adverse effect of anxiety on working memory. Drawing on Miyake et al.'s (2000) work on working memory, ACT predicts that anxiety will impair the inhibition (i.e., resisting disruption or interference from task-irrelevant stimuli) and the shifting functions (i.e., reallocating attention to task-relevant stimuli) of working memory. In particular, when a performer experiences anxiety, the anxious feeling will make the performer less resistant to task-irrelevant stimuli such as worry (impairing the inhibition function). Simultaneously, the anxious feeling will prevent the performer from reallocating attention to the task, and will keep directing the performer's attention to excessive worry (impairing the shifting function). The impaired inhibition and shifting functions account for the cognitive interference induced by anxiety.

The ACT has received support in sport psychology. For example, Wilson, Vine, and Wood (2009) asked a group of experienced basketball players to perform free throw shooting while tracking their eye gaze fixations. There was a significant reduction in eye gaze duration on the target (i.e., the restraint of the goal-directed attentional system) and more fixations of short duration on various targets (i.e., the overactivation of the stimulus-driven attentional system), which accompanied the reduced performance. In another study of football penalty kicks, Wilson, Wood, and Vine (2009) found that football players fixated longer on the goalkeeper (i.e., participants were stimulus-driven) in a high- compared to a low-anxiety condition, which was responsible for decreased shooting accuracy and supported the debilitating effect of anxiety on the attentional system.

Bridging Skill-Focused and Distraction Theories

From a theoretical perspective, skill-focused theories and distraction theories are fundamentally different. However, since effort plays a role in both the skill-focused perspective and the distraction perspective, it is possible that reinvestment in the skill-focused perspective reflects a maladaptive use of effort whereas attentional control in the distraction perspective reflects an adaptive use of effort (Woodman & Hardy, 2001). In other words, sometimes performers try harder (but ineffectively; reinvestment) and sometimes performers try smarter (attentional control).

Anxiety can lead to an increase in on-task effort, and such effort can result in performance breakdowns (i.e., reinvestment), maintained performance (i.e., attentional control), or even increased performance (e.g., via greater effort). For example, Mullen and Hardy (2000) found experienced golfers managed to maintain performance across low and high anxiety in either control or task-irrelevant conditions (i.e., dual-task distractions) but not in task-relevant conditions (i.e., reinvestment through conscious processing). Since effort increased similarly in all these three conditions, it is possible that the failure to maintain performance in the task-relevant conditions was due to the inappropriate use of effort as a result of accessing unnecessary technical instructions. Lam, Maxwell, and Masters (2009) also demonstrated similar findings. In their study, novice female basketball players were trained in either an explicit or an implicit (analogy) learning group, and they were asked to perform a basketball shooting task while concurrently responding to the same auditory tone. While the increased effort in the explicit and implicit learning groups was comparable, only the performance of the explicit group suffered. Wilson et al. (2007) also found some indirect evidence to support the coexisting phenomena of reinvestment and attentional control. These researchers found that high trait anxiety golfers increased mental effort and took more time to initiate a putt, but performed poorly under high pressure (i.e., reflecting the possible use of maladaptive effort through reinvestment). In contrast, low trait anxiety golfers managed to maintain their normal performance under high pressure despite increased mental effort and pre-putting time (i.e., reflecting the possible use of adaptive effort through attentional control).

An increase in effort under high anxiety can lead to both reinvestment and attentional control. However, apart from different training methods (e.g., explicit versus implicit training) and personality traits (e.g., low versus high trait anxiety), less is known about the circumstances under which anxiety may increase the likelihood of reinvestment or attentional control.

Theory of Ironic Processes of Mental Control

While attempting to explain the anxiety-performance relationship, researchers mostly refer to the aforementioned skill-focused and distraction theories. Nonetheless, theories and models have also suggested other potential mechanisms via which anxiety may impair performance. One such candidate for providing an alternative explanation for anxiety-induced performance failure is the Theory of Ironic Processes of Mental Control (TIP; Wegner, 1994, 2009). Central to the TIP is a dual-control cognitive feedback system that leads to both intentional (e.g., to achieve good performance) and counter-intentional effects (e.g., to avoid bad performance). Such effects are achieved by two cognitive processes: the *operating process* and the *monitoring process*. According to the TIP, the intentional *operating process* is consciously guided to search for information consistent with intended goals. Conversely, the counter-intentional *monitoring process* is autonomously activated to search for information of undesirable states. The TIP suggests that the breakdown of this dual-control system under high cognitive load (e.g., anxiety) accounts for the *ironic effect*. Specifically, since the monitoring process identifies lapses in mental control, it keeps the mind sensitive to conditions indicating any failure of intentional control. When cognitive load (e.g., anxiety) is low, the availability of conscious resources will allow the monitoring process to reactivate the operating process to retain intentional control toward one's desirable states. In other words, under low cognitive load, we can largely do what we want to do. However, a high cognitive load occupies a large proportion of the limited conscious resources, which suppresses the operating process such that one then has limited access to information regarding the desirable state. Under these circumstances, the autonomous monitoring process becomes prevalent —by keeping the mind sensitive to the failure of intentional control, the monitoring process makes unwanted thoughts dominate one's cognitive process, increasing accessibility to the states that one typically wants to avoid. The increase in the awareness of the to-be-avoided states leads to a greater likelihood to do specifically what one wants not to do. This outcome is *ironic* because the monitoring process, which is normally responsible for ensuring *successful* execution of tasks, is directly responsible for the *breakdown* of these tasks.

There is support for TIP in the context of performance. For example, Wegner, Ansfield, and Pilloff (1998) demonstrated that when instructing participants not to over putt in golf or not to move a pendulum in a particular direction, the likelihood of performing the to-be-avoided actions increased under high cognitive load. However, the cognitive loads in Wegner et al.'s studies (e.g., reduced visibility, the dual-task condition) were not directly related to anxiety in performance settings. To test the ironic effect in a performance anxiety environment, Woodman and colleagues (Woodman & Davis, 2008; Woodman et al., 2015) used competition and monetary rewards (i.e., up to £100) to manipulate performance anxiety. When they asked golfers to putt toward a target, but to be particularly careful not to hit the ball past the target, participants overshot the target more times in a high- compared to a low-anxiety condition (Woodman & Davis, 2008). Similarly, when given precise instructions to aim for specific areas and to avoid other specific areas, hockey players and darts players hit specifically more into the to-be-avoided zones when anxious (Woodman et al., 2015; see also Barlow et al., 2016).

The unwanted consequences of ironic processing are not limited to performing what one wants to avoid. For example, Binsch, Oudejans, Bakker, and Savelsbergh (2009) demonstrated that anxious performers might overcompensate at times. In other words, in an effort not to putt long, the golfer might tend to putt too short, rather than putt too long. Indeed, Wegner's conceptualization of the TIP leaves room for possible overcompensation. Specifically, the key to ironic processing is the dysfunctioning operating process and the overly active monitoring process under high cognitive load. When breakdown of the dual-control system occurs under high cognitive load, it is possible that the performer may reallocate extra cognitive resources to redirect control to avoid the undesirable states. Such attempt to redirect control to prevent the unwanted states may fail (i.e., and produce an ironic effect) or be overly adjusted (i.e., overcompensation) due to the failure of precise control as a result of the dysfunctioning operating process. Therefore, both ironic effect and overcompensation are possible unwanted consequences that anxiety might induce.

Multidimensional Anxiety Theory

So far, the discussion in this chapter on anxiety-performance theories has focused mainly on the cognitive component of anxiety (i.e., worry). However, competitive anxiety has both cognitive and somatic components (Liebert & Morris, 1967). An early theory that incorporated the influences of both cognitive and somatic anxiety on performance is Multidimensional Anxiety Theory (MAT; Martens et al., 1990). MAT states that: (1) the relationship between cognitive anxiety and performance is negative and linear; and (2) the relationship between somatic anxiety and performance follows an inverted-U shape. However, the predictions of MAT have received considerable criticism, with only limited support (see Woodman & Hardy, 2001).

MAT's sole focus on the negative effects of competitive anxiety on performance led Jones (1995) to propose that performers' interpretation of anxiety-related symptoms (i.e., viewing anxiety as facilitative or debilitative) will determine how anxiety exerts its influence on performance. A large body of research supports the facilitative-debilitative distinction of anxiety interpretation by examining its correlates such as level of expertise (Jones, Hanton, & Swain, 1994; Jones & Swain, 1992), locus of control (Ntoumanis & Jones, 1998), perception of goal attainment (Jones & Hanton, 1996; O'Brien, Hanton, & Mellalieu, 2005), hardiness (Hanton, Evans, & Neil, 2003; Hanton, Neil, & Evans, 2013), coping strategies (Eubank & Collins, 2000; Jerome & Williams, 2000; Ntoumanis & Biddle, 1998), and psychological skills (Fletcher & Hanton, 2001; Neil, Mellalieu, & Hanton, 2006). However, the influence of anxiety interpretation on performance, and any associated mechanism(s), are less understood (Wagstaff et al., 2012).

Catastrophe Models of Anxiety and Performance

Dissatisfied with the rather simplistic predictions of MAT, Hardy (1990) proposed two catastrophe models of anxiety and performance. Adapting Zeeman's (1976) catastrophe theory to anxiety and performance, Hardy (1996A, 1996B) proposed that performance catastrophe models would overcome the limitations of MAT and provide more in-depth insight into how cognitive and somatic anxiety *interactively* affect performance.

The Cusp Catastrophe Model of Anxiety and Performance (CCM; Hardy, 1990) was the initial catastrophe model that proposes the interactive effects of cognitive anxiety and physiological arousal (somatic anxiety) on performance. Specifically, the CCM predicts that cognitive anxiety will be facilitative to performance when physiological arousal is low and detrimental when physiological arousal is high. More importantly, changes in performance as a result of changes in physiological arousal can follow either a continuous or a discontinuous path, depending on the level of cognitive anxiety. Specifically, when cognitive anxiety is low, increases in physiological arousal lead to minor performance fluctuations following a mild inverted-U shape. Under these circumstances, the initial increase in physiological arousal results in a small increase in performance to an optimal point, beyond which any further increase in physiological arousal results in slight decreases in performance. Conversely, when cognitive anxiety is high, increases in physiological arousal lead to dramatic and discontinuous performance fluctuations. Under such circumstances (high cognitive anxiety), as physiological arousal increases so too does performance to an optimal performance point (i.e., the cusp), beyond which any further increase in physiological arousal leads to a drop in performance that is immediate, dramatic, and irreversible—a performance *catastrophe*. Once the catastrophe takes place, performance cannot simply *bounce* back to the optimal level. Indeed, performance can only be recovered once physiological arousal is reduced to a level that is considerably lower than where the catastrophe occurs (i.e., the hysteresis).

To test the CCM, Hardy and Parfitt (1991) asked a group of basketball players to perform set shots on one day before an important match (i.e., high cognitive anxiety) and one day after a critical game (i.e., low cognitive anxiety). On each of these days, Hardy and Parfitt used the shuttle run task to work up participants' heart rate to the target zones prior to performing the set shots. Results demonstrated that as physiological arousal increased to an optimal point, an immediate and dramatic performance drop only occurred when cognitive anxiety was high (supporting the catastrophe hypothesis), and performance recovered gradually only when physiological arousal reduced to a lower level than where performance had collapsed (supporting the hysteresis hypothesis). Moreover, results revealed that players achieved both their highest and their lowest levels of performance in the high cognitive anxiety condition, which supports the catastrophe model's central feature that cognitive anxiety can both facilitate and harm performance—in other words, cognitive anxiety rarely has an indifferent effect on performance. Further support for the CCM has also been provided in a number of other studies (e.g., Edwards, Kingston, Hardy, & Gould, 2002; Hardy, Parfitt, & Pates, 1994; Woodman, Albinson, & Hardy, 1997).

Hardy (1990, 1996A) also proposed the Butterfly Catastrophe Model of Anxiety and Performance (BCM) to acknowledge the essential role that self-confidence plays in the anxiety-performance relationship. In Hardy's BCM, self-confidence is a bias factor that moderates the interaction between cognitive anxiety and physiological arousal on performance. Specifically, high self-confidence swings the typical performance fold, or the "cusp" point under high cognitive anxiety, to a higher level of physiological arousal. In other words, when cognitively anxious, confident performers can tolerate greater physiological arousal before suffering a dramatic performance drop (i.e., a performance catastrophe).

To test the BCM, Hardy, Woodman, and Carrington (2004) employed an innovative segmental quadrant analysis, examining the maximum interaction effect between cognitive and somatic anxiety at different levels of somatic anxiety for different levels of self-confidence. Since the catastrophe phenomenon features the performance increase before the "cusp" and the sudden performance decrease beyond the "cusp," the "cusp" should lie where the maximum interaction effect of cognitive and somatic anxiety takes place. Considering the potential moderating effect of self-confidence, Hardy et al. argued that the maximum interaction effect should lie at a lower level of somatic anxiety when self-confidence is low and at a higher level of somatic anxiety when self-confidence is high. After collecting data from a group of golfers throughout a tournament, Hardy et al. found that confidence shifted the maximum interaction effect size to a higher level of physiological arousal. This result supports the moderating effect of self-confidence on the interaction between cognitive and somatic anxiety, such that confident golfers were able to withstand higher levels of somatic anxiety before suffering from performance breakdown (see also Woodman & Hardy, 2005).

In summary, existing theories and models have helped us to understand how anxiety may exert its influence on performance. Although anxiety is widely considered a negative emotion that individuals typically seek to *avoid*, it is noteworthy that in certain circumstances individuals appear motivated to *approach* anxiety-inducing situations, or more precisely fear-inducing situations. A typical context that will facilitate the understanding of why some people are prone to approach fear-inducing situations is high-risk sports.

Approaching Fear: Lessons From High-Risk Sports

High-risk sports refer to sports where participants have to reckon with the possibility of severe injury or death (Barlow et al., 2015; Breivik, 1999). Despite, or perhaps because of, the possible fatal consequences of participating in high-risk sports, individuals are drawn to the movement toward *and* away from danger. That is, individuals fear losing their life in high-risk sports and thus strive to return to safety, but then reasonably rapidly seek to return to the fear-provoking environment once more (Woodman, Hardy, & Barlow, 2018; Woodman, Hardy, Barlow, & Le Scanff, 2010). Thus, in the high-risk sport domain, fear is no longer what individuals want to avoid but is the emotion that they pursue.

Early research suggested that sensation seeking may be the critical motive that underpins individuals' engagement in high-risk sport. In his *Theory of Sensation Seeking*, Zuckerman (1969, 1979, 1994) proposed that individuals have optimal levels of arousal (OLA) for cognitive activity, motoric activity, and positive affective tone. As such, sensation seekers (i.e., individuals who have a high OLA) would feel stressed under sensory deprivation situations because they need greater stimulation to achieve their OLA. According to Zuckerman, the willingness to seek intense sensations to satisfy one's need contributes to risk-taking behaviors. Using the Sensation Seeking Scale (SSS-V; Zuckerman, Eysenck, & Eysenck, 1978) to assess the motives in the high-risk sport, early evidence seemed to suggest that high-risk sports participants might be a homogenous group of sensation seekers (see Zuckerman, 2007).

This indiscriminate view was comprehensively challenged and rebutted by Barlow, Woodman, and Hardy (2013; see also Woodman et al., 2018). Barlow et al. (2013) found strong evidence that some high-risk sport participants (e.g., skydivers) are motivated by a drive for thrills and novel sensations, but that other participants (e.g., mountaineers, ocean rowers) are driven by a need to regulate their emotions and to derive a sense of agency. In the development of Agentic Emotion Regulation Theory, Woodman et al. (2010) argued that not all individuals engaging in high-risk sports are sensation seekers, and they provided initial support for emotion regulation and agency as the motives for participating in high-risk expeditionary activities. Notably, compared to control groups, transatlantic rowers and mountaineers had greater difficulty describing their feelings regarding their loving relationships. However, after the challenging crossing and the mountaineering expedition, transatlantic rowers and mountaineers reported feeling more able to identify and express their emotions in the interpersonal settings in which they usually have difficulty.

The basic premise to agentic emotion regulation is that the fear and hardship that are experienced in extreme conditions (e.g., roaring waves, stormy and cold conditions) are more identifiable than the underlying anxiety regarding domestic life (e.g., maintaining loving relationships). By approaching hazardous environments, individuals who suffer from emotional difficulties (an underlying anxiety) in daily life gain the opportunity to identify momentarily the source of their unpleasant nebulous states—namely fear. In this sense, engaging in a high-risk sport enables individuals to compensate for their low efficacy in exercising control over their emotional life events by coping successfully with the fear in other perceived emotionally extreme environments.

Barlow et al. (2013) also found that individuals participating in high-risk expeditionary sports have higher expectations regarding emotional regulation and agency, and can transfer the coping skills learnt from threatening events back into their daily life. In addition, Woodman, MacGregor, and Hardy (2018) reported that the need for emotion regulation and agency discriminated individuals engaging in high-risk sports from individuals who participate in other low-risk sports. Furthermore, these agentic emotion regulation difficulties accounted for the self-esteem benefits that are derived from successful engagement with high-risk domains.

In general, the lesson from high-risk sports appears to be that fear-provoking situations are not necessarily what all individuals want to avoid; some individuals appear to approach anxiety-inducing situations in order to gain an intra- and interpersonal regulatory benefit. This regulatory process may be of particular relevance to competitive sports. Indeed, the ultimate goal for sport competitors is to strive for peak performance. However, the ego-threatening competitive arena can induce high levels of fear and anxiety (e.g., fear of failure). As such, it would confer a competitive advantage if a competitor chose to compete precisely because of the anxiety that competition generates, in contrast to the competitor who competes while having to overcome troublesome anxiety (see also Neil & Woodman, 2017; Roberts & Woodman, 2017).

Future Directions

While a large body of literature provides insight into how anxiety affects performance, several issues warrant further research. First, the extant literature has focused primarily on the effect of anxiety on performance *outcomes* rather than on the *processes* that underpin performance. Thus, it is unclear whether anxiety affects performance planning (e.g., offline movement planning), performance execution (e.g., online movement control), or both; and if both are affected, to what degree they are each affected (see Allsop, Lawrence, Gray, & Khan, 2017; Lawrence, Khan, & Hardy, 2013). This avenue of research is important because it will help to point to where performance is breaking down in the skill process, and thus where interventions might be best targeted. Research suggests that anxiety affects performance execution more than it affects performance planning (e.g., Allsop et al., 2017; Lawrence et al., 2013). However, these laboratory-based studies have only utilized simple aiming tasks of which the ecological validity is limited. Indeed, sport performance tasks can be very complex and anxiety may not exert the same influence on the planning and execution of all performance tasks. Future research should consider using real or ecological valid performance tasks to quantify precisely the influence of anxiety on performance planning and execution rather than solely targeting performance outcomes.

Second, while different theories are in agreement regarding the debilitative effect of anxiety on cognitive function and subsequently on performance, the cognitive functions conceptualized in different theories are rarely tested. For example, although Eysenck et al.'s (2007) ACT predicts that anxiety impairs the inhibition and shifting functions of the central executive, which is what contributes to performance failures, little work has tested the core functions of the central executive in a performance setting (see Wilson, Vine et al., 2009, for an exception). A possible reason for the lack of direct tests on these theoretically conceptualized functions is the limited knowledge of the markers of these functions. As such, future research should consider investigating these important functions and their markers to allow for more direct tests of these theories.

Furthermore, none of the existing theories and models on its own perfectly explains how anxiety affects performance. Bridging or uniting existing theories and models may contribute to a better understanding of the "whole picture." Two research avenues may emerge from this position. One possible avenue advocates a *situation-specific approach* such that different theories may be more pertinent and applicable under different conditions. For example, Gray, Orn, and Woodman (2017) tested ironic and reinvestment effects in baseball pitching following different instructions. They assigned experienced pitchers to either a target-only group (i.e., showing only the pitching target zone) or the ironic group (i.e., showing both the target zone and the to-be-avoided zones) and measured the expertise-related kinematic variables throughout their performance under low- and high-pressure conditions. Although both groups hit fewer targets in the high-pressure condition, the process by which they did so was different. The target-only group had significant reductions in expertise-related kinematic variables, which reflects a reinvestment effect such that pitching execution became less smooth. Conversely the ironic group had no significant change in expertise-related kinematic variables, which reflects the maintenance of expert movement control. Importantly, despite maintaining good movement control, the ironic group initiated more specifically ironic hits in the to-be-avoided zones. The findings demonstrate that reinvestment and ironic effects manifest in different situations during baseball pitching. More research would do well to adopt this situation-specific approach to improve our understanding of the effects of anxiety as proposed in different theories.

The other possible avenue different to the *situation-specific approach* would be an *integrative approach* such that the mechanisms underlying the anxiety-performance relationship as proposed in different theories and models might interactively account for performance effects. For instance, anxiety-induced reinvestment and distraction may together account for performance failure. Specifically, since reinvestment (e.g., step-by-step monitoring) requires cognitive resources, the extent to which distraction pre-empts working memory may determine the degree of adverse effect of reinvestment on performance. When distraction is high, increases in reinvestment may be particularly problematic for performance because no extra resources are available to allow for a smooth performance execution in addition to such reinvestment. However, when distraction is low, an increase in reinvestment may not necessarily lead to the breakdown of performance automaticity due to the possible compensatory function of extra resources. This position has yet to be tested directly but there is some indirect support from literature. Specifically, Gucciardi and Dimmock (2008) asked participants to generate three technique cues (i.e., arm, weight, and head) during a golf putting task and found such reinvestment impaired performance under pressure, whereas Wilson, Chattington, Marple-Horvat, and Smith (2007) asked participants to generate the position of their left hand compared to right hand (i.e., high, low, same) during a simulated rally driving task and found such reinvestment did not impair performance. Such discrepancies may be due to the monitoring hand position during driving being less resource-consuming (i.e., less distractive) than monitoring technique cues during putting. The availability of extra resources may thus compensate for the negative influence of reinvestment in Wilson et al.'s driving task, which is not the case in Gucciardi and Dimmock's (2008) putting task. Nonetheless, the potential interaction between reinvestment and distraction is worthy of further testing by manipulating the levels of both reinvestment and distraction using the same performance task. Future research would do well to consider adopting an integrative approach to bridge different theories and models.

Finally, individual differences, typically personality traits, have yet to receive much research attention in the anxiety-performance literature (see also Roberts & Woodman, 2015, 2016, 2017). However, a wide range of personality traits may play vital roles in performance settings. For example, optimism (e.g., Scheier & Carver, 1992), perfectionistic striving (e.g., Gaudreau, 2015), and mental toughness (e.g., Hardy, Bell, & Beattie, 2013) or hardiness (e.g., Hanton et al., 2013) or resilience (e.g., Sarkar & Fletcher, 2014), are traits that are thought to benefit performance. Research on serial gold medal winners (Hardy et al., 2017; Rees et al., 2016) demonstrated that these traits successfully distinguished world-leading serial medaling athletes from their less successful (non-medaling) counterparts. Nonetheless, the literature has yet to see a significant amount of research testing these traits in relation to different anxiety-performance theories. Also, although existing evidence and theory suggests that individuals high in these traits should perform well, they are unlikely to perform well always. As such, it would be worthwhile to investigate the conditions under which individuals high in these traits may or may not perform well under high anxiety.

Also, while many individuals may view anxiety-inducing or fear-provoking situations apprehensively, individuals high in either narcissism (Wallace & Baumeister, 2002; Woodman, Roberts, Hardy, Callow, & Rogers, 2011) or alexithymia (Roberts & Woodman, 2015; Woodman, Cazenave, & Le Scanff, 2008; Woodman et al., 2010; Woodman, Huggins, Le Scanff, & Cazenave, 2009) might be rather attracted to high-pressure environments. Typically, anxiety-inducing and fear-provoking situations offer opportunities for glory/admiration (e.g., to perform at one's best under stress, to demonstrate an ability to do what others cannot do) and for agentic emotion regulation (e.g., to regulate one's emotions in an easily identifiable fashion). These opportunities satisfy narcissists' need for self-enhancement (Roberts, Woodman, & Sedikides, 2017) and the alexithymic need of intra- and interpersonal regulation (Woodman et al., 2018). Therefore, individuals high in either narcissism or alexithymia are thought to be more capable of performing well in anxiety-inducing or fear-provoking situations compared to those low in these traits. However, research is unclear as to whether possessing traits such as narcissism and alexithymia would make individuals experience fewer unpleasant states (e.g., experience less anxiety and thus perform well) or tolerate more readily unpleasant states (e.g., experience high anxiety and still perform well). Future research should consider testing the role of narcissism and alexithymia in these high-pressure performance settings.

While research has generally treated personality traits as moderators of the anxiety-performance relationship, this approach is lacking in its applied value because personality traits are difficult to change. For example, although research is fairly conclusive that the performance of individuals high in certain traits such as neuroticism (John & Srivastava, 1999) tends to suffer (e.g., Barlow et al., 2016), from an applied perspective it is difficult to make individuals less neurotic with a view to optimizing performance under pressure. To provide valuable applied implications, it would be worth exploring potential moderators of the relationship between certain personality traits and performance. For instance, Roberts, Callow, Hardy, Woodman, and Thomas (2010) assessed participants' narcissistic traits and assigned them to either an internal imagery group (i.e., imagining looking out through one's own eyes) or an external imagery group (i.e., imagining watching themselves from a third-person perspective) to perform in a low-anxiety setting followed by a high-anxiety competition. Individuals high in narcissism improved performance only when they used external imagery but individuals low in narcissism remained consistent in different conditions regardless of different imagery perspectives. The findings suggest that external imagery perspective is a tailored strategy that is particularly beneficial to individuals high in narcissism in anxiety-inducing performance settings (e.g., competition; see also Roberts, Woodman, Hardy, Davis, & Wallace, 2013). However, literature has yet to see a significant amount of research exploring the moderators of the effect of personality on performance in high-anxiety settings. Future research in the field of individual differences in performance psychology should move forward to investigate the precise strategies tailored for different individuals to cope better with performance anxiety.

Conclusion

Anxiety and fear have dominated the attention of performance-focused psychology researchers. Research has revealed how anxiety may exert its influence on performance, and more recently how and why individuals may be prone to suffer or to thrive in high-pressure environments. Although researchers have made much progress in understanding the mechanisms that might underlie the anxiety-performance relationship, future research will benefit from conducting more experimental work and exploring the largely overlooked field of individual differences in the context of performance psychology.

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