



Anxiety in Sport

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Learning Objectives

Basic:

- Distinguishing anxiety from similar constructs and describing anxiety as a situation-specific state that depends on attention and appraisal processes
- Naming the internal and external factors that influence these processes and describing the relevant models and theories

Advanced:

- Imagining and examining the anxiety reaction with its physiological, experiential and behavioural components and demonstrating how to measure these components
- Naming effects of anxiety in sports, identifying the relationship between anxiety and performance in sport and explaining the mechanisms of this relationship

Experts:

- Demonstrating how anxiety can be regulated and managed in sport
- Explaining how sport can contribute to the regulation and management of anxiety

12.1 Introduction

Sport is associated with different emotions for everyone involved—whether the athlete “on the pitch”, whether the coach on the sideline or even the spectators in the stands. However, one emotion sticks out among athletes: anxiety. The beach volleyball player who serves for the match ball in the Olympic final, the climber at base before a free solo ascent on El Capitan, the student in the gymnastics lesson who is standing in line and waiting to jump over the vaulting horse or the parachutist just before jumping out of the plane at 4000 m—they are all likely to feel anxiety at this moment. If we take a closer look at these and similar situations, the question arises whether the experience of anxiety in these situations can explain the person’s behaviour (e.g. the faking of an injury in the gymnastics lesson, the serving mistake in the Olympic final, the intensive preparation at the foot of El Capitan or the joy on the ground after a successful parachute landing). In fact, one of the central questions in sport psychology is the connection between anxiety and performance. Other questions relate to how and why anxiety actually arises in sport situations as people usually approach these voluntarily. Furthermore, we have to establish the meaning of the term anxiety—is it the volleyball player’s sweaty hand, the worried look of the climber, the student’s worry about an injury or the skydiver’s weak stomach?

In the “Emotion” chapter, various approaches to research on emotion have already been presented.

Several models can explain the development of emotions, their expression and their effects in sport. To provide an insight into anxiety in sport and the currently discussed theories, models and findings, this chapter takes a very pragmatic approach. Therefore, the presentation and understanding of anxiety in sport is based on the Consensual Modal Model of Emotion (Gross, 2008; Mauss & Robinson, 2009). This model corresponds to a lay understanding of emotion, but also—if simplified—to most of the theoretical approaches and empirical findings currently being discussed.

- A core topic for both applied sport psychology and research is the connection between anxiety and sport performance.

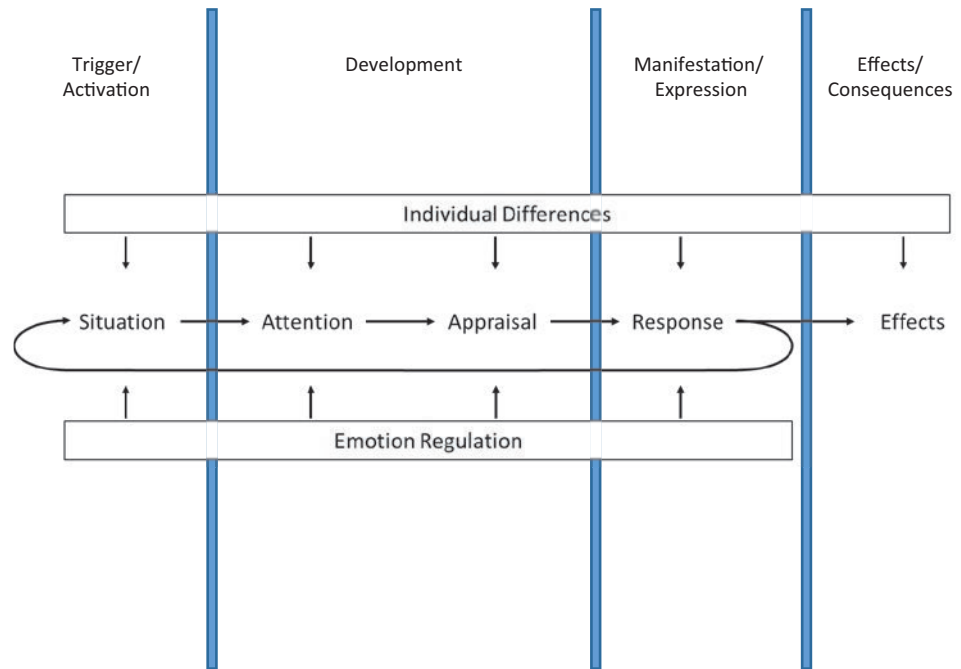
Within this Consensual Modal Model, an emotion develops over time, triggered by a situation that initiates an evaluation (or appraisal) process by the person. Depending on how the situation is evaluated, a complex emotional reaction develops, which has a physiological and behavioural component in addition to the subjective experience. This reaction can in turn be the basis for the next emotional episode, but it also has other effects on the behavioural and physiological level (■ Fig. 12.1).

Along the lines of the Consensual Modal Model, this chapter explains which characteristics of situations in sport trigger anxiety and how cognitive processes of attention and of situational appraisal lead to an anxiety reaction, which components make up this anxiety reaction and what effect anxiety has on behaviour in sport. The Consensual Modal Model also allows us to illustrate the effects that the characteristics of people in this process have and, finally, the strategies that exist for coping with, or regulating, anxiety, in sport. Interestingly, sport itself can contribute to changing the experience of anxiety.

■ What Is Anxiety?

When people talk about anxiety in everyday life, they usually talk about the manifestation or experience of the feeling of anxiety rather than the process leading to this experience. The experience, which is explained in more detail in ► Sect. 12.4, is usually the central component of the anxiety reaction when it comes to defining anxiety. Definitions, or rather descriptions, of anxiety usually revolve around three facets: Anxiety (1) is a temporary state, usually perceived as unpleasant, which (2) arises as a reaction to a threat in a situation and (3) is characterized by changes at the physiological, experiential and behavioural levels. Anxiety ultimately arises from an expectation about the progress of a situation, i.e. from the anticipated consequences of a situation or action. It is thus temporally preceding an event.

Fig. 12.1 Extended representation of the “Consensual Modal Model” of Emotion (Gross, 2008). It depicts emotions as a process and thus allows the structured presentation of findings on anxiety in sport. In sport, these findings relate primarily to the triggering situation of competition



As a construct, anxiety should serve to explain and predict individual behaviour and experiences. Anxiety is therefore often distinguished from other constructs such as fear, arousal and stress, although this distinction is difficult and sometimes controversial. In particular, the triggering conditions and reactions would have to be distinguished in a meaningful way in order to be able to speak of different constructs.

Anxiety is a temporary state that is usually perceived as unpleasant and is characterized by changes at the physiological, experiential and behavioural levels. It arises from an undefined outset and the uncertain anticipation about future threat and is thus temporally preceding an event.

■ Anxiety and Fear

Fear and anxiety are both revolving around threat and share an unpleasant state of activation and negative feelings. Yet, fear is considered to be more object-related regarding a fairly well-defined (imminent) danger and is therefore a more short-term reaction to a single event. Because fear thus is also more concrete than anxiety, its functionality consists of showing immediate defensive behaviour (“fight/flight”). In contrast, anxiety is usually understood as a somewhat vague, objectless emotion, which can also last longer and is more oriented towards expected future environmental conditions. Therefore, anxiety should motivate information processing and even planning behaviour (Öhman, 2008). On the physi-

ological level, specific reactions are also postulated—for example, different hormonal reactions; in addition, anxiety, fear and their respective reactions are associated with different subcortical brain regions. Thus, the amygdala appears to be the central switch point for fear, and the nucleus stria terminalis is likely the central switch point for anxiety (LeDoux & Pine, 2016). In practice, it is difficult to clearly assign fear to a situation in sport. If there is an immediate (real or perceived) threat of physical (or psychological) harm in a situation, for example, the student’s first look at the gymnastics vaulting horse, fear could be the main emotion. Nevertheless, the normally uncertain or vague outset, the “not knowing” what will happen, ► Sect. 12.2, is the trigger for anxiety (and not fear) in sport.

Fear can be described as a short-term, object- and present-related reaction that motivates immediate defence or escape behaviour.

■ Anxiety and Arousal

It is obvious that emotions are always associated with a physiological response, and for a long time, understanding the role of physiological responses in the development of emotions was important (see Chap. 10: Emotion). This physiological reaction is referred to as arousal, especially in the context of anxiety research. The underlying idea is that humans or organisms are in a state of energy at all times, which can vary between complete rest (e.g. in deep sleep) and complete arousal (e.g. in

panic). This state of energy or physiological excitement is functionally connected to emotions: The arousal that accompanies anxiety is supposed to energize the organism. That way the organism is ready to flee or fight and able to protect itself. In some studies, arousal is not only seen as a part of anxiety but is equivalent to anxiety, for example, in models about the relationship between anxiety and performance. However, this equation is problematic for many reasons. An increased or even high level of arousal is associated not only with anxiety but also with other unpleasant (anger) and pleasant (joy) emotions. Moreover, arousal does not seem to be a one-dimensional construct, but rather different dimensions or facets can be distinguished. Arousal can take place centrally (i.e. in the brain or more precisely in the cortex) or peripherally, for example, through the activity of the autonomous nervous system. Many studies also use the term “activation”, which is sometimes understood synonymously but could be different. For example, arousal is understood as the activation of the sensory organs and all afferent information processing, while the actual activation refers to the effector organs and the efferences. Arousal is also seen as a “tonic” level of activation, whereas activation is phasic (i.e. a reaction to a stimulus). Activation could then even be understood as an increase in arousal (Barry et al., 2005). Arousal then might be characterized by the activity of the autonomic nervous system, while activation expresses the activity of the central nervous system. Cognitive processes control both the energy intensity and its direction and are thus able to control peripheral (excitation) processes (cf. Beckmann & Rolstad, 1997).

Arousal refers to the more general level of activation of the organism, characterized by the energy of the autonomous nervous system and related to the processing of afferent information (i.e. the perception of stimuli).

Activation can be understood as a consequence of task-related activity of the central nervous system, which occurs as a result of stimuli and events and refers primarily to the (efferent) energy of effector organs.

Only very rarely is a differentiation of the concept of arousal made in sport psychology literature. This makes a summarized description of different works difficult. In this chapter, the term activation is used throughout,

regardless of whether the respective literature refers to arousal (which is probably more frequent) or activation. This unification is based on the assumption that the physiological response measured in the context of anxiety in sport is an expression of cognitive processes based on an (anticipated) situation. Furthermore, the physiological response is usually also related to the preparatory activation in order to act—it is therefore activation rather than arousal.

➤ Anxiety is associated with an energy state of activation that is at least originally functional (“fight/flight”).

■ Anxiety and Stress

If you asked the gymnastics student preparing for the vault or the skydiver in the plane about how they feel, they might not say that they are afraid but rather that they are stressed or experiencing stress. In fact, the distinction between anxiety and stress is not easy. One reason for this is the use of the term stress—stress is sometimes understood as the state of the organism, sometimes as the process of stress development and sometimes as the reaction of the body. Depending on the theoretical approach, stress is also considered from different perspectives. From a reaction-oriented perspective, stress is seen as a reaction to a stressor, for example, in the form of increased activity of the autonomic nervous system in response to an acute threat. From a stimulus-oriented perspective, stress is also a reaction to stimuli, but these are defined more broadly, so that all stimuli and stimulus constellations requiring adaptation are stressors. These stressors can then even be ordered hierarchically according to the need for adaptation. Finally, cognitive approaches are interested in the subjective view and in the evaluation processes that lead to the experience of stress—but this also makes stress more of a process (see Chap. 27 for an overview of theories and approaches). Common to all approaches, however, is the idea that stress is an imbalance (or a reaction to it) between demands on an organism or a person and his or her capacity to cope with the demands.

From these perspectives, the emotion of anxiety is difficult to separate from stress (cf. Weinberg & Gould, 2018). Anxiety is accompanied by physiological activation, especially of the autonomic nervous system. Situations and stimulus constellations can be identified that trigger anxiety (► Sect. 12.2), which can hardly be separated from stress-triggering ones. Anxiety is said to arise as a consequence of appraisal processes—the perception of threat and lack of coping options. The decisive difference is therefore likely to lie in the temporal extension (cf. Scherer, 1985): Anxiety represents a state in a situation, an acute reaction to an (anticipated)

threat. Stress, on the other hand, is subject to the same mechanisms of development, but the system is out of balance in the long term or repeatedly (McEwen, 1998) and stress may last correspondingly longer. In this respect, the student in gymnastics lessons may indeed be more likely to experience stress—because he has already been exposed to the situation repeatedly—and the skydiver may show a physiological stress reaction but may also experience anxiety. This difference becomes decisive when it comes to the question of how to deal with anxiety and stress—stress as a long-term process must then be coped with, but anxiety as a state must be regulated (see ► Sect. 12.6).

► **Anxiety and stress are related constructs, which differ mainly in that anxiety is experienced rather in the short term and before an event and stress is rather longer term and is a reaction to an event.**

■ **Trait and State Anxiety: Global or Domain-Specific?**

Finally, it is important to separate anxiety, as a momentary experience, as a state, from trait anxiety. Trait anxiety can be understood as a personality trait that expresses a person's tendency or disposition to experience anxiety (Spielberger, 1966). People differ in the extent of their trait anxiety—in situations in which they experience anxiety, how quickly anxiety develops and how pronounced the anxiety state is.

The constructs trait and state anxiety are supposed to serve to explain and predict behaviour. However, since behaviour takes place in situations, psychological research soon asked the question whether situations can be grouped into classes or domains for which domain-specific anxiety can then be assumed and measured. People could then, for example, be minimally anxious in general but feel more anxious in examination situations, for example. If anxiety is then assessed in a specific domain, e.g. academic exams or tests, the prediction of behaviour should also be more accurate.

State anxiety is a momentary and temporary feeling, while trait anxiety expresses the general tendency to experience anxiety in different situations.

Even within the domain of sport, domain-specific anxieties have been assumed. An (early) approach of anxiety research in sport (and especially in Germany) was the assumption of “sport anxiety”: Individuals should differ in the extent to which they feel anxiety in different situations in sport, largely independent of (general) anxiety. In these conceptions, the fear (or anxiety) of injury represents an important facet. Next to this is social

anxiety—people evaluate their own performance and their appearance. This facet of evaluation is the focus of two domains of anxiety in sport that are now playing a greater role in research: competitive anxiety and social physique anxiety. Whereas competitive anxiety actually refers to one domain of situations—namely, competitions—social physique anxiety is concerned with how others perceive and evaluate the external body appearance. This concern can occur in various situations but is more prevalent in situations where the body is visible, such as swimming or physical education. Sport psychology research is particularly interested in anxiety in competition and its relation to performance. Therefore, the majority of the considerations in this chapter will be related to competitive anxiety.

► **In sport, social anxiety plays a particularly important role, which is expressed in specific domains as competitive anxiety and social physique anxiety.**

Self-Reflection: My Own Experience of Anxiety in Sport

When and if we experience anxiety is rather individualistic and subjective. Make a list of three concrete situations in which you have experienced anxiety in sports—e.g. in sports lessons, at a competition and in the gym. Try to remember each situation vividly. Then, for each situation, describe (1) what might have triggered the feeling in that situation, (2) what you noticed or felt when you were anxious and (3) the short- or long-term consequences of the anxiety experience.

The construct anxiety can thus be differentiated from other related constructs such as fear, stress or activation. However, the distinction is difficult and sometimes controversial. Theoretically, these constructs may by definition differ from one another. In concrete situations, however, a mixture of many of these emotions occurs, so that it seems practical to use anxiety as an umbrella term. This chapter will use anxiety under this umbrella meaning. Whenever it is necessary to differentiate, specific terms will be used.

12.2 Trigger of Anxiety in Sports

The situations described in the introduction are exemplary, perhaps even prototypical of situations in which people experience anxiety in sport. To understand anxiety and develop interventions for dealing with anxiety in sport, it is also helpful to know which situations or characteristics of situations can trigger anxiety in detail. An important research approach is to first generate lists of stress- or anxiety-inducing situations or situa-

tion characteristics using qualitative methods. We may then assign these characteristics to topics or categories. A second approach originates from social psychology and mostly experimental research on the connection between anxiety and performance or the phenomenon of “choking under pressure”. Characteristics of a “pressure situation” are defined, which can then be systematically manipulated and examined against their effect on performance. Both approaches again essentially focus on anxiety before or during a competition.

12.2.1 Sport Psychological Approach

Hackfort (1986) probably offers the most detailed analysis of anxiety in the context of sport and the specific characteristics of the person-environment relationship that leads to this anxiety (referred to as “sources”). For Hackfort, the central point is that people in competitive sports are particularly concerned about the uncertainty of the situation. This feeling of uncertainty manifests in four types of fear: fear of (1) failure, (2) the unknown, (3) negative social evaluation and (4) injury or physical harm. This means that apparently an essential characteristic of competitive sports, namely, the openness of the outcome of the competition, is a significant source of anxiety! This openness results first and foremost from the fact that both success and failure are possible (fear of failure). Secondly, openness is linked to the observation that the outcome is only partly under the control of the person acting but is also dependent on external factors such as the opponents or the weather and material conditions (fear of the unknown). The outcome of competitions is also closely linked to self- and external evaluations: Failure can lead to a feeling of incompetence or inadequacy. People in sport worry what others (e.g. trainers, family and friends) think about their performance and fear a negative evaluation (fear of negative social evaluation). Finally, the fourth source of fear is physical: Athletes fear injuring themselves or getting injured by others during competitions (■ Fig. 12.2). This differentiation (Hackfort, 1986) is supported by empirical results. In a study with a group of young wrestlers, 33 different sources of stress were named, but these are only assigned to three factors (Gould et al., 1983): fear of failure/feeling of inadequacy, external control/blame and social evaluation. Gould and Weinberg (1985) further found that wrestlers were particularly concerned with their expected performance and its evaluation. A similar list of characteristics of stress-/anxiety-inducing situations is provided by Lazarus and Folkman (1984) in the context of the transactional stress model (► Sect. 12.3.2), which can be supplemented by two sport-specific characteristics (Thatcher & Day, 2009).



■ Fig. 12.2 A classic anxiety situation: queuing for the jump over the vaulting horse and the fear of pain and injury should be in the foreground

► Sport psychology studies show that anxiety is characterized by fear of:

- Failure
- The unknown
- Negative evaluation by others
- Injuries

? What characteristics of situations cause stress and anxiety (in sport)? If:

- The event is new and unknown.
- The progression of the situation is not predictable or only predictable with difficulty.
- It is not certain whether the event will actually occur and when.
- The situation persists.
- The situation is unclear in itself and there is insufficient information or knowledge to assess it.
- The timing of the event coincides with other significant events
- A direct comparison with others in terms of performance-related characteristics (e.g. technical execution) is possible.
- The athlete is underprepared physically for the competition.

Preparation for a competition refers to the preparation in training yet also to the circumstances immediately before a competition. Conversely, the circumstances immediately before a competition influence a person’s preparedness. For example, athletes that report poor sleep before competitions may feel increased anxiety regarding the competition (Ehrlenspiel et al., 2018a).

Finally, qualitative studies in competitive sports show that expectations—about your own performance and the performance of others—lead to anxiety (Hill et al., 2010). However, the interaction of own and other people’s expectations seems unclear. Although it would

be plausible to assume that the expectations of others increase the concern to make a good impression, which presumably leads to (social) anxiety, this mechanism has not yet been explicitly investigated.

12.2.2 Social-Psychological Approach

Social-psychological research in the 1960s and 1970s investigated the effect of situational characteristics on different performances and especially how “pressure situations” affected motor performance. Baumeister (1984) defined a “pressure situation” as “any factor or combination of factors that increases or enhance the importance of good performance during special occasions” (p. 610). These factors, which were later called situational incentives for optimal performance (Baumeister & Showers, 1986), are characterized as external characteristics (i.e. the environment and the situation) and internal characteristics (i.e. individual perceptions or states). Baumeister and Showers (1986) identified central pressure-generating factors including observation by spectators, the contingency of reward and punishment, competition and the personal importance of the task. Research on the relationship between anxiety and performance provides evidence for the anxiety-inducing effect of these factors. They are therefore often used in experimental research to design pressure situations under laboratory conditions.

➤ From a social-psychology perspective, “pressure” in sport arises from situational incentives for optimal performance, which may include (but are not limited to) observation by spectators, the contingency of reward and punishment, competition and the personal importance of the task.

12.2.2.1 Audience Effects

It is impossible to imagine sport, at least competitive sport, without spectators, and it is easy to see that spectators (can) create pressure and cause anxiety (■ Fig. 12.3). The presence of spectators is therefore suitable to create pressure in an experimental, mostly laboratory situation. Essential characteristics of the audience are directly related to the perceived pressure, with a supportive, large and educated audience increasing the athlete’s performance pressure. If performing in front of a supporting audience, this may create “impression management” issues and the (perceived) need to “look good” arises. Butler and Baumeister (1998) compared the performance in a task performed in front of a supporting, hostile or neutral audience. A supportive

audience leads to not only increased anxiety but also a decrease in accuracy performance. This effect was found even with people stating they would be happy to have the encouragement of the (supporting) audience when performing.

In experimental research investigating the relationship between anxiety and performance, video cameras are also widely used to increase perceived pressure. Even among experienced golfers, a video camera increased state anxiety during a golf putt task (Linder et al., 1999). However, when using video cameras to manipulate pressure, instructions must be followed carefully. These should relate primarily to the impression the person is expected to make on others and threaten the person’s self-concept (e.g. as a successful sportsman; Mesagno et al., 2011).

➤ The direct (spectators) or indirect (video cameras) observation in sports leads to anxiety, especially if it increases the necessity to leave a good impression on others.

12.2.2.2 Contingencies

Rewards or punishments are usually contingent on performance in competition situations—a first free solo ascent of a route on El Capitan, for example, leads to great media coverage and worldwide recognition. Contingencies lead to a perception of pressure. In experimental studies, financial incentives are often used, mostly in the sense of positive contingencies (possible profit), occasionally in combination with negative contingencies (loss of expected payment; see Masters, 1992). In these studies, it was indeed shown that anxiety increases and performance suffers (Baumeister, 1984; Beilock & Carr, 2001; Linder et al., 1999; Masters, 1992). However, in the progression of these studies, other characteristics were usually manipulated, for example, the personal importance (“ego relevance”) of the tasks or video cameras or spectators was used. Although such combined study designs can be used to manipulate anxiety well, it is impossible to determine whether the financial incentive or, for example, the expected evaluation by an expert is the cause of anxiety and the associated loss of performance. Only one study with experienced golfers (Gucciardi & Dimmock, 2008), using a performance-based financial incentive but without further ego-relevant or social pressure manipulation, found a significant increase in state anxiety from a practice to a test situation in golf. Thus, it appears that although financial incentives can motivate people to perform better, they do not necessarily instil anxiety and therefore tend to have a performance-enhancing effect (Mesagno et al., 2011).



Fig. 12.3 Serve in the Olympic final (LEON NEAL/AFP/Getty Images)

➤ Financial incentives in pressure situations probably increase motivation above all without necessarily creating anxiety.

12.2.2.3 Competition

Sport is usually characterized by competition. Whether during a scrimmage at the end of a practice, or the Olympic Games, it is usually about comparing the performance of one person (or a group of people) to another and finding a winner. Competition does not even have to exist formally or explicitly. An (implicit) competition is created when you tacitly want to perform better than another person during voluntary training. Apparently, competitions lead to the perception of pressure and often poor performance (Baumeister & Showers, 1986).

In applied sport psychology, the main focus is on overcoming competitive anxiety and thus supporting athletes and achieving optimal performance in competitive situations. In the context of psychological skill training, attempts have been made to integrate characteristics of competition into daily training. In addition to the characteristics already described (e.g. spectators, or positive/negative contingencies), other characteristics (e.g. limited number of attempts) often specific to a

particular sport are also incorporated into training (e.g. Low et al., 2021).

? What are the most anxiety-inducing characteristics of competitions in sport?

- An audience is present.
- Consequences are contingent upon the outcome of the competition.
- A direct comparison of performance with other persons or groups.
- The relevant action is attempted only once (e.g. penalty kicks) or is attempted only to a limited extent (e.g. a maximum of three attempts).
- The timing of the competition is uncontrollable (e.g. starting time is fixed) or even unpredictable (starting time of tennis match fluctuates due to match length on competition day).

12.2.2.4 Importance of the Event

A problem in laboratory-based, experimental research is that the experimental situation itself is usually not very important for the participants being tested. Many findings show that the importance of a situation—usually competitions or competition simulations—is positively associated with increased (competitive) anxiety

(Marchant et al., 1998; Martens et al., 1990a). The importance of a performance situation can result from the context of the situation itself (e.g. training vs. competition) or the possible consequences (e.g. win or loss). The extent to which the importance aspects contribute to anxiety depends primarily on a person's motivational orientation. If the task performed is closely linked to a person's self-esteem, this will lead to more anxiety. Thus, people who feel successful when they perform better than others ("ego orientation") are more likely to report anxiety in competitive situations than those who improve their own performance based on mastery of the skill ("task orientation"; Hall et al., 1998). In a study in golf, the effect of incentives of different levels (consequences;

Marchant et al., 1998) was examined. Golfers with a low handicap (i.e. at a fairly high level of expertise) were divided into pairs and completed a golf chipping task. The prizes for winning were either golf balls (low importance) or golf shoes (high importance). It was found that people involved in the high importance, compared to low importance, incentive indicated a higher level of anxiety. The importance of the consequences was therefore a strong positive predictor of anxiety.

- Only in important performance situations in sport does anxiety arise; this importance arises both from the context of the actor's situation and from the consequences of the action.

Experimental Comparison of the Effect of Pressure Conditions

The self-presentation model (► Sect. 12.3) aims to explain how anxiety and poor performance can occur in competitive situations. The model assumes that situational and personal characteristics influence self-presentation and anxiety. In an initial study (Mesagno et al., 2011) of the self-presentation model of choking under pressure (more discussion of choking under pressure later), hockey players were asked to take penalty shots under normal "training" condi-

tions or under "high pressure." For the "high pressure" condition, the participants were randomly assigned to different manipulations. The "self-presentation" condition involved a social evaluation situation, where the penalty shots were taken in front of spectators or under video observation where the camera was focused on the performer and participants were told their performance would be scrutinized by their coach. In a "motivational" pressure condition,

participants were able to earn money depending on their performance, or the video camera was focused on the target to ensure accurate recording of scores. Results indicated that the self-presentation condition reported higher anxiety and also showed decreased performance under pressure than the motivational pressure manipulation. This indicates a connection between self-presentation, increased anxiety and choking under pressure.

Reflection: Competition Preparation

In psychologically oriented training, an attempt is made to make everyday training "psychologically valuable." For example, the training conditions can be adapted as closely as possible to the conditions of the competition or these can be simulated. In this way, it is possible to practice dealing with conditions that trigger anxiety. For "your" sport, think about which aspects of a competition you could incorporate into a typical final training session (and how).

12.3 How Anxiety Arises in Sport

Various external situations and internal states can thus be described as outsets for anxiety. These outsets are only possible, perhaps even necessary conditions for the development of anxiety in sport, but certainly insufficient. Whether anxiety develops from objective situations must therefore depend on other factors. In the Consensual Modal Model (Gross, 2008), these are attention and appraisal processes.

- Whether anxiety arises from specific characteristics of situations in sport, such as a competition, depends on attention and appraisal processes.

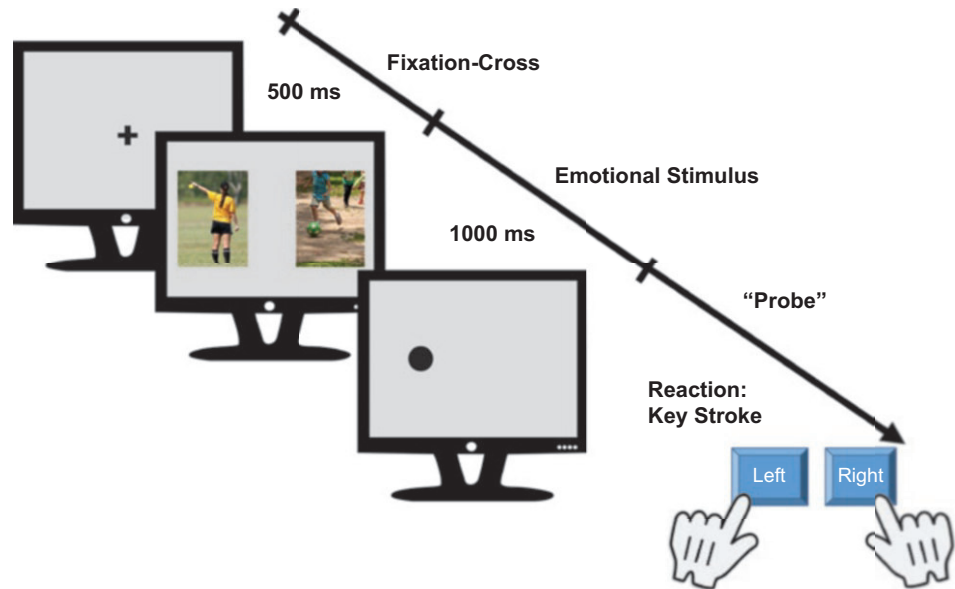
12.3.1 Attention Processes

It seems plausible that in a given situation an emotion—in this case anxiety—only arises when corresponding emotionally relevant features are perceived. There is some evidence of a connection between emotions and a corresponding distortion of attention towards the emotionally relevant characteristics of the situation (“emotion-related attentional bias”). Empirically, this distortion of attention phenomenon is often investigated by means of two reaction-time paradigms: the emotional Stroop test (Williams et al., 1996) and the dot probe test (MacLeod et al., 1986) (see Figs. 12.4 and 12.5 in the Methods Box). In each test, emotionally related stimuli (e.g. words) attract attention and are processed more quickly, thereby inhibiting other processes simultaneously and facilitating subsequent appropriate processes.

List 1	List 2
blue	Relegation Fight
green	Front Runner
red	Endurance
blue	Sports Jacket
yellow	Ball Loss
red	Final Victory

Fig. 12.4 Stroop test: The task is to name the printed colour of the displayed words as quickly and accurately as possible

Fig. 12.5 Dot probe test: stimuli with emotional content attract attention—this leads to shorter reaction times if the “dot probe” appears at the location of the emotional stimulus



[Paradigms: Emotional Stroop Test and Dot Probe Test]

The Stroop test is a classic test for measuring attentional processes. Participants are presented with a list of words (originally words of colours), printed in different colours (see list 1). The task is to name the printed colour of the words as quickly and accurately as possible. John Ridley Stroop reported in 1935 in his classic study that there is interference of the word meaning with the naming of the printed colour. If word meaning and printed colour match, the answers are quicker and more correct than if they are different. The emotional Stroop test is designed to determine whether the emotional content of a word

attracts attention and whether there is interference. A person who suffers from anxiety in competitions may therefore take a little longer to name the colour (“yellow” or “red”) for the “negative” words in list 2 (“relegation fight”, “ball loss”).

The dot probe test is used to record selective attention to emotional, especially threatening, stimuli. Participants look at a monitor on which a fixation cross appears to ensure that the person is actually looking at the monitor. Then, for a predetermined time, images are shown to the left and right of the fixation cross: one “neutral” (e.g. “playing children”)

and one with emotional stimuli (e.g. “referee shows a yellow card”). Then a dot appears at the position of one of the two images (i.e. right or left), and the task is to press a corresponding button (i.e. “left”/“right”) as quickly as possible when the dot appears. The special processing of emotional stimuli or the “attentional bias” is then shown with shorter reaction times to dots that appear at the position of the emotional stimulus. The attention was therefore already drawn to the dot by the emotional stimulus and was not distributed equally.

Both paradigms provide clear evidence of attentional bias towards threat or anxiety-related stimuli in individuals with high anxiety and anxiety disorders (Bar-Haim et al., 2007). Both conscious, top-down, and unconscious, bottom-up, processes (see definitions information below) contribute to this distortion of attention. It is controversial whether people with anxiety disorders usually draw attention to threatening stimuli or whether a preferred perception of threatening stimuli may lead to an anxiety disorder.

In sports, this anxiety-related distortion of attention has rarely been investigated. Moreover, the few findings are not entirely consistent. With the help of a version of the emotional Stroop test adapted to competitive sports, Lautenbach et al. (2016) showed that athletes seem to gravitate towards negative, threatening sports-related stimuli independently of the “pressure” prevailing within a situation. In a dot probe test, however, Chuang et al. (2015) could not find any behavioural distortion of attention to negative, threatening stimuli in archers.

Bottom-Up Process

When events or stimuli “automatically” attract attention, we speak of bottom-up processes, for example, the reactions to a loud bang.

Top-Down Process

If attention is consciously and intentionally directed to selected events or stimuli, we speak of top-down processes.

Attentional processes are also often accessed through the analysis of eye movements. Thus, indirect indications of the connection between attention and competitive anxiety are found in research on gaze behaviour, where pressure situations influence eye movement behaviour. In a study on free-throw basketball, a pressure situation led to a reduction in a “quiet eye” period (e.g. the final fixation of the target with task-related and external attentional focus; see Methods Box), an increase in fixations and a decrease in fixation duration (Wilson et al., 2009). Apparently, pressure leads to an impairment, perhaps an interruption, of cognitive processing of task-related processes—an indication, in turn, of preferred processing of anxiety-related stimuli.

Method: Quiet Eye

Usually we control our movements by processing visual stimuli, for example, when a volleyball is to be played over a net or a small rock ledge is to serve as the next footing in climbing. With the help of eye movement cameras, the eye movements necessary for the perception of visual stimuli can be recorded and examined. The “last look” before the beginning of a movement plays a key role in the processing of visual information—a topic to which Joan Vickers has devoted extensive research time and gave it the name “quiet eye” (QE) (see Vickers, 2016). QE is defined as the last fixation of

an eye movement before the start of the final movement (e.g. stretching the arm in volleyball, stretching the legs when climbing). The fixation is understood as the lingering of the gaze within an angle of vision of 3° around a location or an object for a time of at least 100 ms.

The quiet eye period likely leads to better motor performance due to effective motor programming. The significance of QE for motor performance is deduced by comparing experts or top athletes with people who are less successful in their sport or have only been doing it for a short time. Furthermore, QE can be com-

pared between successful and unsuccessful performances. Meanwhile, there are also studies in which the duration of QE has been experimentally manipulated (Klostermann et al., 2013). These studies show that the length of QE is directly related to success in different motor tasks, with the general rule: The longer QE, the better performance. Successful athletes not only fixate longer—they usually succeed by fixing earlier—they are also more constant in their QE. However, motor tasks make specific demands on the optimal duration of QE. The QE can also be trained.

? Which personality and personal characteristics influence anxiety-related attention processes in sports?

- When experiencing anxiety, people who interpret anxiety as performance-inhibiting generally process ambiguous stimuli more intently (Eubank et al., 2002).
- People with high competitive anxiety tend to avoid anxiety-related stimuli, i.e. tend to divert their attention (Chuang et al., 2015).
- QE training leads to pressure situations being interpreted less as a threat and instead more as a challenge (Moore et al., 2013b).

Lazarus observed that characteristics of the person seem to have an influence on this effect. He therefore assumed that there is a bidirectional, transactional relationship between the individual and the situation or environment, in which cognitive processes mediate whether (subjective) stress is actually triggered by an (objective) stressor. These cognitive processes should essentially be about appraising the significance and characteristics of the situation and events in this transactional relationship (Lazarus & Folkman, 1984). This appraisal (see Fig. 12.6) includes how significant the situation is for a person (“primary appraisal”) and whether the individual has the resources to cope with the demands of

12.3.2 Appraisal Processes

Fundamental to all approaches within the Consensual Modal Model (Gross, 2008) is the assumption that the (objective) characteristics of a situation do not directly lead to the (subjective) experience of anxiety. Rather, these characteristics are first assessed in terms of their meaning/significance for the individual and, in the case of anxiety, the situational appraisal as “threatening.” The most prominent and also first explicit theoretical idea about these cognitive appraisal processes was formulated by Richard Lazarus (1966) in his transactional stress model.

12.3.2.1 Transactional Stress Model

While stress research after the Second World War was still strongly behaviourist and interested in the direct effects of stress conditions on behaviour, Richard

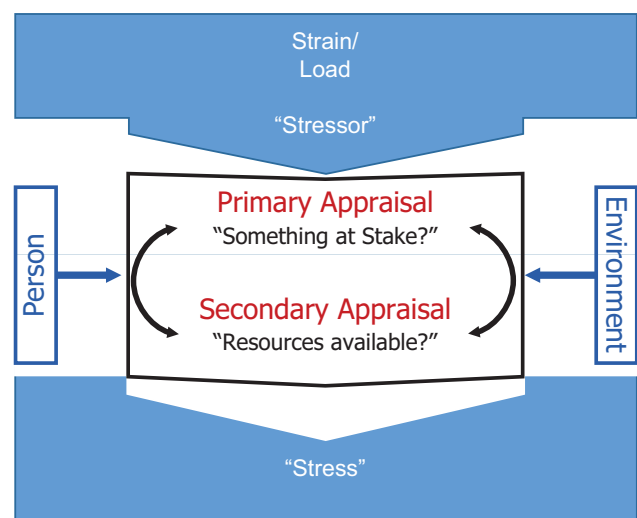


Fig. 12.6 Schematic representation of the transactional stress model

the situation (“secondary appraisal”). In principle, an event or situation can be cognitively appraised as irrelevant, benign-positive or stress-relevant. If the situation is appraised as a stressor, the individual would have to adapt to the situation. This need for adaptation can be perceived as a challenge, a loss/harm or a threat. A perception of loss or harm clearly refers to a situation in the past, whereas a perception of threat refers to possible loss or damage in the future—which then leads to stress. The term secondary appraisal seems to imply a hierarchical or sequential process. However, Lazarus and Folkman (1984) postulate that the appraisal of whether the person has possibilities for coping with the need for adaptation—such as corresponding own competences, social support or other resources—runs rather parallel and interacts with the primary, situational appraisal.

The transactional stress theory was further developed by Lazarus into an emotion theory, the “cognitive-motivational-relational theory” (Lazarus, 1991), in which the two appraisal processes still play the central role. The “primary appraisal” now includes not only what relevance an event has for the achievement of personal goals but also how much it is in line with personal goals and what consequences the event has for the self (e.g. self-worth, own values). In the “secondary appraisal”, it is a question of not only whether behaviour can be generated to cope with the situation but also what causes (or “causers”) can be found for an event and how the situation likely develops regarding one’s goals. According to Lazarus (1991), emotions are linked to specific appraisal patterns. Therefore, anxiety should arise from the appraisal that a situation or an event has high importance for the achievement of one’s goals, whereby one’s goals are rather threatened and one’s self-esteem must be protected.

➤ Key Points

Stressors (situations, events) are not always and, for everyone, equal triggers for stress/anxiety.

In between, there are appraisal processes of a situation (“Is something at stake?”) and of coping resources (“Can I do it?”).

Appraisal processes are dependent on environmental and personal characteristics.

The “core theme” of anxiety is the expectation of an uncertain, existential threat.

Effect of Stressors in Sport

Even if the transactional stress model is difficult to test as a whole, there are many indications of the validity of its core assumptions in sport. For example, there are interindividual differences in which events and situations are experienced as anxiety-inducing. This can be seen in the lists of anxiety-triggering situations obtained

by interviewing athletes and that there is little agreement between individuals about which situations trigger anxiety. A study of former female figure skaters, for example, revealed five major sources or “triggers” of stress in sport, including the anxiety-relevant area of “negative aspects of competition” (cf. Scanlan et al., 1991). However, only one stressor (“worries about competition”) met with the approval of at least half of the respondents. Furthermore, it was shown that the same event (e.g. “performing in front of an audience”) labelled by some as a “stressor” was labelled by others as “enjoyment”.

Situational and Resource Appraisal in Sport

The perception of a threat also proves to be decisive for the development of anxiety in sport. In a qualitative study with athletes from different sports, anxiety arose from the perception of threat or insecurity in the context of a competitive situation. However, appraisal processes convey not only *whether* anxiety arises in sport situations but also *how strongly* the anxiety is expressed (Cerin & Barnett, 2011; Hammermeister & Burton, 2001). For example, the more the opponent is perceived as strong, or the competition is perceived as important, thus as a threat, the higher the anxiety intensity. With coping or resource appraisal, it shows that perceived resources, especially emotional support, are associated with low anxiety in competition. Furthermore, factors of competition situations over which little control is experienced (e.g. weather) are associated with higher anxiety, and increased perceived situational control is associated with lower anxiety. However, coping appraisal seems less relevant for *triggering* competitive anxiety. It is likely to play a central role in *intensifying* the emotional experience of anxiety in the sense of a spiral of anxiety rather than an initial precursor to it. For example, a table tennis player reports: “I was anxious. I did not play well. I perceived that I was not able to play better. And this situation further increased my anxiety” (Martinent & Ferrand, 2015, p. 60).

➤ Situational (demand) and resource (coping) appraisal in competition are apparently related primarily to the intensity (and the increase) of the cognitive component (or worry) of competitive anxiety.

Personal and Environmental Characteristics as Moderators of Anxiety in Competition

The extent to which environmental and personal characteristics actually play a moderating role between stressors and anxiety experiences has hardly been investigated directly, for example, by means of moderation analysis (Cerin & Barnett, 2011). However, there is a whole range of indirect evidence: If one assumes that competition or

other anxiety-triggering situations are *objectively* the same for all people, then differences in *subjective* anxiety experience must be due to the influence of moderators. Among those, primarily personal and less environmental have been examined.

In sports and especially competitive situations, for example, men usually report lower levels of anxiety intensity than women (Jones et al., 1990, cf. also lower norms in the corresponding diagnostic instruments, e.g. Ehrlenspiel et al., 2009). It is assumed that age and experience are associated with low anxiety—but research findings are contradictory and mostly indicate that age, experience and performance level play a limited role. Even within a group of people who had competed at least nationally, age had no effect on anxiety, but experience (> 10 years) and a current top competition level were associated with lower competitive anxiety (Hanton et al., 2008b). Thus, it is probably competition experience that leads to a more favourable coping appraisal and thus lower anxiety. Correspondingly, cross-sectional studies (Fletcher & Hanton, 2001) and intervention studies (Ehrlenspiel & Elbe, 2008) show that the possession of psychological skills such as relaxation or imagery ability—which are acquired during basic sport psychological or skill training (Beckmann & Elbe, 2015)—can reduce anxiety experiences.

12

➤ It is mainly the experience with competition, rather than age or practice of the sporting disciplines or techniques, that leads to low anxiety in competition.

? On which personal and environmental characteristics does the degree of anxiety of competition depend?

Factors associated with higher anxiety:

- Female gender (Jones et al., 1990).
- Neuroticism (Cerin & Barnett, 2011).
- Perfectionism (Hall et al., 1998).
- Competitive trait anxiety (Hanton et al., 2002).
- Strong identification with the role as athlete (“athletic identity”; Mesagno et al., 2011).
- “Performance” vs. “mastery” goals (Kaye et al., 2015), with female athletes affected more by performance approach goals than male athletes (Stenling et al., 2014).
- An “entity mindset” vs. a “growth mindset” (Stenling et al., 2014).
- Gross (rugby) vs. fine motor (golf) sports (Mellalieu et al., 2004).
- Parental behaviour including being very directive (Fink et al., 2013) or initiating a low mastery or high ego motivational climate (O’Rourke et al., 2011).

- Red vs. blue uniform of the opponent (Recours & Briki, 2015).
- Individual sports (Martin & Hall, 1997; Flowers & Brown, 2002). Nevertheless, aggravating effects of team sports have been found as well (Cooke et al., 2013).

Factors associated with lower anxiety:

- “Hardiness”/resilience (Hanton et al., 2013)
- Training climate that promotes mastery vs. performance goals (Smith et al., 2007)
- Perceived cohesion in a team (Borrego et al., 2012)
- Home competition (Wolf et al., 2015)

12.3.2.2 Theory of Challenge and Threat States in Athletes

A further framework for understanding the emergence of anxiety is provided by the theory of challenge and threat states in athletes (TCTSA, Jones et al., 2009). The TCTSA (see ■ Fig. 12.7) also fits well into the Consensual Modal Model (Gross, 2008). Similar to Lazarus (1966), the core assumption is that a person appraises a situation within a goal-oriented performance action either as a challenge or a threat (Blascovich, 2008). This (cognitive) appraisal process includes both the evaluation of situational demands and individual resources for coping (Blascovich & Mendes, 2000).

The evaluation of the situational demands results in the perception of the significance of a situation, for example, when hazards are perceived, uncertainty prevails or a great deal of effort will be required. The evaluation of one’s resources then determines whether a person perceives the demands and the situation as a challenge or a threat. The situation is perceived as challenging if the person assesses that he or she has sufficient resources to cope with the situational demands and perceived as threatening if the person assesses insufficient resources to cope with the situation. These possible resources include abilities and skills and knowledge but also dispositional (i.e. stable) characteristics of the person such as self-efficacy and perception of control or goal orientation but also external support (Blascovich et al., 2003). In addition, Skinner and Brewer (2004) assume that a perception as challenge occurs when the situation offers sufficient prospects of success and the opportunity to acquire or develop one’s competencies. This, in turn, should increase confidence that the situational demands can ultimately be met. Conversely, a perception of threat should arise when a person assesses that the demands threaten his or her own self-esteem and he or she has little confidence in own abilities to cope with the demands. Challenge and threat are understood in the model as motivational states that indicate how a person deals with a personally significant situa-

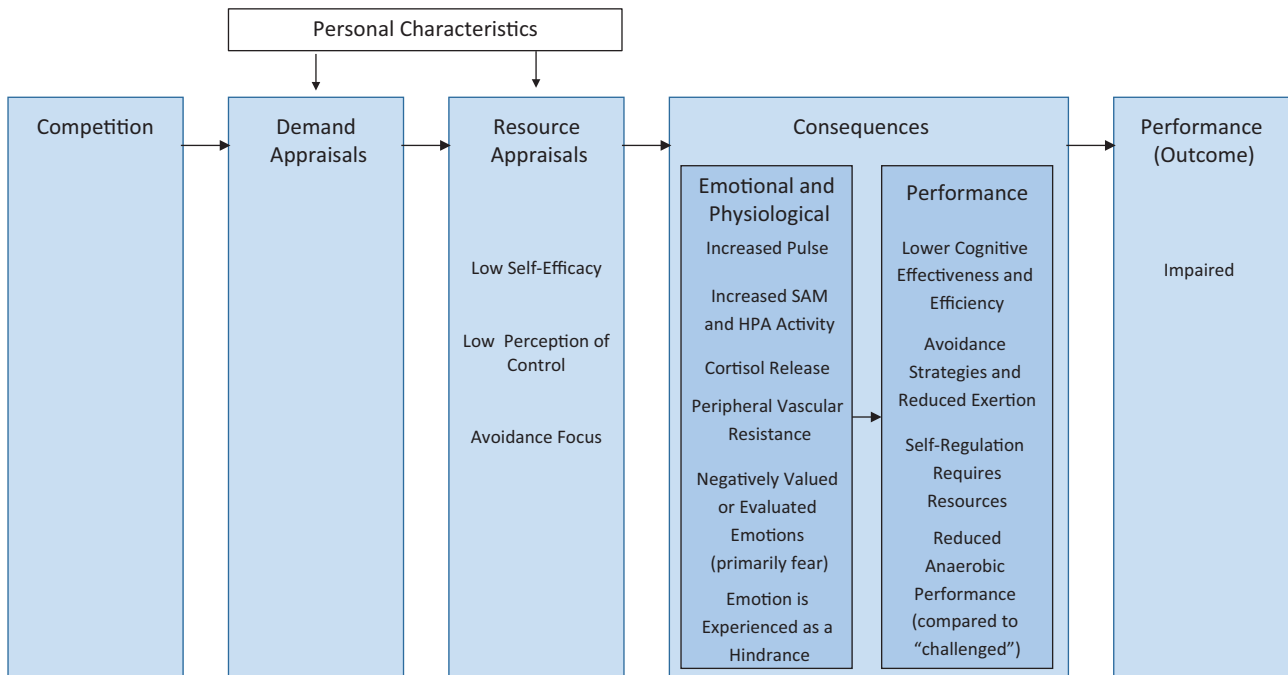


Fig. 12.7 Theory of challenge and threat states in athletes: the state of threat (after Jones et al., 2009)

tion (Blascovich & Mendes, 2000). For athletes, sport and competitions in general are likely “personally meaningful”, which is why states of challenge or threat—and, in the latter case, anxiety—arise very quickly.

➤ Situations in sport are more likely to be seen as challenging if coping with them is also associated with a gain, such as the acquisition of skills.

As a biopsychosocial model, TCTSA is somewhat more explicit in its assumption of the resulting reactions than the transactional stress model: The challenge or threat perception of a situation results in corresponding physiological and emotional reactions. As motivational states, both perceptions lead to an activation of the organism, but two “routes” of activation can be distinguished: the activation of the so-called sympathetic-adrenomedullary system (SAM), as well as the parallel activation of hypothalamic-pituitary-adrenal axis (HPA) (see Table 12.1).

The TCTSA further assumes that the emotions associated with the motivational states can become the subject of evaluation or rather interpretation processes and that these interpretations then (retroactively) influence the currently activated motivational state (Mendes et al., 2008).

Table 12.1 Comparison of reactions to situations that are perceived as threats or challenges (Blascovich & Tomaka, 1996)

Challenge	Threat
Activation of the sympathetic-adrenomedullary system (SAM) <ul style="list-style-type: none"> - Activation of the sympathetic nervous system - Release of nor-/adrenaline 	Activation of the sympathetic-adrenomedullary system (SAM)
Coordinated cardiovascular response <ul style="list-style-type: none"> - Increased cardiac output - Reduced peripheral vascular resistance - Increased blood flow - Efficient energy consumption 	Parallel activation of the hypothalamic-pituitary-adrenal axis (HPA) <ul style="list-style-type: none"> - Inhibition of nor-/adrenalin release - (Slight) increase in vascular resistance - Blood pressure rises - Inappropriate energy consumption
Joy, hope	Fear, anxiety

➤ Negative emotions (e.g. anxiety)—usually associated with a motivational state of threat—can also lead to the perception of a challenge if they are interpreted as helpful for overall performance.

Studies in sports show that a state of threat is associated with a stronger perception of anxiety, which is also interpreted as impairing performance compared to a state of challenge. It is generally assumed that challenging motivational states lead to a positive performance outcome, whereas threatening motivational states lead to decreased performance (e.g. Moore et al., 2013a; Turner et al., 2012).

12.3.2.3 Social Evaluation Processes

Situations in sport offer a social situation in which perceptions of threat and threat appraisal can occur in a variety of ways. According to Leary (1992), situations in sport are deeply social.

A key term that can explain why anxiety increases in such social situations is self-presentation. Self-presentation is described as a process in which people try to monitor and control how they are perceived and evaluated by others (Schlenker, 1980). This means that when people find themselves in a social situation, they want to behave in a way that they leave a positive impression on others. As a result of self-presentation, corresponding thoughts or concerns can arise (“self-presentation concerns”), in particular the anxiety of being evaluated by others. These thoughts and concerns in turn influence how people continue to behave in this situation. As a result of self-presentation, athletes may have concerns about their current form or fitness or about their own (lack of) ability. Doubts may also arise as to whether they can cope with pressure situations at all (e.g. Williams et al., 1999; Wilson & Eklund, 1998).

Self-presentation means to monitor and control how you are perceived and evaluated by others.

In a qualitative study, self-presentation proved to be a source of anxiety in competitions focusing on the importance of the competition itself or the presence of family and friends (James & Collins, 1997). Furthermore, 67% of the 48 sources of anxiety and stress around a competition could be attributed to the topic of self-presentation—a strong indication that these concerns about observing and evaluating oneself are widespread in sport. Research also shows a clearly positive correlation between self-presentation (or the thoughts and worries that follow from it) and state and trait anxiety (e.g. Hudson & Williams, 2001; Wilson & Eklund,

1998). Despite the knowledge of these apparently positive connections between self-presentation, anxiety and sources of stress in sports, the connection between self-presentation and anxiety has not yet been investigated directly. In a small correlational study of young competitive skiers, concerns about social evaluation and anxiety of competition before a competition were indirectly investigated (Bray et al., 2000). The concerns were mainly about the evaluation of competitive performance by family and friends but also the evaluation of skiing itself by friends and competitors. The level of concern about the social evaluation of competitive performance was also positively correlated with concerns about the outcome of the competition. Conversely, concerns about the evaluation of aspects not directly related to performance correlated more with the degree of perception of (physiological) excitement.

➤ Many people in sports are concerned that they are observed and evaluated (“self-presentation concerns”), which can lead to increases in anxiety.

As shown earlier in this chapter in the analysis of the sources of stress in sport study, observation by video cameras or spectators alone is not always sufficient to cause anxiety. This insight can also be well integrated into more comprehensive theoretical concepts (“social evaluative threat theory”, e.g. Rohleder et al., 2007), which define five necessary elements for the perception of social threat (see Question box below). It is assumed that people react to social threats in a similar way as to physical threats. Sporting competition situations are used to test predictions of the theory, for example, in dance sports. Furthermore, there are approaches to integrate the five elements into the design of training conditions in order to better prepare people for competitions and, in particular, to reduce anxiety (Argelaguet Sanz et al., 2015).

❓ Under what conditions does the perception of social threat arise?

- The situation involves a goal that is important to the person.
- A skill or personal attribute (e.g. “strength”) must be demonstrated that is important to the person.
- This skill or attribute is evaluated by others.
- A negative evaluation results in the loss of recognition or social status.
- Factors affecting goal achievement are perceived as insufficiently or as not at all controllable.

12.4 The Core: The Anxiety Response in Sport

Now we know characteristics of situations in sport that can trigger anxiety, and we know that attention and evaluation processes take place in these situations, which ultimately lead to the anxiety experienced. But how do we know that we are afraid? How can anxiety be described? If you asked the gymnastics student before his attempted vault, he would probably answer that he is quite excited, maybe a little shaky, and that he is worried that everyone will be watching and laughing at him if he makes a mistake. The student experiences and feels anxiety quite subjectively, without outsiders being able to judge it. Nevertheless, anxiety can also become visible to others, for example, when the teacher feels the student's cold hands or looks into his worried face while helping. The anxiety reaction can therefore be described—like any emotional reaction—as a multidimensional construct with reactions on different levels. A distinction is usually made between an experiential, a physiological and a behavioural component (Mauss & Robinson, 2009; Hackfort & Schwenkmezger, 1989). In principle, “anxiety” can be measured by means of all three components, although it is generally shown that there is little agreement between the measurements of the components—all three components therefore each represent something specific (Mauss & Robinson, 2009).

➤ Anxiety as a reaction is expressed in subjective experiences, physiological responses and behaviour.

12.4.1 Experiential Component

The experiential component makes up the actual “feeling” (i.e. the phenomenal and conscious experience) and its accompanying thoughts. It comprises everything that a person consciously experiences and “has in his/her head” in a situation. It is the level of reaction that probably has the fundamental meaning for the person, which includes feelings of tension, fear and arousal. In sport psychology studies, this reaction component is also in the forefront, especially when it comes to the question what effect anxiety has on sporting performance (► Sect. 12.5.1). Although there are approaches that assume anxiety as a unidimensional reaction (Spielberger, 1966), two facets of the anxiety experience are predominantly discussed in sport, namely, emotionality and worry (Liebert & Morris, 1967). Emotionality

(also known as “somatic anxiety”) is the *subjective* perception of physical bodily experiences. This is different to the actual physiological reactions of a situation where arousal changes. In fact, the two facets of reaction do not even have to be related (Mauss & Robinson, 2009). Emotionality is therefore the perception of how much excitement and tension a person feels, for example, the perception of a racing heart or the perception of “butterflies in the stomach”. The worry facet, conversely, encompasses the pure thought content, which in an anxiety situation mainly comprises worries and negative expectations but also negative thought loops, ruminations about oneself, the current situation or event and possible consequences (Morris et al., 1981). However, there are also indications that the distinction between somatic and cognitive anxiety experience can also be distinguished neurophysiologically. Apparently, somatic anxiety (as “anxious arousal”) and cognitive anxiety (as “anxious apprehension”) are based on the activation of different specific networks (e.g. Burdwood et al. 2016).

Emotionality refers to the perception of physiological symptoms of anxiety, such as the queasy feeling in the stomach. It is also known as somatic anxiety.

Worry is the cognitive component of anxiety, which is expressed in worries, apprehensions and negative thought loops. It can be referred to as cognitive anxiety.

Measuring the experience of trait or state anxiety is important for researchers to understand the interaction between anxiety and performance. The experiential component of anxiety can only be determined by asking the individual about the content of his or her emotion. This is of course possible by asking open questions (qualitative approach) or by using standardized measuring methods, namely, questionnaires (quantitative approach). For qualitative inquiry into competitive anxiety, mostly semi-structured interviews have been used but also analyses of diaries, open questions in questionnaires or recordings of think-aloud verbalizations (Neil et al., 2009). While there is a whole range of instruments for measuring trait anxiety in different sports contexts, there are only a few instruments for measuring state anxiety (see Methods Box and ► Table 12.2).

Table 12.2 Questionnaires for assessing trait anxiety and state anxiety, which are frequently used for research studies but also in counselling practice in sport

Questionnaire	Introduction/item-stem	Subscales	Example for item content
State-Trait Anxiety Inventory (Trait)	Answer which best describes how you usually feel	–	I'm worried about a possible mishap
State-Trait Anxiety Inventory (State)	Give the answer which seems to describe your present feelings best	–	I am perturbed
Sport Anxiety Scale (Trait)	[Answer] how you <i>usually</i> feel before or while you compete in sports Before or while I compete in sports:	Somatic anxiety	... I feel tense in the stomach
		Cognitive anxiety	... I worry that I will not play well
		Concentration disruption	... I cannot think clearly during the game
Competitive State Anxiety Inventory-2	... choose the answer which describes your feelings right now	Somatic anxiety	... my heart is racing
		Cognitive anxiety	... I'm concerned about performing poorly
		Self-confidence	... I'm confident I can meet the challenge

? What methods are available for measuring trait anxiety and state anxiety in sport?

Trait anxiety

- Physical Activity and Sport Anxiety Scale (PASAS; Norton et al., 2004)
- Sport Anxiety Scale (SAS; Smith et al., 1990; Revised Form: Smith et al., 2006; translations and adaptations into French, German, Norwegian, Spanish and other languages)
- Sport Competition Anxiety Test (SCAT; Martens et al., 1990b)
- Sport Injury Anxiety Scale (SIAS; Rex & Metzler, 2016)
- Sport Injury Trait Anxiety Scale (SITAS; Kleinert, 2002)
- Social Physique Anxiety Scale (SPAS; Hart et al., 1989)
- Trait version of the State-Trait Anxiety Inventory (STAI, Spielberger et al., 1983; translations into many other languages)

State anxiety

- State version of the STAI (Spielberger et al., 1983; translations into many other languages)
- Competitive State Anxiety Inventory-2 (Martens et al., 1990a; new version Cox et al., 2003; translations and adaptations into Brazilian, French, Greek, Swedish, and other languages)
- Mental Readiness Form (Krane, 1994)
- Retrospectively through direct questioning in an interview (e.g. Mesagno et al., 2009).

For the situations described in the introduction, there are many indications of increased anxiety reaction in

the experiential component. For example, it was shown that competition-related somatic anxiety and also cognitive anxiety in the period of 4 days before a competition increase towards the day of the competition, with a greater increase in somatic anxiety (Hanton et al., 2002). There is evidence that climbers report higher levels of somatic and cognitive anxiety using the CSAI-2R in the ascent than in the descent (Draper et al., 2008). When people skydive for the first time, they report higher levels of state anxiety when waiting in the airplane for their jump than when they fill out the questionnaire after the jump (Hare et al., 2013).

12.4.2 Physiological Component

Emotions are always associated with activation states of the body, which are accompanied by changes in the different physiological systems operated by the brain or the autonomic nervous system. These represent functional changes in response to the perception of a threat. The core of the physiological reaction component of anxiety is an activation of the organism—especially the autonomic nervous system—and thus a change in the activity of the sympathetic and parasympathetic nervous systems. This leads to measurable physiological changes in the various systems. Hackfort and Schwenkmezger (1989) have tried to categorize these changes into three different classes: respiratory-cardiovascular, electrophysiological and biochemical changes. Psychophysiology provides methods of detecting these changes. A general problem with measuring anxiety in sport via the physiological component is that sporting activity in itself causes physiological changes.

■ **Table 12.3** Physiological indicators of anxiety and methods of measuring them (Hackfort & Schwenkmezger, 1989)

Indicator	Physiological change	Measurement method
Respiratory-cardiovascular	Blood pressure rises Heart rate increases Heart rate variability Respiratory frequency increases Depth of breath increases Peripheral vasoconstriction	Sphygmomanometer Heart rate monitor Electrocardiogram (ECG) Respiration sensor (chest/abdominal belt) Photoplethysmography
Electrophysiological	Skin conductance increases Muscle tone increases Cortical spontaneous activity changes	Electrodermal activity (EDA) Electromyogram (EMG) Electroencephalogram (EEG)
Biochemical	Adrenaline release Cortisol release Alpha-amylase increase Lactate increase	Plasma, urine samples Plasma, saliva samples Saliva sample Blood sample

An increased pulse rate before the 100 m run, for example, is probably largely due to the warm-up programme. ■ Table 12.3 gives an overview of physiological indicators of anxiety and how to measure them.

Methods for measuring changes in the cardiovascular system as well as electrophysiological changes are often used in laboratory studies for a so-called manipulation check (**Manipulation check**). Thus, “pressure situations” can be detected in the laboratory by increased heart rate (e.g. Masters, 1992), increased sweating (measured via electrodermal activity, e.g. Tremayne & Barry, 1990), an increase in muscle tone (e.g. Caruso et al., 1990) or altered neurophysiological processes (e.g. Murray & Janelle, 2007).

In contrast, biochemical or neuroendocrine indicators are often used in field studies. Many neuroendocrine indicators or “markers” can now be easily collected using saliva samples and evaluated in the laboratory (Strahler & Klumbies, 2012) (■ Fig. 12.8).



■ **Fig. 12.8** Parachutist shortly before exiting the airplane

Manipulation Check

In psychological experiments, one would like to determine the effect of a condition on a dependent variable, for example, the effect of anxiety on the performance of a sporting task. To do this, an experimental manipulation is first carried out to create this condition in the laboratory. Anxiety is to be created, for example, by a simulated competition situation. In order to be able to trace changes in the dependent variable (here, execution of movement) back to the condition (here, anxiety of compe-

tion), this condition must have been proven to exist. It is easy to imagine that “competitive anxiety” cannot be generated in a psychological laboratory immediately. Therefore, it is important to test the effectiveness of the manipulation of conditions (e.g. by spectators or the threat of punishment) independently of the effect (e.g. changed, shaky execution of movements). In experiments on the phenomenon of choking under pressure, therefore, it is usually first checked whether the participants were “under

pressure”, e.g. by means of an anxiety questionnaire (e.g. Ehrlenspiel et al., 2010) or by means of changes in physiological variables such as heart rate (e.g. Masters, 1992). Only when this proof has been successful can changes in the dependent variable be meaningfully attributed to the experimental manipulation. In the experiments of Ehrlenspiel et al. (2010), for example, only the data of people who actually reported higher anxiety in the “pressure condition” were therefore evaluated.

12.4.3 Behaviour Component

Since emotions have evolved, presumably to produce adaptive behaviour, emotions are also associated with behaviour or behavioural tendencies. Depending on the conception, the behavioural component comprises only expressive behaviour (e.g. facial expressions and gestures) or information processing processes (e.g. attention) or even behavioural willingness and tendencies (e.g. approach or avoidance behaviour).

12.4.3.1 Expressive Behaviour

How anxiety in sport is reflected in expressive behaviour has not yet been explicitly investigated. But the results of studies on non-verbal expressive behaviour in football (e.g. Furlley et al., 2012) can be interpreted in such a way that the so-called submissive behaviour of, for example, a penalty kicker—lowered gaze, avoidance of eye contact, drooping shoulders—gives goalkeepers the impression that the kicker experiences anxiety. It is also suspected that penalty shooters who hurry to prepare their shot and may even turn away from the goalkeeper to take a run-up are also expressing anxiety (Jordet & Hartman, 2008). This behaviour can also be interpreted as escape or at least avoidance behaviour—a central behavioural tendency associated with anxiety. Because actual escape behaviour is not possible, for example, in a penalty shootout, escapist tendencies might include a final, shorter preparation time or avoiding eye contact to at least provide a quick, albeit short-term relief from anxiety and the social evaluation situation. However, analyses of World and European Championship penalty shootouts show that this behaviour also tends to lead to missed penalty shots (Jordet & Hartman, 2008). It remains unclear in these studies on expressive behaviour and behavioural willingness whether and to what extent they are really related to anxiety or even express anxiety. It is obvious to assume anxiety in the case of a penalty shooter. Surveys of participants in a penalty shootout at a European Championship confirm

this impression (Jordet & Elferink-Gemser, 2012), but in the studies themselves anxiety was not recorded or even deliberately manipulated.

- Anxiety in sport is expressed at the behavioural level in the form of submissive (e.g. lowered gaze) or avoidance behaviour (e.g. turning away from the goalkeeper).

12.4.3.2 Information Processing

The altered cognitive processes associated with anxiety are also blamed for the often unfavourable effects of anxiety on behaviour—such as on athletic performance in competition (► Sect. 12.5). The focus is on altered attention processes, and there is also evidence of altered decision-making processes. The latter have so far been studied mainly in referees (e.g. Neil et al., 2013). It can be assumed that anxiety is also associated with altered processes, for example, in individual or group tactical decisions. While the self-report of English referees (Neil et al., 2013) did not indicate any effect of pressure characteristics (such as spectator behaviour) on their decisions in the game, an experimental study was able to prove such an influence (Balmer et al., 2007). In the evaluation of controversial video scenes of a football match, noise from the spectators led to a preferential treatment of the home team. This tendency to judge was stronger the more the experienced referees reported cognitive anxiety.

- Anxiety also expresses itself in changed and rather unfavourable attention processes and decision-making behaviour.

More extensive are the findings on altered attention processes, which play a major role in explaining performance deficits under pressure. In theory, the altered cognitive processes can be classified in the Attentional Control Theory: Sports (Eysenck & Wilson, 2016).

Side Story

[Attentional Control Theory: Sports]

If one wants to explain how anxiety leads to poor performance (► Sect. 12.5), information processing and especially attention processes play a major role. According to the attentional control theory (Eysenck et al., 2007), anxiety is associated with a lower processing efficiency of information processing, although this is not necessarily reflected in perfor-

mance effectiveness. This distinction thus allows to explain why pressure situations do not necessarily lead to worse performance. Additional effort and motivation can compensate for the reduced processing efficiency and maintain performance. The theory also distinguishes two attention systems: a targeted, intentional “top-down” system of “proactive control” and a stimulus-driven “bottom-up” system

of “reactive control” that responds to sensory stimuli. Under pressure, proactive control is disturbed. Especially central executive functions such as “inhibition” (i.e. of stimuli and reactions) and “shifting” (i.e. changing of attention) should be impaired. Stimulation (and thus bottom-up attention) is thus given greater importance, but a person would also be more easily distracted from the actual task.

The extension to Attentional Control Theory: Sports (ACTS; Eysenck & Wilson, 2016) takes into account the specific conditions of performance situations in sports compared to the cognitive performance usually investigated. Thus, the current anxiety state probably plays a more important role. According to ACTS, this arises primarily from distorted attention control and a distorted appraisal of the situation (Sect. 12.3). In a sport performance situation (“pressure”), threat-relevant stimuli (e.g. the opponent) are perceived and ambiguous stimuli (e.g.

spectators) are perceived as threatening, which increases anxiety. These cognitive distortions are also accompanied by increased “error monitoring”—people compare the execution of tasks with a target and are more likely to perceive mistakes. This can create a vicious circle in sport situations: The increased perception of errors also leads to a perception of failed execution or even failure, which is likely to result in increased anxiety and increased selective attention to threatening stimuli and their interpretation. Sporting situations with their mostly

immediate performance feedback and the “costs” associated with failure represent special conditions in this respect. However, the ACTS explicitly assumes that inadequate attention control occurs only rarely and only under particularly high levels of anxiety, for example, when serving in the Olympic final or after a particularly unsuccessful attempt. However, in order for the targeted and proactive control system to remain activated even in cases of anxiety, either special motivation or at least additional processing resources and self-control are required.

Anxiety seems to be primarily associated with the fact that distracting or disturbing thoughts are harder to suppress (“inhibition”, [Attentional Control Theory: Sports](#)) and that the focus of attention is unfavourably changed (“shifting”, [Attentional Control Theory: Sports](#)). That disturbing thoughts appear in anxiety situations can be shown by qualitative methods. Correspondingly, a quarter of the statements of top athletes on thought content during competitions could be assigned to the categories “distraction” or “disturbance”, whereby the recording was thus again based on the experience component (Oudejans et al., 2011).

- **Anxiety in sport is expressed in the fact that distracting thoughts are harder to control and the focus of attention is directed to threat-relevant stimuli.**

More objectively and actually on the behavioural component, attention processes can be inferred by recording eye movements. The “quiet eye” (Methods Box Quiet Eye) is particularly relevant here (i.e. the final fixation) in the course of movement. The quiet eye requires attention control in terms of orientation and shielding from other stimuli (Eysenck & Wilson, 2016). Accordingly, anxiety should affect the duration of the quiet eye and the number of fixations. And indeed, a study on free-throw basketball (Wilson et al., 2009) showed that under anxiety the duration of the quiet eye decreased and at the same time the number of (further) fixations increased—an indication of impaired inhibition and greater distractibility by external stimuli. Attentional control can also be trained, for example, by means of simple visual search tasks on a monitor. After such attention training, tennis players in a pressure situation showed longer final fixations and more stable scoring performance compared to a control group without attention training (Ducrocq et al., 2016).

- **Anxiety is expressed in the gaze behaviour by numerous and restless eye movements and a short last fixation (“quiet eye”).**

Sports Practice

In football, the penalty kick represents the greatest possible pressure situation for shooters. In addition to the situation as such, the goalkeeper’s behaviour has a strong influence on the penalty kick and thus causes further uncertainty among the players. When it was still one of the truths in football—or at least a felt truth—that English teams in particular lose in important penalty kicks, this was one of the reasons why the British Association of Sport and Exercise Sciences invited experts to compile the most important findings on psychological preparation for a penalty kick and to communicate them in an understandable way in an “expert statement” (Wilson et al., 2013).

While it is difficult to imitate in training the tension of a penalty kick during a World Cup final, the action strategies of penalty takers can be trained. Such strategies can be derived from many research findings and should be developed jointly in team meetings. Penalty takers show more precise performance when they choose their target independently of the goalkeeper. A hard and precise penalty kick is difficult to “save” anyway. So work should be done to constantly convert shots from the penalty spot into all four corners of the goal. In order to increase the difficulty of the exercise and the pressure, the goalkeeper can even be told the shot direction in advance. The sequence of action steps during the penalty, from the placing of the ball on the penalty spot to the cheering after the goal, can also be

stabilized by rituals. The individually rehearsed routines help players to achieve maximum performance in extreme situations such as the World Cup final.

In competition, it is important that players trust their own learned skills, set the goal in advance and focus on it. In addition, it is crucial to maintain temporal consistency throughout the course of the action to avoid rushed shots and unsuccessful performance. For example, players were more successful if they took more time when placing the ball and after the referee’s whistle (Jordet & Hartman, 2008). Finally, penalty kicks are not only about doing your own job, but also about keeping your teammates on the ball. Cheers and openly displayed emotions after a goal is scored are conducive to encouraging those who follow and intimidating the opposing team.

Finally, tactical measures can also be used; it is a psychological advantage to start in a penalty shootout with the first penalty kick. If you take a penalty kick that promotes your team’s victory, you are more likely to succeed than if you take a penalty kick to avoid defeat (i.e. you are currently behind).

12.5 Effects of Anxiety in Sport

The question of the effects of anxiety in sport, especially on athletic performance, is one of the core questions in sport psychology research and consulting. Anxiety is often seen as the cause of failure in competition or of apparent avoidance behaviour in physical education. Research first attempts to clarify the relationship between anxiety and behaviour and especially performance in sport (see Fig. 12.9). From this personality psychological “state perspective” (Ehrlenspiel et al., 2018b), the connection between anxiety and performance is quantified, for example, by correlating values in an anxiety questionnaire with sporting performance. Research also attempts to elucidate the mechanisms of this relationship and to establish generally valid rules. From this “general psychological” perspective, cognitive processes, especially of attention control during movement but also of motivation, are suspected and tested. Finally, research attempts to identify stable characteristics of people (and situations) that have an influence on this relationship (the “trait perspective”). In addition to the effect of anxiety on performance in sport situations, anxiety has other effects such as preventive actions, but these have rarely been studied.

12

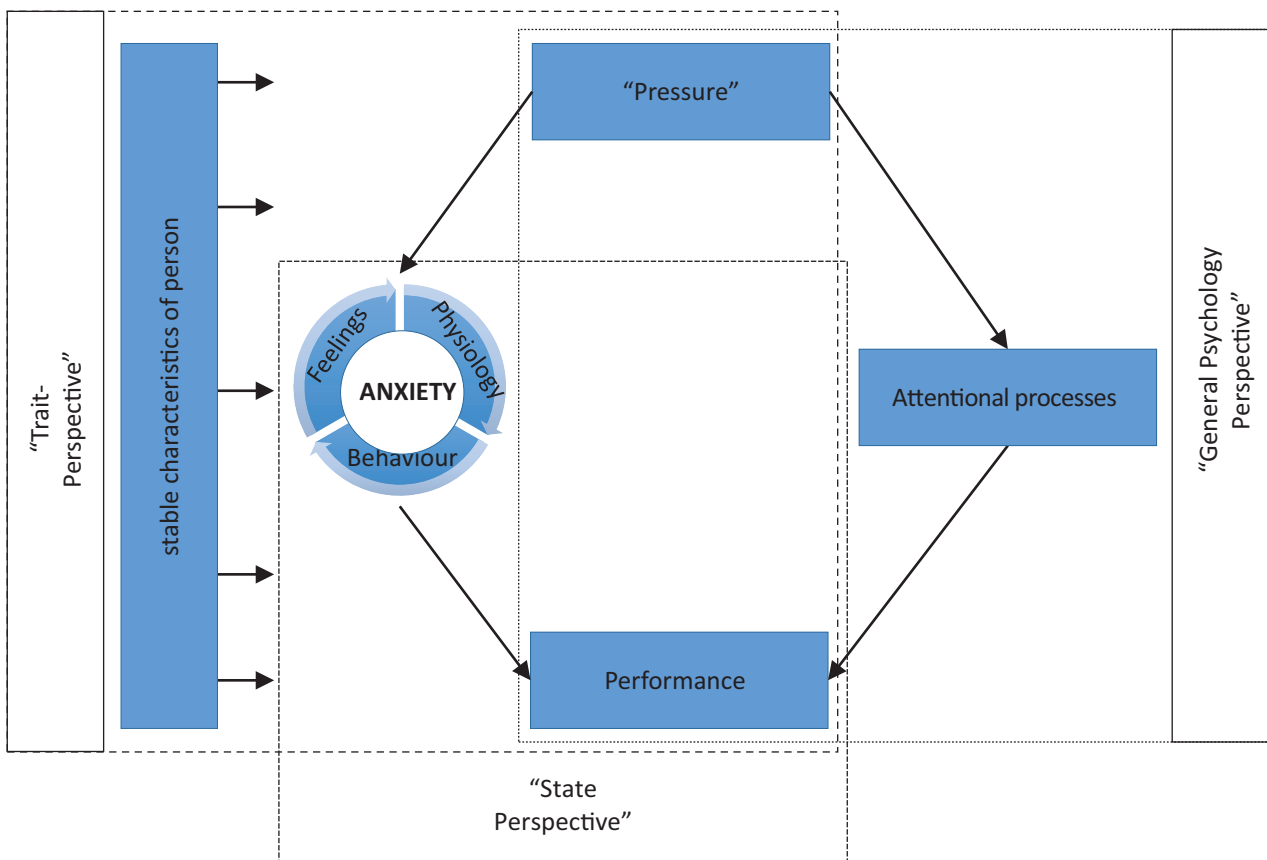


Fig. 12.9 Perspectives on the relationship between anxiety and performance

12.5.1 Anxiety and Athletic Performance

Intuitively, the relationship between anxiety and sporting performance might be that anxiety has a negative effect on sporting performance and that this becomes even stronger with an increase in anxiety intensity. However, research over the last 100 years shows that this relationship is by no means simple.

12.5.1.1 Drive

An early conceptual anxiety-performance relationship was Hull's drive theory and the expansion of Spence's approach (Hull, 1952; Spence & Spence, 1966). In essence, this is a motivation theory which assumes that energy activation of the organism occurs when especially primary and thus mostly physiological needs are threatened or unstable (so-called drive). With increasing drive, the activation ("arousal") also increases, which in turn increases effort, emotions and motivation. The greater the drive or activation, the better the sporting performance should be. However, perhaps also on the basis of personal experience, one can doubt whether an increased level of activation in all sports is purposeful and results in optimal performance. Golfers, for example, do not usually hype themselves up before they tee off or putt; they want to be calm. And (only) in this way they are able to consistently achieve their best performance in these situations. Hull's theory is therefore not particularly successful in predicting athletic performance under conditions of increased activation. Moreover, as a motivation theory, it cannot explain important phenomena—such as the motivational effect of money, which does not satisfy any physiological need. But it is the basis for a more general psychological extension, which assumes that differences in activation stimulate different cognitive processes.

12.5.1.2 Inverted-U Hypothesis

A better-known anxiety and performance assumption is an initially positive effect of increased (anxiety-related) activation but, rather than linear, an inverted U-shaped connection between anxiety (or, more precisely, activation) and performance. This assumption, also known as the "Yerkes-Dodson hypothesis", states that when activation increases, (athletic) performance also increases until an optimal activation level is reached. Once the optimal activation level is reached, however, a further increase in activation leads to decreased performance. This means that moderate activation levels create optimal performance. Low or high activation levels, conversely, can result in poorer performance. This assumption is based on a study of mice by Yerkes and Dodson (1908). The mice learned to orient themselves in a labyrinth and were punished with electrical shocks of

different currents when they made mistakes. Mice that were punished with a medium current needed the least learning attempts; at very high or very low currents, the mice learned much slower.

- The inverted-U hypothesis' means that a medium activation level is most effective for optimal performance.

The inverted-U hypothesis offers an intuitive and easy answer about the anxiety-performance relationship (Krane, 1992), and some empirical evidence of its validity can also be found. For example, an inverted U-shaped relationship between competitive anxiety and performance was found in female basketball players (Sonstroem & Bernardo, 1982) when comparing three games. In the game, the players indicated a medium level of competitive anxiety, and the best performance was also shown.

? What are the criticisms of the so-called inverted-U hypothesis?

- Some researchers suggest that the theory, by its simplicity, is not able to describe what happens when performance drops dramatically and abruptly.
- Optimal performance does not occur in all sports or all athletes at a moderate level of activation.
- Research on the inverted-U hypothesis takes a one-dimensional perspective. In essence, it refers only to the physiological aspect, the activation, but not to the experience.
- In many empirical studies, however, the physiological aspect is then only investigated by means of questionnaires and the recording of emotionality.

12.5.1.3 Multidimensional Anxiety Theory

With the development of a multidimensional understanding of anxiety with the components worry and emotionality, the idea of the connection between anxiety and performance also changed. The focus of the multidimensional anxiety theory (MAT; Burton, 1988; Martens et al., 1990a) is no longer physiological activation but the subjective experience of anxiety with its components. For both components, different specific correlations with performance are postulated.

For cognitive anxiety, the hypothesis is that it is linearly negatively related to performance. Performance decreases with an increase in cognitive anxiety because essential resources are consumed by cognitive anxiety and therefore no further attention capacity is available to support task performance (Wine, 1971). The MAT assumes the relationship between somatic anxiety and performance has an inverted-U relationship, whereby optimal performance can be expected with moderate

somatic anxiety. Performance slumps, however, can occur when the optimal level of somatic anxiety is not achieved or is exceeded. In addition, the MAT indicates that self-confidence has a moderating influence on the anxiety-performance relationship. Self-confidence is conviction in the ability to successfully perform an action or behaviour. In general, the more self-confidence a person has, the less anxiety he or she feels. Self-confidence and performance have a positive linear relationship. With increasing confidence, performance is also enhanced.

- According to multidimensional anxiety theory, cognitive anxiety is negatively related, and emotionality is inversely U-shaped, to performance.

Only a few studies have explicitly tested the inverted-U relationship between somatic anxiety and performance. Burton (1988) found an inverted-U relationship between somatic anxiety and performance in various swimming competitions and a negative linear relationship between cognitive anxiety and performance. However, this negative linear correlation seems to be only slight. This is shown by meta-analyses (Craft et al., 2003; Woodman & Hardy, 2003), and these also fail to agree on the influence of gender or competitive level on this correlation (Ehrlenspiel et al., 2018b). The correlation between self-confidence and performance seems to be a strong positive correlation (i.e. confidence leads to better performance). One might say that it is not anxiety that leads to poor performance but the absence of anxiety that leads to good performance.

- In summary, the MAT assumes that the best possible performance is achieved when there is high self-confidence, a moderate level of somatic anxiety and low cognitive anxiety.

12.5.1.4 Catastrophe Theory

A major criticism of the MAT is that it cannot explain why a significant sudden drop in performance can occur even though, for example, an athlete has shown a good competitive performance up to that point. These sudden drops in performance are the beginning of the “catastrophe theory”. It is based on a multidimensional understanding of anxiety and assumes an interaction, a mutual influence of somatic and cognitive anxiety (Hardy, 1990).

The catastrophe theory predicts that when cognitive anxiety is low, the relationship between physiological activation (arousal) and performance changes depending on the level of cognitive anxiety. In principle, the catastrophe theory assumes an inverted-U shape between arousal and performance. Moderate arousal leads to optimal performance; too low or too high

arousal can impair performance. Increasing cognitive anxiety now results in a more pronounced inverted-U relationship. With increases in cognitive anxiety, increasing physiological arousal increases performance to an optimal point. A further increase in arousal (under higher cognitive anxiety) beyond this point results in “drastic” performance losses, a “catastrophe” (Hardy & Parfitt, 1993). This catastrophe is also reflected in a hysteresis effect: When a catastrophe occurs, a significant reduction in arousal is necessary to restore the previous performance level.

- According to catastrophe theory, the effect of arousal on performance is also inversely U-shaped, but increasing cognitive anxiety leads to a more pronounced correlation and therefore tends to lead to drastic performance losses.

The dramatic course, the “catastrophe”, between anxiety increase and performance is, for example, presented in a qualitative study (Edwards et al., 2002): The athletes from very different sports complained about a sudden but also an unstoppable drop in performance. In quantitative studies, however, there was often no evidence of the hysteresis effect (Hardy et al., 1994). Presumably, self-confidence could have a buffering effect on the relationship (Hanton et al., 2008a). For example, athletes with strong self-confidence may be able to tolerate increased arousal before a drastic drop in performance occurs.

- Once sporting performance has collapsed under high cognitive anxiety due to too much arousal, a significant relaxation is required before performance can be maintained or increase again.

The merit of the catastrophe theory lies first in that at least two components of anxiety are no longer only considered independently of each other (as in the MAT) but that they (obviously) interact. However, the postulated nonlinear relationship is difficult to test empirically (cf. Krane, 1992). And in terms of content, it remains controversial whether this is actually arousal (i.e. the physiological) or whether the somatic anxiety (i.e. the experiential component) is not actually the more relevant factor.

12.5.2 Anxiety and Movement Control

Based on the anxiety-performance relationship discussed thus far, one might question what processes are responsible for declines in performance as a result of increased anxiety. From a general psychological perspective, we try to uncover generally valid mechanisms

that can explain *how* anxiety leads to poor performance. Important explanatory approaches were initially based on the ideas of the drive theory already discussed (Hull, 1952), which focused primarily on physiological arousal. Currently, however, mainly attention processes are discussed, partly in connection with working memory.

The first theoretical approaches to the mechanisms of the anxiety-performance relationship originate from a diametrically opposed research approach, the research on social facilitation. Beginning with the observation by Norman Triplett (1898) that cyclists in his laboratory rode faster when other cyclists were present, attempts were made to investigate the (beneficial) effect of spectators or those present on (athletic) performance. With increasing research, there were increasing indications of a “paradoxical” effect (Baumeister & Showers, 1986), namely, failure under pressure—known as choking under pressure (i.e. choking). It seems important to note that for choking to occur, the increase in perceived anxiety and a decrease in performance below the individual’s normal performance level are essential (Mesagno & Hill, 2013).

Choking under pressure is the acute and significant decline in skill and performance caused by increased anxiety under perceived pressure, even if one’s own performance expectations were actually achievable (Mesagno & Hill, 2013).

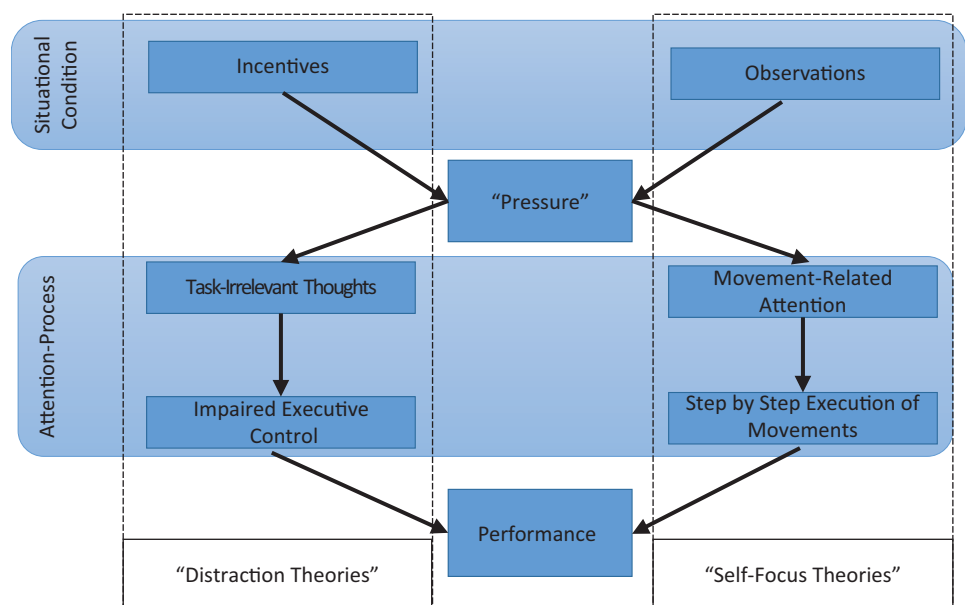
Optimal performance in sport is characterized by the direction of attentional focus towards task-related information and simultaneous ignoring of irrelevant information (Moran, 1996). For example, a student queuing

to perform a gymnastics vault might concentrate on a specific point on the vaulting horse (task-related information) rather than focusing on the painful experiences of previous attempts over the apparatus (irrelevant information). Focusing on a specific point would help the student to successfully complete the task. Under increased anxiety, however, unfavourable attentional shifts may occur, and in the case of choking it is discussed whether anxiety leads to distraction (Distraction Model) or to increased self- or movement-related attention (Self-Focus Model) (see Fig. 12.10).

12.5.2.1 Distraction

In sport, the so-called distraction models of choking show that athletes are more easily distracted by task-irrelevant information when their anxiety increases (Mesagno & Beckmann, 2017). This leads to a shift in attention away from task-relevant information. Choking occurs mainly because the processing of task-irrelevant information (e.g. also anxiety, explicit self-instructions) exceeds a certain level of attention capacity and thus reduces the potential space of attention that would be necessary for optimal performance. Evidence of the validity of the “distraction” assumption is derived from qualitative studies on the experience of “pressure” by competitive athletes and from experimental studies, especially on perception and eye movements. In a qualitative, interview-based study, experienced competitive athletes stated that in decisive situations (i.e. “pressure situations”) they focused primarily on worries and negative thoughts and thought little about the execution of movements (Oudejans et al., 2011). In addition, they often expressed the desire to choose a positive internal-personal attention focus, which could be used for motivation or concentration control. If one examines eye

Fig. 12.10 Contrast of the two most discussed approaches to explain the phenomenon of choking under pressure



movements under pressure, athletes tend to look at more places, more briefly, and, in particular, focus on the target more briefly, than under no anxiety (e.g. Vickers & Williams, 2007; Wilson et al., 2009).

➤ **Distraction models assume that under pressure, task-irrelevant information is processed and therefore attention resources are missing.**

One mechanism is explicitly postulated by the attentional control theory ▶ Sect. 12.3.1 of Eysenck et al. (2007), which assumes that anxiety impairs working memory functions. As a result, more task-irrelevant internal and external stimuli are processed, and the capacity of working memory decreases further. This deficient information processing can, however, be compensated by increased effort, and experiments have shown evidence of impaired attention processes (in the EEG; Murray & Janelle, 2007 or in eye movements; Alder et al., 2016) while maintaining the same effectiveness (i.e. performance). However, these compensation strategies can also be ineffective (Eysenck & Calvo, 1992).

12.5.2.2 Movement Focused Attention

Advocates of the so-called self-focus models (e.g. Baumeister, 1984; Beilock & Carr, 2001; Masters, 1992) assume that choking occurs because attention is focused on the execution of movement when anxiety increases. The origins for self-focus models are theories of motor learning (e.g. Fitts & Posner, 1967). These theories assume that, at least in explicit (i.e. conscious) motor learning processes, movements are initially performed step by step, consciously and in a controlled manner. With increasing skill level, the execution no longer requires constant conscious control. From a moderate skill level and above, movements are automated and one can, for example, work on other (cognitive) tasks. The volleyball player, for example, no longer has to concentrate on the sequence of partial movements of the jump serve but is rather able to perceive and process the tactical signs of her teammate and execute her serve accordingly. With increased anxiety, however, people may involuntarily focus their attention on their own movement execution. Conscious observation (“explicit monitoring”; see Beilock et al., 2002) or even conscious execution (“conscious processing”; Masters, 1992) of movements should then interfere with the otherwise automatic execution of movements and lead to choking under pressure.

➤ **Self-focus models assume that attention is drawn to the movement under pressure, which impairs the “automatic” fluid execution.**

Beilock and Carr (2001) showed that pressure can lead to performance-impairing attempts at conscious control and a step-by-step execution of movements, even if these are otherwise already executed automatically. Normally fluid movements, which are necessary for the successful execution of movements, are thus prevented. In this way the volleyball player could become aware of the steps required for a serve, and through this conscious control, mistakes could arise, for example, at transitions between partial movements.

Masters (1992) furthermore suggested that under “pressure” explicit knowledge about movement is reinvested (i.e. becomes conscious and is used to control movements). This knowledge is usually used at the beginning of motor learning processes and also traditionally at the heart of skill instruction. Controlled execution, as it takes place at the beginning of learning, should then lead to poor performance. In his study, masters’ participants were supposed to learn golf putts—by explicit (explicit instructions on how to execute movements) or implicit movement learning (without explicit instructions, with additional task). The golf putts were then to be executed under low and high stress. Masters was able to prove that the performance of participants who had acquired the skills through explicit movement learning deteriorated under stress. In contrast, those participants who had learned the skills implicitly were able to maintain their performance. People who learn movements implicitly should therefore be able to automatically retrieve their performance under stress, as they do not have explicit information available to them, which may be detrimental under stress.

➤ **Learning processes in sport are often designed in such a way that a lot of explicit knowledge about movement is generated. However, implicit learning, for example, via analogies or metaphors, could prevent choking.**

12.5.2.3 Environmental and Personal Characteristics as Moderators

There are attempts to reconcile the two different approaches (see Mesagno et al., 2015), with “distraction” and “self-focus” as two sides of the same coin—movement-related attention would then be nothing more than a drain on attention resources. However, this approach does not appear to be effective in view of the very different mechanisms of action (Ehrlenspiel et al., 2018b). It would probably be more beneficial to look for moderators (i.e. for situation or personal characteristics) that could influence the relationship between anxiety and performance.

On the situational side, there are indications that distraction is more likely to be effective in cognitive perfor-

mance (e.g. arithmetic tasks). Attentional resources are then no longer available for executive functions such as planning. In the case of procedural performances such as sport, movement-related attention should interfere with otherwise automatic execution. The type of “pressure” is discussed as a further situation characteristic. If “pressure” results mainly from incentives or the avoidance of negative consequences (“outcome pressure”), this should lead to distracting thoughts. If, however, “pressure” results from the expectation of an evaluation of the person (“monitoring pressure”), self-monitoring and conscious task execution arise (see Beilock & Carr, 2001).

People also differ in their inclination to certain attention or information processing processes, especially when they are under pressure. In the research literature, two very close constructs are discussed: tendency to reinvest and state orientation. The “theory of reinvestment” (Masters & Maxwell, 2008) states that individuals have a predisposition to focus on the execution of movement, whereby they can retrieve knowledge about the components of the skill. Reinvestment thus describes the tendency of people

in sport to make declarative knowledge of movement sequences conscious and to control them, even though they are already well mastered. Indeed, this tendency to conscious attention control seems to be related to failure under pressure (Masters & Maxwell, 2008).

Similarly, state-oriented people, especially in assessment situations (Kuhl, 1992), tend to maintain cognitive, affective and attention-related states—for example, to ruminate—even if this is accompanied by impaired performance. By contrast, action-oriented people are able to change these states in order to optimize their performance. In fact, it has been shown that state-oriented people perform worse in pressure situations than action-oriented people, e.g. in basketball free throws (Gröpel, 2016). Apparently, it is more difficult for state-oriented people under pressure to change their focus of attention and divert it away from themselves.

- The risk of choking under pressure increases for people who tend to think intensively about the way they move and/or their current condition.

Mediation Versus Moderation

Psychological research attempts in particular to make statements about which characteristics of a person or a situation have an effect on the behaviour and experience—for example, whether the presence of spectators leads to poor performance in a competition. However, people are usually more complex than such simple cause-and-effect relationships would suggest. Either another characteristic can influence the cause-and-effect relationship (moderation), or the cause does not act directly, but via another variable (mediation). For example, the

more persons think intensively about how they present themselves in public and what other people think about them, the more likely and stronger it is that the presence of spectators will lead to poor performance. There is therefore an interaction between the situation characteristic of the presence of spectators and the person characteristic of “self-awareness”. Analyses of variance examine the interaction effects of two independent *discrete* variables or characteristics on a dependent variable. By means of a moderation analysis, the interaction

of continuous variables can be examined; self-awareness would then be the moderator. Mediation analyses, on the other hand, examine paths of effects: The presence of spectators leads to self-monitoring and attention being focused on the execution of movements, which in turn leads to altered execution of movements and ultimately to poor performance. A mediator such as attention control is thus simultaneously a dependent variable (on the presence of spectators) and an independent variable (it affects performance).

The Self-Presentation Model Empirically Tested

A subsequent study shows that these connections are moderated by personal characteristics. Here, the effect of pressure manipulation on the performance of basketball players was examined, who showed a low or high degree of fear of negative evaluation (Mesagno et al., 2012). Participants attempted basketball free throws in a normal or pressure condition, where pressure was generated by a combination of cash

incentives, a video camera and the presence of other players. Both the anxiety state and the free-throw performance were recorded. Athletes with a pronounced fear of negative evaluation had higher anxiety levels and showed weaker performance under pressure than those with a low fear of negative evaluation. In fact, people with a low fear of negative evaluation did not experience an increase in anxiety and

were even able to improve their performance under pressure—clear indications of resilience. Mediation analyses also showed that the personality trait of fear of negative evaluation not only had a direct effect on performance but that this effect was also partly mediated by cognitive anxiety. Performance apparently declines under pressure because the fear of negative evaluation causes worry and doubt.

12.5.3 Other Effects of Anxiety in Sport

Sport and anxiety is—as seen—mainly considered from the perspective of sport or motor performance. Accordingly, both the theoretical considerations of the connection and the empirical findings are extensive and detailed. As our initial examples show, we encounter anxiety in sport outside the performance context, and anxiety has other additional effects and functions, yet only limited research has been done on these other effects.

12.5.3.1 Physical Activity and Exercise

For example, anxiety in sport has been associated with the level of participation in physical education or physical activity in general. However, with regard to social physique anxiety, no clear connection can be deduced from the research (Sabiston et al., 2014). Studies show that increased social physique anxiety is associated with less effort in physical education and even absenteeism (Cox et al., 2011). Other studies show that social physique anxiety is not directly related to sports (Melbye et al., 2007) or even to increased physical effort in sports (Aşçı et al., 2006). In fact, social physique anxiety is also associated with excessive exercise (i.e. exercise dependence) or even sports addiction (Cook et al., 2015).

➤ Studies show that anxiety in the form of concerns about one's appearance can lead to both increased or decreased physical activity.

Personal and situational characteristics are blamed for these at least apparently contradictory findings, and it is assumed that social physique anxiety is not directly related to sporting activity but primarily influences motivational variables (Sabiston et al., 2014). For example, social physique anxiety is more likely to be observed in individuals—predominantly women—with high self-presentation concerns (► Sect. 12.3.2). It is also found among people who feel less recognized by their environment and those who do sports mainly because of their own appearance. Social physique anxiety therefore may also lead to less sporting activity if one's own figure (or that of other participants) becomes more visible during sport—for example, through mirrors or figure-hugging clothing (Crawford & Eklund, 1994). There is also evidence that social physique anxiety is associated primarily with lower intrinsic motivation to engage in sports and a more controlled regulation of motivation (Cox et al., 2011). However, a major problem with research on sporting activity and social physique anxiety remains that studies predominantly use cross-sectional designs. Therefore, one can only make statements about correlations,

but not inferences about causalities. It is quite conceivable that sporting activity leads to a confrontation with the body, from which anxiety could arise.

12.5.3.2 Risk and Safety Behaviour

From our introductory examples from climbing and skydiving, it is clear that anxiety in sport can also arise from a real danger. In such sports, which are also known as high-risk sports, serious injury or even death must be expected as an inherent part of the sport (Barlow et al., 2015).

People who engage in these risky sports often do so in search of intense emotional experiences. In other words, they are virtually searching for the anxiety experiences associated with risky sports. Anxiety is then not necessarily experienced as unpleasant, but as pleasant and rewarding. People probably expose themselves to such anxiety experiences in sport for two different motives: the pure constant search for unusual, new and intense experiences—what is also called “sensation-seeking” (Zuckerman, 2007)—and the search for experiences to determine how to handle emotions and cope with them. In order to further strengthen the intense experiences, people with a need for sensation-seeking often try to further increase danger and the risk of physical injury through special risky behaviour (e.g. not wearing protective equipment). Experiencing anxiety thus leads to risky behaviour (■ Fig. 12.11).

➤ Sensation-seekers—people in search of unusual, intense experiences—increase their anxiety experiences through risky behaviour. Anxiety is perceived as pleasant.

Another motivation for engaging in risky sports activities is that people are looking for ways to handle emotions and cope with them because they tend to have a rather shallow emotional experience in everyday life (Barlow et al., 2013). Their outdoor activities therefore differ from other common activities of sensation-seekers such as dangerous driving or skydiving. Rather, the chosen risky sports such as rock climbing, expeditions in the perpetual ice of the Antarctic or round-the-world single-handed sailboat trips always involve great efforts both in preparation and execution. These then offer the opportunity to experience a strong and concrete emotion such as anxiety and to see how this is heightened by the activity but also how it can be “brought under control” through behavioural measures. The risky sport then serves the experience of emotion regulation.

Correspondingly, sensation-seekers tend to deliberately provoke risks and put themselves in danger, while people who are motivated to engage in risky sports with the opportunity to regulate their emotions tend to act



■ **Fig. 12.11** Free solo climbing: risky sport with intensive emotional experiences

cautiously and with precautionary. Risks in sports and the associated experience of anxiety can therefore lead to both risky and protective behaviour—depending on overarching personality traits.

➤ For many people who practice dangerous outdoor sports, the focus is not on the anxiety experience but on coping with anxiety—which then also leads to preventive safety behaviour.

? Question

Reinhold Messner, one of the most famous mountaineers, who among other things was the first person to summit all 14 eight-thousanders without supplementary oxygen, once said: “Stress, anxiety, the cold and the state between life and death are such powerful experiences that we need them again and again. We become addicted. Strangely enough, we try hard to get back home safely, but at home we want nothing more than to return to danger” (Reinhold Messner in Coffey, 2005, p. 17).

Think about what type of motivation might be the main focus for Reinhold Messner. Also do some research on his attitudes towards mountaineering with aids (such as bottled oxygen) or on how he dealt with the death of his brother on Nanga Parbat.

12.6 Managing Anxiety in Sport

Our initial examples from beach volleyball, climbing, gymnastics lessons and skydiving have shown that we encounter anxiety in many sport situations. Since anxiety is a condition that is usually perceived as unpleasant and is often closely related to poor performance, it seems sensible to consider how to manage it. Attempts at managing anxiety, however, do not necessarily have to lead to a reduction in anxiety to have positive effects on performance. It seems more important that the individual attempts to reach an emotional state that allows to master the task in the respective sporting situation. Although this idea of an (individual) “zone of optimal functioning” (Hanin, 2000) takes into account various positive and negative emotions, reaching an adaptive, a functional level of anxiety is pertinent to reach optimal performance.

➤ Coping with anxiety in sport means that a person achieves a state that is functional for him or her and that is conducive to coping with the task in the sporting situation.

Managing anxiety can be viewed from two temporal perspectives: anticipation and compensation. Anxiety often arises in anticipation and is an expression of the perception of a threat from a future situation. Thus, anxiety may occur when putting on gym clothes or when warming up for the Olympic finals. From a compensation perspective, which is temporally prior to an event, it is primarily about managing the situation and preventing the feeling of anxiety from arising in the first place. These coping efforts can be particularly well anchored in the transactional stress model (Lazarus & Folkman, 1984), where they are also referred to as “coping”. However, compensatory strategies are also necessary if anxiety is to be regulated in a situation, for example, immediately before jumping out of an airplane or while climbing a rock (see Tenenbaum & Sacks, 2007).

In this context, coping with anxiety is understood to mean the preventive and rather long-term preparation for the situation, whereas anxiety regulation is aimed at the immediate change in the anxiety experienced during a certain situation.

While coping efforts are usually aimed at reducing negative emotions or conditions such as stress, emotion regulation can also serve to intensify or transfer emotions into others. Negative emotions such as anxiety can also be intentionally amplified if this is functional in the situation, for example, to increase energy (or arousal) before a 100 m run. Emotion regulation can be well described within the Consensual Modal Model (Gross, 2008). An attempt is made to assign strategies and techniques of anxiety regulation in sport to the individual phases of the emotional process. Many of the techniques of anxiety regulation can also be understood as coping techniques.

- Anxiety regulation does not only mean the reduction of anxiety but possibly also the increase of anxiety or the change to another emotion.

12.6.1 Coping with Anxiety

In ▶ Sect. 12.3.2, the transactional stress model (Lazarus & Folkman, 1984) was described, whereby anxiety should arise from a threat perception, the perception may indicate the situational importance, and a limited ability to cope with the stressor is determined. Coping or stress management is therefore understood by Lazarus (1999) as a process consisting of coping with a stressor. It includes efforts on the cognitive, affective and behavioural levels. Such a stress would be, for example, the unimaginably large audience in the stadium and behind television screens around the world when serving in the Olympic beach volleyball final.

Coping efforts can have different functions and can therefore be assigned to different categories. Lazarus and Folkman (1984) generally distinguish at least strategies that directly deal with the problem and the situation (“problem-focused coping”) from those that are more aimed at alleviating the effects of the stress (“emotion-focused coping”). In the breaks between the sets of a beach volleyball match, for example, the players could try to block out the spectators by pulling towels over their heads, or they could do relaxation exercises. Both strategies mentioned here could also be assigned to another common category, namely, avoidance coping (Roth & Cohen, 1986).

Problem-focused coping with anxiety tries to directly change the situation or behaviour, whereas emotion-focused coping attempts to alleviate the stress and its associated experiences.

To avoid such conceptual overlaps between possible categories, a three-factorial system has been proposed (Nicholls et al., 2016), which distinguishes between “mastery” coping, “internal regulation” and “goal withdrawal”. Mastery coping includes all attempts to bring the situation under control and/or to remove the stress or anxiety trigger. This includes, for example, methods of goal-setting or targeted preparation. “Internal regulation” attempts to control the internal, psychological and physiological stress or anxiety reaction, for example, by relaxing or blocking out the environment with a towel. Finally, “goal withdrawal” aims at overcoming stress and anxiety by not pursuing the goal of the action or by lowering expectations. Furthermore, an effective strategy for coping with anxiety of competition seems to be “self-handicapping” (Coudeville et al., 2008). Berglas and Jones (1978) defined self-handicapping as “any action or choice of performance setting that enhances the opportunity to externalize (or excuse) failure and to internalize (reasonably accept credit for) success” (p. 406). An example of self-handicapping before a competition might be an athlete suggesting that an alleged, or actual, bad sleep may affect performance. This coping strategy might decrease anxiety because it may decrease the importance of the event, but it is sometimes counter-productive to sport performance.

Long-term stress management in sport, however, includes not only measures that relate to behaviour but also those that intend to change conditions. Based on the transactional stress model, the idea is not only to change appraisal processes or to regulate the stress response, but stressors can be reduced and conditions for successful coping can be created. For example, by seeking social support or by setting tasks differently (real training breaks for recovery), this can then also be called stressor management (Beckmann & Ehrlenspiel, 2018).

For physical education research on interventions is lacking. Schack (1997) presents a comprehensive intervention for overcoming anxiety. This aims at a (re-)establishment of action control. Here, different approaches are combined, for example, regulation of tension through breathing and counting exercises or imagination. In the course of the intervention, the school age students are taught what functional benefits anxiety can have. For example, anxiety signifies possible actual dangers and ensures caution. In this way it should no longer be perceived as a “foe” to be overcome, but as a helpful friend.

- In order to cope with anxiety, it helps to become aware that anxiety can be helpful, for example, it leads to preventive behaviour (▶ Fig. 12.12).



Fig. 12.12 Climbers in a secured lead: Anxiety can help to ensure that safety measures are taken

12.6.2 Anxiety Regulation

Based on the Consensual Modal Model (Gross, 2008), strategies of emotion regulation can be explained. A distinction must be made between strategies that aim to prevent the development of emotions (“antecedent-focused”) and those that tend to change the experience and expression of emotions (“response-focused”). In an interview study, table tennis players were asked about their emotion regulation strategies (Martinent et al., 2015). Players stated they did not try to regulate in any way (intentionally) some emotions. However, whenever they experienced anxiety, they did regulate anxiety intentionally. The strategies mentioned can be assigned to the stages in the Consensual Modal Model.

Emotion regulation refers to “processes by which individuals influence what emotions they have, when they have them and how they experience and express these emotions” (Gross, 1998, p. 275).

- Emotion regulation can refer both to the development of the emotion and to its change in experience and expression over time.

12.6.2.1 Situation

The triggers of anxiety described in ▶ Sect. 12.2 can also be the start of the regulation of anxiety in sport. Here, one can distinguish, albeit somewhat overlapping, strategies that involve the selection of situations, from strategies that involve the modification of a situation. Avoidance behaviour would be a classic form of anxiety regulation through selection. Sitting on the bench while others have to jump over the vaulting horse feels good. Situations cannot be avoided permanently in competitive sports, but they can be changed to a certain extent. Situation modification refers to the change of the external environment, not the internal experience. In the Olympic final, one strategy for regulating anxiety could be to bring friends or the coach into the stadium. And the tense situation of the skydivers in the airplane shortly before jumping could be eased (and thereby changed) by “cracking” a few jokes.

12.6.2.2 Attention

Situations provide stimuli that offer information about the existence of a threat. These stimuli then come to the forefront, are given preferential treatment and promote the development of anxiety (see ▶ Sect. 12.3.1). The intentional control of attention therefore effectively influences the development of emotions. While the table tennis players in the study by Martinent et al. (2015) did not name a situation-related regulation strategy, attentional strategies were the most frequently used. The players expressed above all an increased concentration on the game in order to be able to fade out anxiety and anxiety-relevant stimuli. Other strategies consisted in the targeted planning of actions, for example, by designing tactical measures. Finally, the table tennis players reported that they specifically tried to stop negative thoughts and focus on the current game situation. Such thought-stopping techniques, such as actually imagining a stop sign, can be learned well and is the subject of “mental skill training” (Beckmann & Elbe, 2015).

12.6.2.3 Appraisal

Even if a potentially threatening situation such as gymnastics lessons or the Olympic final cannot be avoided or at least changed and the relevant stimuli such as the gymnastics vaulting horse or the many spectators are perceived, anxiety only arises from appraisal processes. In this respect, conscious and intentional appraisals can prevent the “natural” course of anxiety development.

A central strategy of emotion regulation therefore consists of “reframing”, in a reappraisal, in which the situation is evaluated under a new light. For this purpose, the table tennis players mainly used self-talk with either rational or positive contents. Rational self-talk is about seeing things reasonably and logically regarding other criteria. In the Olympic beach volleyball finals, such self-talk could include that this match point is what I have been training so hard for to this stage. The student could also rationally say to himself before the vaulting horse attempt that the injured knee during the last football match probably hurt more than the possible fall into the mat might hurt. Positive self-talk includes more optimistic content and positive memories. A climber could talk about the climbs he has already mastered and the skydiver could talk about the adrenaline that is about to come. But self-talk can simply have self-encouraging content in the sense of “I can do it!”.

12.6.2.4 Anxiety Response

Finally, the last form of emotion regulation is to change the emotional response. All three components are available for this: experience, physiology and behaviour. The table tennis players (Martinent et al., 2015) regulated anxiety mainly through behaviour but also through the regulation of their physiological reaction. For example, they slowed down the time between rallies or points, or they tried to follow a very conscious routine. In fact, pre-performance routines (also called pre-shot routines) are often taught in sport psychology training. A pre-performance routine is any systematic cognitive and behavioural preparation strategy that an athlete engages in prior to performance execution (Cotterill, 2010). Routines specify behavioural patterns that run in a certain order and are thus intended to prevent the experience of anxiety because they convey a feeling of security and controllability. Pre-performance routines are effective in stabilising performance under pressure (Gröpel & Mesagno, 2019).

Since anxiety is associated with increased arousal, strategies are used to reduce arousal. For example, breathing exercises or relaxation techniques may help in reducing anxiety, which is one reason why teaching relaxation competence is a core component of basic sport psychology training (Beckmann & Elbe, 2015).

➤ Methods of Regulating Anxiety in Sport

- Aim at the prevention of anxiety (“antecedent-focused”).
- Change the experience and the anxiety reaction (“response-focused”).
- This may include:

- Avoiding or changing the situation before a competition
- Focusing attention on less anxiety-inducing stimuli
- Reappraising of the situation
- Changing the emotional response, for example, through relaxation exercises or routines

12.7 Regulation of Anxiety Through Sport

The previous sections of this chapter have been devoted to the topic of anxiety in sport from the perspective of how anxiety arises in and affects sport situations. However, can sport be used to help cope with anxiety and anxiety disorders? In general, sport has positive influences not only on physical but also on mental health. For many facets of mental health, there is strong evidence for the positive effects of sport and, more generally, physical activity (Ekkekakis et al., 2013)—from quality of life to the reduction of mental disorders such as depression and aging successfully. There are also a number of empirical studies on the effect of sport on anxiety as well as surveys and meta-analyses (Utschig et al., 2013).

- The health effects of sport go beyond physical effects; sport also has a positive impact on mental health and can help people to cope with anxiety and anxiety disorders.

12.7.1 Studies About the Efficacy of Sport on Anxiety

The empirical studies on the impact and effectiveness of sports follow different research approaches, which are based on different groups of people and use different success criteria. However, this diversity of studies makes it difficult to draw firm conclusions on effectiveness even when using meta-analyses.

12.7.1.1 Reduction of Anxiety in Healthy Populations

In cross-sectional studies, usually epidemiological studies covering a large sample, a negative correlation between physical activity and anxiety is often found. In a study of almost 20,000 Dutch twins, for example, those who were moderately active for about 4 h a week reported lower anxiety and neuroticism scores than those who did not engage in any sporting activity (De Moor et al., 2006). However, this correlation could also be because anxious people are less likely to engage

in sport. It is therefore necessary to prove the causal relationship between physical activity and anxiety by means of experimental studies. To do this, at least one experimental group that participates in sport or physical activity as a treatment or intervention must be compared with a control group that receives no intervention or at least no intervention with sport participation (see ► **Study Box**). Overall, the experimental findings show (despite some methodological weaknesses) that

an increase in physical activity leads to a reduction in anxiety experiences and a reduced risk of developing an anxiety disorder in people who do not otherwise complain about physical impairments or mental disorders (Herring et al., 2014).

► **Epidemiological and experimental studies show that sport and physical activity lead to less state anxiety and trait anxiety.**

Similar Patterns of Change in Physiological and Mood Parameters as a Result of an Exercise Intervention

In a first controlled experiment, DiLorenzo et al. (1999) investigated the effects of exercise on anxiety. Participants were randomly assigned either to an intervention ($n = 82$) or a “wait list control” group ($n = 29$). Participants received training on a bicycle ergometer four times a week for 12 weeks (intervention group) or had to wait for participation in the intervention (“wait list control” group). Participants went through assessment and testing before the intervention period, immediately post and 3, 6 and 12 months’ post intervention. The assessment consisted first of a battery of psychological questionnaires on anxiety, depression and mood. Importantly, the study controlled for the fitness effects of the interven-

tion. Thus, secondly a functional fitness test (bicycle ergometer test) was also applied at all times of measurement. Only participants that did show (intervention group) or did *not* show (control group) an increase in fitness were used for analyses. These revealed a remarkable decrease in anxiety levels immediately after the exercise intervention in the intervention compared to the control group. Anxiety slightly increased within 3 months’ follow-up but remained lower compared to before the intervention over a period of 1 year. Similar patterns of change were found for the other mood-related outcomes (e.g. depression) but also fitness outcomes (submaximal heart rate, body weight). Although this study provides strong

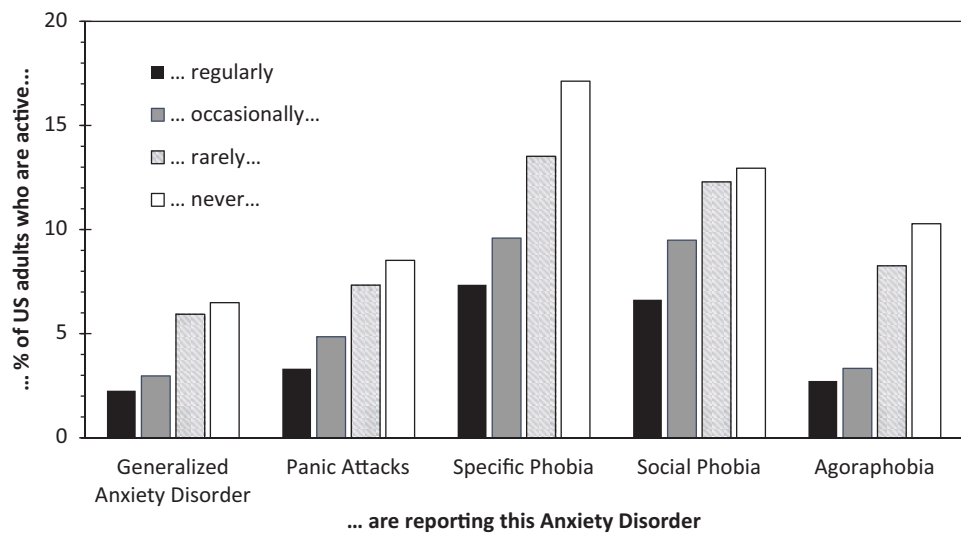
experimental evidence of the benefit of exercise for anxiety and depression, it does not reveal the underlying mechanisms. As the authors conclude, the benefits could be explained, for example, by any or a combination of the following factors: the weight loss and subsequent more positive body image, the experience of social interaction and support during the group intervention, that exercise simply provided a distraction from worries and elevated levels of biochemicals such as serotonin associated with better mood. Unfortunately, the authors also do not report correlations between changes in fitness level or physiological data and psychological outcomes.

12.7.1.2 Sport, Physical Activity and Anxiety Disorders

But is physical activity or sport participation also suitable as a treatment for people who already suffer from an anxiety disorder? Anxiety disorders such as panic disorder, generalized anxiety disorder or phobias are among the most common mental disorders. They are characterized by a pronounced and chronic experience of anxiety, which is often associated with high levels of physical arousal and which leads to avoidance behaviour, for example, social withdrawal (Utschig et al., 2013). A large-scale representative cohort study in the United States showed that almost 25% of women and 12% of men had been diagnosed with an anxiety disorder within the last 12 months. However, the probability of this diagnosis was drastically reduced in people who were regularly

physically active. In fact, there was even a dose-response relationship: The more active people were, the less likely they were to be diagnosed with an anxiety disorder (Goodwin, 2003; see ► Fig. 12.13). Experimental studies, however, do not provide clear evidence of the effectiveness of physical activity for the treatment of anxiety disorders. For example, in a study of 75 people with panic disorder, 4 treatment methods were compared (Wedekind et al., 2010). The interventions over 10 weeks consisted of either running or relaxation training, each of which was supplemented by either drug therapy or placebo therapy. For all four groups, improvements were found in specific symptoms—with stronger improvements in those who had received the drug. Only for the general clinical assessment was there a small advantage for the groups that had received running training over the relaxation groups.

Fig. 12.13 Dose-response relationship between self-reported frequency of physical activity. Anxiety disorders in adults in the United States: Groups of people with higher physical activity levels have a lower prevalence. (According to Goodwin, 2003)



Overall, meta-analyses have concluded that experimental studies provide evidence that physical activity is a beneficial and practical treatment for anxiety disorders yet a number of methodological shortcomings are listed that make a reliable assessment difficult (Stonerock et al., 2015; Stubbs et al., 2017).

➤ While epidemiological studies show that physical activity is also a treatment for anxiety disorders, controlled experimental studies do not provide clear evidence.

❓ What shortcomings have meta-analyses identified in studies on the effectiveness of physical activity in the treatment of anxiety disorders?

- Low test strength (“power”) due to small number of participants
- Participants and study management insufficiently “blinded” with regard to study purposes and group allocation
- Scope and intensity of sport insufficiently recorded
- Physiological effects not investigated
- Too many different measures (acute vs. chronic, subjective vs. objective...)
- Unclear mechanisms—psychological (e.g. about self-efficacy?) or physiological models (e.g. about serotonin neurotransmitter system)

Meta-analysis

In a meta-analysis, the results of empirical studies on a research question are not only summarized but also statistically evaluated. The idea behind this is that although the results of each individual study are associated with a certain error, the combination of several studies allows a more precise estimate of a “true effect”. Today, meta-analyses follow standardized rules, as do systematic reviews, in which the results are evaluated in terms of content but not statistically (Moher et al., 2009). Initially, all empirical studies on a particular issue (e.g. anxiety-reducing effects of sport) are researched in databases and then evaluated accord-

ing to inclusion and exclusion criteria (e.g. intervention design with control group) and, if necessary, excluded. Hedges’ *g*, which is a measure of the size of the estimated “true” effect, is then often calculated from the various mean differences between the studies. Meta-analyses of experimental studies (called *randomized controlled trials*, RCTs) on a treatment method are necessary, for example, to establish this as an “evidence-based method”. Although meta-analyses are important for the evaluation of a research field or a treatment method, they are also viewed critically. A major problem is the possible systematic distortion of

the results of meta-analyses. Thus, the selection of studies included in a meta-analysis is ultimately subjective, even if objective criteria are mentioned. A further distortion can arise from the fact that usually empirical studies are more likely to be published if they show effects, but non-significant or negative results tend to remain in the proverbial drawer of a researcher’s “filing cabinet”. A meta-analysis then overestimates the effect, because negative or zero effects may not be included in the analysis. Although there are methods to identify possible distortions (e.g. “funnel plot”), even these may be controversial.



Fig. 12.14 Green exercise—experiencing nature can enhance the health effects of sport or physical activity such as hiking

12.7.2 Implication for Practice

It is neither certain to what extent physical activity and sport have an effect on anxiety and anxiety disorders, nor is it clear how sport affects them. Nevertheless, from the many studies and meta-analyses, some recommendations can be derived—at least cautiously—on the duration, type and intensity of physical activity and the setting of treatment. The setting of physical activity may have an effect on anxiety reduction. The gym may not be the best place to do physical activity for “anxiolytic effects” (anxiety-reducing effects) since studies have shown that “green exercise” (training outdoors) has a greater psychological effect (Mackay & Neill, 2010). Moreover, the potential of (high-)risk sports such as mountaineering or climbing, which are likely to further intensify the experience of nature, has not yet been tapped for targeted use in the treatment of anxiety and anxiety disorders. As seen, an important motive for participating in such risky sports seems to be the ability to regulate and manage intense emotions (Fig. 12.14).

? What characteristics should a sports programme with long-term effects (reduction of anxiety, anxiety disorders) have (see Schwerdtfeger, 2012)?

- According to general health recommendations for physical activity at least two to three training sessions per week
- Over a period of at least 9 weeks

- Moderate intensity to increase aerobic endurance (from at least 50% maximum heart rate or, for example, a brisk walk)
- In the form of an institutionalized intervention (as part of a programme, facility or fitness studio)
- Change in physical activity as the main focus of the programme, not simultaneously addressing other health behaviour (e.g. nutrition)

Learning Control Questions

Basic:

1. Does an athlete that constantly shows superior performance in practice but fails under pressure more likely have a state anxiety or a trait anxiety problem?
2. What is meant by “social physique anxiety”? Explain how social physique anxiety may be related to the sources of uncertainty found for competitive anxiety.
3. What empirical evidence is there that shows that even in competition our attention is biased towards the perception of threatening, anxiety-inducing stimuli?
4. Which basic strategies for coping with stress can be distinguished?
5. Before jumping out of the plane, a skydiver tells a lot of jokes. Which strategy for regulating emotions and to which stage in the process of developing anxiety can this be assigned?

Advanced:

6. Compare the characteristics of anxiety-triggering situations in sport, as defined from the sport psychological and social psychological approaches. Which essential facet of anxiety in sport is probably missing in the social-psychological approach?
7. Imagine yourself serving in the Olympic beach volleyball finals. For this situation, formulate a “primary appraisal” that leads to a stress perception and a “primary appraisal” that does not lead to stress.
8. Think about the situation of the student before the vaulting horse attempt and think of a “secondary appraisal” from which stress arises and of a “secondary appraisal” from which no stress would arise.
9. A climber is in a critical position on the rock face. According to the theory of challenge and threat states in athletes, how could we tell whether the climber perceives this situation as a threat or a challenge?
10. You are training a young athlete and want to prepare her optimally for the upcoming championships. What methods could you use to determine whether she is afraid in competitions?
11. Is there anything good to be gained from anxiety in sport?

Experts:

12. A female footballer tells you about the new sport psychologist, who primarily conducts relaxation training. He explains that the players are then less excited before matches. Think about and describe whether or to what extent relaxation before a game is actually beneficial for performance. Why? Why not?
13. Compare and contrast the two currently discussed theories for explaining choking under pressure and consider whether they are not mutually exclusive.
14. Why can the evidence for the effectiveness of sport in treating anxiety disorders not be interpreted clearly?

References

- Alder, D., Ford, P. R., Caser, J., & Williams, A. M. (2016). The effects of high- and low-anxiety training on the anticipation judgments of elite performers. *Journal of Sport and Exercise Psychology, 38*, 93–104.
- Argelaguet Sanz, F., Multon, F., & Lécuyer, A. (2015). A methodology for introducing competitive anxiety and pressure in VR sports training. *Frontiers in Robotics and AI, 2*, 10.
- Aşçı, F. H., Tüzün, M., & Koca, C. (2006). An examination of eating attitudes and physical activity levels of Turkish university students with regard to self-presentational concern. *Eating Behaviours, 7*, 362–367.
- Balmer, N. J., Nevill, A. M., Lane, A. M., & Ward, P. (2007). Influence of crowd noise on soccer refereeing consistency in soccer. *Journal of Sport Behavior, 30*, 130–145.
- Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg, M. J., & van Ijzendoorn, M. H. (2007). Threat-related attentional bias in anxious and nonanxious individuals: A meta-analytic study. *Psychological Bulletin, 133*, 1–24.
- Barlow, M., Woodman, T., Chapman, C., Milton, M., Stone, D., Dodds, T., & Allen, B. (2015). Who takes risks in high-risk sport?: The role of alexithymia. *Journal of Sport and Exercise Psychology, 37*, 83–96.
- Barlow, M., Woodman, T., & Hardy, L. (2013). Great expectations: Different high-risk activities satisfy different motives. *Journal of Personality and Social Psychology, 105*, 458–475.
- Barry, R. J., Clarke, A. R., McCarthy, R., Selikowitz, M., & Rushby, J. A. (2005). Arousal and activation in a continuous performance task. *Journal of Psychophysiology, 19*, 91–99.
- Baumeister, R. F. (1984). Choking under pressure: Self-consciousness and paradoxical effects of incentives on skillful performance. *Journal of Personality and Social Psychology, 46*, 610–620.
- Baumeister, R. F., & Showers, C. J. (1986). A review of paradoxical performance effects: Choking under pressure in sports and mental tests. *European Journal of Social Psychology, 16*, 361–383.
- Beckmann, J., & Ehrlenspiel, F. (2018). Strategien der stressregulation im Leistungssport. In R. Fuchs & M. Gerber (Eds.), *Handbuch stressregulation und sport* (pp. 417–433). Springer.
- Beckmann, J., & Elbe, A. M. (2015). *Sport psychological interventions in competitive sports*. Cambridge University Press.
- Beckmann, J., & Rolstad, K. (1997). Aktivierung, selbstregulation und leistung: Gibt es so etwas wie übermotivation? *Sportwissenschaft, 27*, 23–37.
- Beilock, S. L., & Carr, T. H. (2001). On the fragility of skilled performance: What governs choking under pressure? *Journal of Experimental Psychology: General, 130*, 701–725. <https://doi.org/10.1037/0096-3445.130.4.701>
- Beilock, S. L., Carr, T. H., MacMahon, C., & Starkes, J. L. (2002). When paying attention becomes counterproductive: Impact of divided versus skill-focused attention on novice and experienced performance of sensorimotor skills. *Journal of Experimental Psychology: Applied, 8*, 6–16.
- Berglas, S., & Jones, E. E. (1978). Drug choice as a self-handicapping strategy in response to noncontingent success. *Journal of Personality and Social Psychology, 36*, 405–417.
- Bascovich, J. (2008). Challenge and threat. In A. J. Elliot (Ed.), *Handbook of approach and avoidance motivation* (pp. 431–445). Psychology Press.
- Bascovich, J., & Mendes, W. B. (2000). Challenge and threat appraisals: The role of affective cues. In J. Forgas (Ed.), *Feeling and thinking: The role of affect in social cognition* (pp. 59–82). Cambridge University Press.
- Bascovich, J., Mendes, W. B., Tomaka, J., Salomon, K., & Seery, M. (2003). The robust nature of the biopsychosocial model challenge and threat: A reply to Wright and Kirby. *Personality and Social Psychology Review, 7*, 234–243.
- Bascovich, J., & Tomaka, J. (1996). The biopsychosocial model of arousal regulation. *Advances in Experimental Social Psychology, 28*, 1–51.
- Borrego, C. C., Cid, L., & Silva, C. (2012). Relationship between group cohesion and anxiety in soccer. *Journal of Human Kinetics, 34*, 119–127.
- Bray, S. R., Martin, K. A., & Widmeyer, W. N. (2000). The relationship between evaluative concerns and sport competition anxiety among youth skiers. *Journal of Sports Sciences, 18*, 353–361.
- Burdwood, E. N., Infantolino, Z. P., Crocker, L. D., Spielberg, J. M., Banich, M. T., Miller, G. A., & Heller, W. (2016). Resting-state functional connectivity differentiates anxious apprehension and anxious arousal. *Psychophysiology, 53*, 1451–1459. <https://doi.org/10.1111/psyp.12696>
- Burton, D. (1988). Do anxious swimmers swim slower? Re-examining the elusive anxiety-performance relationship. *Journal of Sport and Exercise Psychology, 10*, 45–61.

- Butler, J. L., & Baumeister, R. F. (1998). The trouble with friendly faces: Skilled performance with a supportive audience. *Journal of Personality and Social Psychology, 75*, 1213–1230.
- Caruso, C. M., Dziewaltowski, D. A., Gill, D. L., & McElroy, M. A. (1990). Psychological and physiological changes in competitive state anxiety during noncompetitive and competitive success and failure. *Journal of Sport and Exercise Psychology, 12*, 6–20.
- Cerin, E., & Barnett, A. (2011). Predictors of pre- and post-competition affective states in male martial artists: A multilevel interactional approach. *Scandinavian Journal of Medicine and Science in Sports, 21*, 137–150.
- Chuang, L., Huang, C., & Hung, T. (2015). Effects of attentional training on visual attention to emotional stimuli in archers: A preliminary investigation. *International Journal of Psychophysiology, 98*, 448–454.
- Coffey, M. (2005). *Where the mountain casts its shadow: The dark side of extreme adventure*. Macmillan.
- Cook, B., Karr, T. M., Zunker, C., Mitchell, J. E., Thompson, R., Sherman, R., et al. (2015). The influence of exercise identity and social physique anxiety on exercise dependence. *Journal of Behavioural Addictions, 4*, 195–199.
- Cooke, A., Kavussanu, M., McIntyre, D., & Ring, C. (2013). The effects of individual and team competitions on performance, emotions, and effort. *Journal of Sport and Exercise Psychology, 35*, 132–143.
- Cotterill, S. (2010). Pre-performance routines in sport: Current understanding and future directions. *International Review of Sport and Exercise Psychology, 3*, 132–153. <https://doi.org/10.1080/1750984X.2010.488269>
- Coudeville, G. R., Ginis, K. A. M., Famose, J.-P., & Gernignon, C. (2008). Effects of self-handicapping strategies on anxiety before athletic performance. *The Sport Psychologist, 22*, 304–315.
- Cox, A. E., Ullrich-French, S., Madonia, J., & Witty, K. (2011). Social physique anxiety in physical education: Social contextual factors and links to motivation and behaviour. *Psychology of Sport and Exercise, 12*, 555–562.
- Cox, R. H., Martens, M. P., & Russell, W. D. (2003). Measuring anxiety in athletics: The revised competitive state anxiety inventory–2. *Journal of Sport and Exercise Psychology, 25*, 519–533.
- Craft, L. L., Magyar, T. M., Becker, B. J., & Feltz, D. L. (2003). The relationship between the competitive state anxiety inventory-2 and sport performance: A meta-analysis. *Journal of Sport and Exercise Psychology, 25*, 44–65. <https://doi.org/10.1123/jsep.25.1.44>
- Crawford, S., & Eklund, R. (1994). Social physique anxiety, reasons for exercise, and attitudes toward exercise settings. *Journal of Sport & Exercise Psychology, 16*, 70–82.
- De Moor, M. H. M., Beem, A. L., Stubbe, J. H., Boomsma, D. I., & De Geus, E. J. C. (2006). Regular exercise, anxiety, depression and personality: A population-based study. *Preventive Medicine, 42*, 273–279.
- DiLorenzo, T. M., Bargman, E. P., Stucky-Ropp, R., Brassington, G. S., Frensch, P. A., & LaFontaine, T. (1999). Long-term effects of aerobic exercise on psychological outcomes. *Preventive Medicine, 28*, 75–85.
- Draper, N., Jones, G. A., Fryer, S., Hodgson, C., & Blackwell, G. (2008). Effect of an on-sight lead on the physiological and psychological responses to rock climbing. *Journal of Sports Science and Medicine, 7*, 492–498.
- Ducrocq, E., Wilson, M., Vine, S. J., & Derakshan, N. (2016). Training attentional control improves cognitive and motor task performance. *Journal of Sport and Exercise Psychology, 38*, 521–533.
- Edwards, T., Hardy, L., Kingston, K., & Gould, D. (2002). A qualitative analysis of catastrophic performances and the associated thoughts, feelings, and emotions. *The Sport Psychologist, 16*, 1–19. <https://doi.org/10.1123/tsp.16.1.1>
- Ehrlenspiel, F., Brand, R., & Graf, K. (2009). Das Wettkampfangst—Inventar—State. In R. Brand, F. Ehrlenspiel, & K. Graf (Eds.), *Das Wettkampfangst—Inventar. Manual zur komprehensiven Eingangsdiagnostik von Wettkampfangst, Wettkampfangstlichkeit und Angstbewältigungsmodus im Sport* (pp. 71–100). Bundesinstitut für Sportwissenschaft.
- Ehrlenspiel, F., & Elbe, A.-M. (2008). Reduktion der Wettkampfangst mittels sportpsychologischen Grundlagentrainings. *Leistungssport, 38*(4), 25–28.
- Ehrlenspiel, F., Erlacher, D., & Ziegler, M. (2018a). Changes in subjective sleep quality before a competition and their relation to competitive anxiety. *Behavioural Sleep Medicine, 16*, 553–568.
- Ehrlenspiel, F., Geukes, K., & Beckmann, J. (2018b). Stress, angst und leistung im leistungssport. In R. Fuchs & M. Gerber (Eds.), *Handbuch stressregulation und sport* (pp. 391–416). Springer.
- Ehrlenspiel, F., Wei, K., & Sternad, D. (2010). Open-loop, closed-loop and compensatory control: Performance and improvement under pressure in a rhythmic task. *Experimental Brain Research, 201*, 729–741.
- Ekkekakis, P. E., Cook, D. B., Craft, L. L., Culos-Reed, S., Etnier, J. L., Hamer, M. E., et al. (2013). *Routledge handbook of physical activity and mental health*. Routledge.
- Eubank, M., Collins, D., & Smith, N. (2002). Anxiety and ambiguity: It's all open to interpretation. *Journal of Sport and Exercise Psychology, 24*, 239–253.
- Eysenck, M. W., & Calvo, M. G. (1992). Anxiety and performance: The processing efficiency theory. *Cognition and Emotion, 6*, 409–434.
- Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: Attentional control theory. *Emotion, 7*(2), 336–335.
- Eysenck, M. W., & Wilson, M. R. (2016). Sporting performance, pressure and cognition: Introducing attentional control theory: Sport. In D. Groome & M. W. Eysenck (Eds.), *An introduction to applied cognitive psychology* (pp. 341–362). Psychology Press.
- Fink, A., Fischler, K., Raschner, C., Hildebrandt, C., Ledochowski, L., & Kopp, M. (2013). Association between parenting practices and competitive trait anxiety in female gymnasts. *International Journal of Sport Psychology, 44*, 515–530.
- Fitts, P. M., & Posner, M. I. (1967). *Human performance*. Brooks/Cole.
- Fletcher, D., & Hanton, S. (2001). The relationship between psychological skills usage and competitive anxiety responses. *Psychology of Sport & Exercise, 2*, 89–101. [https://doi.org/10.1016/S1469-0292\(00\)00014-5](https://doi.org/10.1016/S1469-0292(00)00014-5)
- Flowers, R. A., & Brown, C. (2002). Effects of sport context and birth order on state anxiety. *Journal of Sport Behaviour, 25*, 41–56.
- Furley, P., Dicks, M., & Memmert, D. (2012). Nonverbal behaviour in soccer: The influence of dominant and submissive body language on the impression formation and expectancy of success of soccer players. *Psychology of Sport and Exercise, 34*, 61–82.
- Goodwin, R. D. (2003). Association between physical activity and mental disorders among adults in the United States. *Preventive Medicine, 36*, 698–703.
- Gould, D., Horn, T., & Spreeman, J. (1983). Competitive anxiety in junior elite wrestlers. *Journal of Sport Psychology, 5*, 58–71. <https://doi.org/10.1123/jsp.5.1.58>
- Gould, D., & Weinberg, R. S. (1985). Sources of worry in successful and less successful intercollegiate wrestlers. *Journal of Sport Behaviour, 8*, 115–127.
- Gröpel, P. (2016). Self-focused attention and motor skill failure: The moderating role of action orientation. *Sport, Exercise, and Performance Psychology, 5*(3), 206.
- Gröpel, P., & Mesagno, C. (2019). Choking interventions in sports: A systematic review. *International Review of sport and exercise psychology, 12*(1), 176–201. <https://doi.org/10.1080/1750984X.2017.1408134>

- Gross, J. J. (1998). The emerging field of emotion regulation: an integrative review. *Review of General Psychology*, 2, 217–299. <https://doi.org/10.1037/1089-2680.2.3.271>
- Gross, J. J. (2008). Emotion regulation. In M. Lewis, J. M. Haviland-Jones, & L. F. Barrett (Eds.), *Handbook of emotions* (pp. 497–512). Guilford.
- Gucciardi, D. F., & Dimmock, J. A. (2008). Choking under pressure in sensorimotor skills: Conscious processing or depleted attentional resources? *Psychology of Sport and Exercise*, 9, 45–59.
- Hackfort, D. (1986). *Theorie und Analyse sportbezogener Ängstlichkeit: Ein situationsanalytischer Ansatz*. Hofmann.
- Hackfort, D., & Schwenkmezger, P. (1989). Measuring anxiety in sports: Perspectives and problems. In D. Hackfort & C. D. Spielberger (Eds.), *Anxiety in sports: An international perspective* (pp. 55–74). Hemisphere.
- Hall, H. K., Kerr, A. W., & Matthews, J. (1998). Precompetitive anxiety in sport: The contribution of achievement goals and perfectionism. *Journal of Sport and Exercise Psychology*, 20, 194–217.
- Hammermeister, J., & Burton, D. (2001). Stress, appraisal, and coping revisited: Examining the antecedents of Competitive State Anxiety with Endurance Athletes. *The Sport Psychologist*, 15, 66–90.
- Hanin, Y. L. (2000). Successful and poor performance and emotions. In Y. L. Hanin (Ed.), *Emotions in sport* (pp. 157–187). Human Kinetics.
- Hanton, S., Mellalieu, S. D., & Hall, R. (2002). Re-examining the competitive anxiety trait-state relationship. *Personality and Individual Differences*, 33, 1125–1136.
- Hanton, S., Neil, R., & Evans, L. (2013). Hardiness and anxiety interpretation: An investigation into coping usage and effectiveness. *European Journal of Sport Science*, 13, 96–104.
- Hanton, S., Neil, R., & Mellalieu, S. (2008a). Recent developments in competitive anxiety direction and competition stress research. *International Review of Sport and Exercise Psychology*, 1, 45–57.
- Hanton, S., Neil, R., Mellalieu, S., & Fletcher, D. (2008b). Competitive experience and performance status: An investigation into multidimensional anxiety and coping. *European Journal of Sport Science*, 8, 143–152.
- Hardy, L. (1990). A catastrophe model of anxiety and performance. In J. G. Jones & L. Hardy (Eds.), *Stress and performance in sport*. Wiley.
- Hardy, L., & Parfitt, G. (1993). A catastrophe model of anxiety and performance. *British Journal of Psychology*, 82, 163–178.
- Hardy, L., Parfitt, G., & Pates, J. (1994). Performance catastrophes in sport: A test of the hysteresis hypothesis. *Journal of Sports Sciences*, 12, 327–334.
- Hare, O. A., Wetherell, M. A., & Smith, M. A. (2013). State anxiety and cortisol reactivity to skydiving in novice versus experienced skydivers. *Physiology & Behaviour*, 118, 40–44.
- Hart, E. A., Leary, M. R., & Rejeski, W. J. (1989). The measurement of social physique anxiety. *Journal of Sport and Exercise Psychology*, 11, 94–104.
- Herring, M. P., Lindheimer, J. B., & O'Connor, P. J. (2014). The effects of exercise training on anxiety. *American Journal of Lifestyle*, 8, 388–403.
- Hill, D. M., Hanton, S., Matthews, N., & Fleming, S. (2010). Choking in sport: A review. *International Review of Sport and Exercise Psychology*, 3, 24–39.
- Hudson, J., & Williams, M. (2001). Associations between self-presentation and competitive A-Trait: A preliminary investigation. *Social Behaviour and Personality: An International Journal*, 29, 1–10.
- Hull, C. L. (1952). *A behavior system; an introduction to behavior theory concerning the individual organism*. Yale University Press.
- James, B., & Collins, D. (1997). Self-presentational sources of competitive stress during performance. *The Journal of Sport and Exercise Psychology*, 19, 17–35.
- Jones, G., Swain, A., & Cale, A. (1990). Antecedents of multidimensional competitive state-anxiety and self-confidence in elite intercollegiate middle-distance runners. *The Sport Psychologist*, 4, 107–118.
- Jones, M. V., Meijen, C., McCarthy, P. J., & Sheffield, D. (2009). A theory of challenge and threat states in athletes. *International Review of Sport and Exercise Psychology*, 2, 161–180.
- Jordet, G., & Elferink-Gemser, M. (2012). Stress, coping, and emotions on the world stage: The experience of participating in a Major Soccer Tournament Penalty Shootout. *Journal of Applied Sport Psychology*, 24, 73–91.
- Jordet, G., & Hartman, E. (2008). Avoidance motivation and choking under pressure in soccer penalty shootouts. *Journal of Sport & Exercise Psychology*, 30, 450–457.
- Kaye, M. P., Frith, A., & Vosloo, J. (2015). Dyadic anxiety in youth sport: The relationship of achievement goals with anxiety in young athletes and their parents. *Journal of Applied Sport Psychology*, 27, 171–185.
- Kleinert, J. (2002). An approach to sport injury trait anxiety: Scale construction and structure analysis. *European Journal of Sport Science*, 2(3), 1–12.
- Klostermann, A., Kredel, R., & Hossner, E.-J. (2013). The “quiet eye” and motor performance: Task demands matter! *Journal of Experimental Psychology: Human Perception and Performance*, 39, 1270–1278.
- Krane, V. (1992). Conceptual and methodological considerations in sport anxiety research: From the inverted-U hypothesis to catastrophe theory. *Quest*, 44, 72–87.
- Krane, V. (1994). The mental readiness form as a measure of competitive state anxiety. *The Sport Psychologist*, 8, 189–202.
- Kuhl, J. (1992). A theory of self-regulation: action versus state orientation, self-discrimination, and some applications: Self-regulation. *Applied Psychology*, 41, 97–129.
- Lautenbach, F., Laborde, S. J. P., Putman, P., Angelidis, A., & Raab, M. (2016). Attentional distraction by negative sports words in athletes under low-and high-pressure conditions: Evidence from the sport emotional Stroop task. *Sport, Exercise, and Performance Psychology*, 5, 296–307.
- Lazarus, R. S. (1966). *Psychological stress and the coping process*. McGraw-Hill.
- Lazarus, R. S. (1991). *Emotion and adaptation*. Oxford University Press.
- Lazarus, R. S. (1999). *Stress and emotion: A new synthesis*. Springer.
- Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. Springer Pub. Co.
- Leary, M. R. (1992). Self-presentational processes in exercise and sport. *Journal of Sport and Exercise Psychology*, 14, 339–351.
- LeDoux, J. E., & Pine, D. S. (2016). Using neuroscience to help understand fear and anxiety: A two-system framework. *American Journal of Psychiatry*, 173, 1083–1093.
- Liebert, R. M., & Morris, L. W. (1967). Cognitive and emotional components of test anxiety: A distinction and some initial data. *Psychological Reports*, 20, 975–978.
- Linder, D. E., Lutz, R., Crews, D., & Lochbaum, M. (1999). Who chokes and when? Situational and dispositional factors in failure under pressure. In M. R. Farrally & A. J. Cochran (Eds.), *Proceedings of the world scientific congress of golf* (pp. 207–212). Human Kinetics.
- Low, W. R., Sandercock, G. R. H., Freeman, P., Winter, M. E., Butt, J., & Maynard, I. (2021). Pressure training for performance domains: A meta-analysis. *Sport, Exercise, and Performance Psychology*, 10(1), 149–163.
- Mackay, G. J., & Neill, J. T. (2010). The effect of “green exercise” on state anxiety and the role of exercise duration, intensity, and greenness: A quasi-experimental study. *Psychology of Sport and Exercise*, 11, 238–245.

- MacLeod, C., Mathews, A., & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology, 95*, 15–20.
- Marchant, D. B., Morris, T., & Anderson, M. B. (1998). Perceived importance of outcome as a contributing factor in competitive state anxiety. *Journal of Sport Behaviour, 21*, 71–91.
- Martens, R. S., Burton, D., Vealey, R. S., Bump, L. A., & Smith, D. E. (1990a). Development and validation of the competitive state anxiety inventory-2. In R. Martens, R. S. Vealey, & D. Burton (Eds.), *Competitive anxiety in sport* (pp. 117–190). Human Kinetics.
- Martens, R. S., Vealey, R. S., & Burton, D. (1990b). *Competitive anxiety in sport*. Human Kinetics.
- Martin, K. A., & Hall, C. (1997). Situational and intrapersonal moderators of sport competition state anxiety. *Journal of Sport Behaviour, 20*, 435–447.
- Martinent, G., & Ferrand, C. (2015). A field study of discrete emotions: Athletes' cognitive appraisals during competition. *Research Quarterly for Exercise and Sport, 86*, 51–62.
- Martinent, G., Ledos, S., Ferrand, C., Campo, M., & Nicolas, M. (2015). Athletes regulation of emotions experienced during competition: A naturalistic video-assisted study. *Sport, Exercise, and Performance Psychology, 4*, 188–205.
- Masters, R., & Maxwell, J. (2008). The theory of reinvestment. *International Review of Sport and Exercise Psychology, 1*, 160–183.
- Masters, R. S. W. (1992). Knowledge, knerves and know-how: The role of explicit versus implicit knowledge on the breakdown of a complex motor skill under pressure. *British Journal of Psychology, 83*, 334–358.
- Mauss, I. B., & Robinson, M. D. (2009). Measures of emotion. *A review. Cognition and Emotion, 23*, 209–237.
- McEwen, B. S. (1998). Stress, adaptation, and disease: Allostasis and allostatic load. *Annals of the New York Academy of Sciences, 840*, 33–44.
- Melbye, L., Tenenbaum, G., & Eklund, R. (2007). Self-objectification and exercise behaviours: The mediating role of social physique anxiety. *Journal of Applied Biobehavioural Research, 12*, 196–220.
- Mellalieu, S., Hanton, S., & O'Brien, M. (2004). Intensity and direction of competitive anxiety as a function of sport type and experience. *Scandinavian Journal of Medicine and Science in Sports, 14*, 326–334.
- Mendes, W. B., Major, B., McCoy, S., & Blascovich, J. (2008). How attributional ambiguity shapes physiological and emotional responses to social rejection and acceptance. *Journal of Personality and Social Psychology, 94*, 278–291.
- Mesagno, C., & Beckmann, J. (2017). Choking under pressure: Theoretical models and interventions. *Current Opinion in Psychology, 16*, 170–175.
- Mesagno, C., Geukes, K., & Larkin, P. (2015). Choking under pressure: A review of current debates, literature, and interventions. In S. D. Mellalieu & S. Hanton (Eds.), *Contemporary advances in sport psychology: A review* (pp. 148–174). Routledge.
- Mesagno, C., Harvey, J. T., & Janelle, C. M. (2011). Self-presentation origins of choking: Evidence from separate pressure manipulations. *Journal of Sport & Exercise Psychology, 33*, 441–459.
- Mesagno, C., Harvey, J. T., & Janelle, C. M. (2012). Choking under pressure: The role of fear of negative evaluation. *Psychology of Sport and Exercise, 13*, 60–68. <https://doi.org/10.1016/j.psychsport.2011.07.007>
- Mesagno, C., & Hill, D. M. (2013). Definition of choking in sport: Re-conceptualization and debate. *International Journal of Sport Psychology- Performance under Pressure, 4*, 267–277.
- Mesagno, C., Marchant, D., & Morris, T. (2009). Alleviating choking: The sounds of distraction. *Journal of Applied Sport Psychology, 21*, 131–147. <https://doi.org/10.1080/10413200902795091>
- Moher, D., Liberati, A., Tetzlaff, J. M., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Open Medicine, 3*, 123–130.
- Moore, L. J., Vine, S. J., Freeman, P., & Wilson, M. R. (2013b). Quiet eye training promotes challenge appraisals and aids performance under elevated anxiety. *International Journal of Sport and Exercise Psychology, 11*, 169–183.
- Moore, L. J., Wilson, M. R., Vine, S. J., Coussens, A. H., & Freeman, P. (2013a). Champ or Chump?: Challenge and threat states during pressurized competition. *Journal of Sport and Exercise Psychology, 35*(6), 551–562.
- Moran, A. P. (1996). *The psychology of concentration in sports performers: A cognitive analysis*. Psychology Press.
- Morris, L., Davis, D., & Hutchings, C. (1981). Cognitive and emotional components of anxiety: Literature review and revised worry-emotionality scale. *Journal of Educational Psychology, 73*, 541–555.
- Murray, N. P., & Janelle, C. M. (2007). Even-related potential evidence for the processing efficiency theory. *Journal of Sports Sciences, 25*, 161–171.
- Neil, R., Bayston, P., Hanton, S., & Wilson, K. (2013). The influence of stress and emotions on association football referees' decision-making. *Sport & Exercise Psychology Review, 9*, 22–41.
- Neil, R., Mellalieu, S. D., & Hanton, S. (2009). The contribution of qualitative inquiry towards understanding competitive anxiety and competition stress. *Qualitative Research in Sport and Exercise, 1*, 191–205.
- Nicholls, A. R., Taylor, N. J., Carroll, S., & Perry, J. L. (2016). The development of a new sport-specific classification of coping and a meta-analysis of the relationship between different coping strategies and moderators on sporting outcomes. *Frontiers in Psychology, 7*, 1674.
- Norton, P. J., Hope, D. A., & Weeks, J. W. (2004). The physical activity and sport anxiety scale (PASAS): Scale development and psychometric analysis. *Anxiety, Stress & Coping, 17*(4), 363–382.
- O'Rourke, D. J., Smith, R. E., Smoll, F. L., & Cumming, S. P. (2011). Trait anxiety in young athletes as a function of parental pressure and motivational climate: Is parental pressure always harmful? *Journal of Applied Sport Psychology, 23*(4), 398–412.
- Öhman, A. (2008). Fear and anxiety: Overlaps and dissociations. In M. Lewis, J. M. Haviland-Jones, & L. F. Barrett (Eds.), *Handbook of emotions* (pp. 709–729). Guilford.
- Oudejans, R. R. D., Kuijpers, W., Kooijman, C. C., & Bakker, F. C. (2011). Thoughts and attention of athletes under pressure: Skill-focus or performance worries? *Anxiety, Stress, and Coping, 24*, 59–73.
- Recours, R., & Briki, W. (2015). The effect of red and blue uniforms on competitive anxiety and self-confidence in virtual sports contests. *Revue Européenne de Psychologie Appliquée, 65*, 67–69.
- Rex, C. C., & Metzler, J. N. (2016). Development of the sport injury anxiety scale. *Measurement in Physical Education and Exercise Science, 20*(3), 146–158.
- Rohleder, N., Beulen, S. E., Chen, E., Wolf, J. M., & Kirschbaum, C. (2007). Stress on the dance floor: The cortisol stress response to social-evaluative threat in competitive ballroom dancers. *Personality and Social Psychology Bulletin, 33*, 69–84.
- Roth, S., & Cohen, L. J. (1986). Approach, avoidance, and coping with stress. *American Psychologist, 41*, 813–819.
- Sabiston, C. M., Pila, E., Pinsonnault-Bilodeau, G., & Cox, A. E. (2014). Social physique anxiety experiences in physical activity: A comprehensive synthesis of research studies focused on measurement, theory, and predictors and outcomes. *International Review of Sport and Exercise Psychology, 7*, 158–183.
- Scanlan, T. K., Stein, G. L., & Ravizza, S. (1991). In-depth study of former elite figure skaters: III. Sources of stress. *Journal of Sport and Exercise Psychology, 13*, 103–120.

- Schack, T. (1997). *Ängstliche Schüler im Sport: Interventionsverfahren zur Entwicklung der Handlungskontrolle*. Hofmann.
- Scherer, K. R. (1985). Stress und emotion: Ein Ausblick. In K. R. Scherer, H. G. Wallbott, F. J. Tolkmitt, & G. Bergmann (Eds.), *Die stressreaktion: Physiologie und verhalten* (pp. 195–205). Hogrefe.
- Schlenker, B. R. (1980). *Impression management: The self-concept, social identity and interpersonal relations*. Brooks/Cole.
- Schwerdtfeger, A. (2012). Sportliche aktivität und angst. In R. Fuchs & W. Schlicht (Eds.), *Seelische gesundheit und sportliche aktivität* (pp. 186–207). Hogrefe.
- Skinner, N., & Brewer, N. (2004). Adaptive approaches to competition: Challenge appraisals and positive emotion. *Journal of Sport and Exercise Psychology*, 26, 283–305. <https://doi.org/10.1123/jsep.26.2.283>
- Smith, R. E., Smoll, F. L., & Cumming, S. (2007). Effects of a motivational climate intervention for coaches on young athletes' sport performance anxiety. *Journal of Sport & Exercise Psychology*, 29, 39–59.
- Smith, R. E., Smoll, F. L., Cumming, S. P., & Grossbard, J. R. (2006). Measurement of multidimensional sport performance anxiety in children and adults: The Sport Anxiety Scale-2. *Journal of Sport and Exercise Psychology*, 28, 479–501.
- Smith, R. E., Smoll, F. L., & Schutz, R. W. (1990). Measurement and correlates of sport-specific cognitive and somatic trait anxiety: The sport anxiety scale. *Anxiety Research*, 2, 263–280.
- Sonstroem, R. J., & Bernardo, P. (1982). Intraindividual pregame state anxiety and basketball performance: A reexamination of the inverted-U curve. *Journal of Sport and Exercise Psychology*, 4, 235–245.
- Spence, J. T., & Spence, K. W. (1966). The motivational components of manifest anxiety: Drive and drive stimuli. In C. D. Spielberger (Ed.), *Anxiety and behaviour* (pp. 291–326). Academic Press.
- Spielberger, C. D. (1966). Theory and research on anxiety. In C. D. Spielberger (Ed.), *Anxiety and behaviour* (pp. 3–19). Academic Press.
- Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the state-trait anxiety inventory*. Consulting Psychologists Press.
- Stenling, A., Hassmén, P., & Holmström, S. (2014). Implicit beliefs of ability, approach-avoidance goals and cognitive anxiety among team sport athletes. *European Journal of Sport Science*, 14, 720–729.
- Stonerock, G. L., Hoffman, B. M., Smith, P. J., & Blumenthal, J. A. (2015). Exercise as treatment for anxiety: Systematic review and analysis. *Annals of Behavioural Medicine*, 49, 542–556.
- Strahler, J., & Klumbies, E. (2012). Foundations in psychoneuroendocrinology. In F. Ehrlenspiel & K. Strahler (Eds.), *Psychoneuroendocrinology of sport and exercise: Foundations, markers, trends* (pp. 20–39). Routledge.
- Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, 18, 643–662.
- Stubbs, B., Vancampfort, D., Rosenbaum, S., Firth, J., Cosco, T., Veronese, N., Salum, G. A., & Schuch, F. B. (2017). An examination of the anxiolytic effects of exercise for people with anxiety and stress-related disorders: A meta analysis. *Psychiatry Research*, 24, 102–108.
- Tenenbaum, G., & Sacks, D. N. (2007). Die emotionale Seite der sportlichen Höchstleistung. In N. Hageman, M. Tietjens, & B. Strauß (Eds.), *Psychologie der sportlichen Höchstleistung: Grundlagen und Anwendungen der Expertiseforschung im Sport* (pp. 118–139). Hogrefe.
- Thatcher, J., & Day, M. C. (2009). Re-appraising stress appraisals: The underlying properties of stress in sport. *Psychology of Sport and Exercise*, 9, 318–335.
- Tremayne, P., & Barry, R. J. (1990). Repression of anxiety and its effects upon psychophysiological responses to relevant and irrelevant stimuli in competitive gymnasts. *Journal of Sport and Exercise Psychology*, 12, 327–352.
- Turner, M. J., Jones, M. V., Sheffield, D., & Cross, S. L. (2012). Cardiovascular indices of challenge and threat states predict performance under stress in cognitive and motor tasks. *International Journal of Psychophysiology*, 86, 48–57.
- Utschig, A. C., Otto, M. W., Powers, M. B., & Smits, J. A. J. (2013). The relationship between physical activity and anxiety and its disorders. In P. Ekkekakis, D. B. Cook, L. L. Craft, S. N. Culos-Reed, J. L. Etnier, M. Hamer, K. A. Martin Ginis, J. Reed, J. A. J. Smits, & M. Ussher (Eds.), *Routledge handbooks. Routledge handbook of physical activity and mental health* (pp. 105–116). Routledge.
- Vickers, J. N. (2016). Origins and current issues in Quiet Eye research. *Current Issues in Sport Science*, 1, 101.
- Vickers, J. N., & Williams, A. M. (2007). Performing under pressure: The effects of physiological arousal, cognitive anxiety, and gaze control in biathlon. *Journal of Motor Behaviour*, 39, 381–394.
- Wedekind, D., Broocks, A., Weiss, N., Engel, K., Neubert, K., & Bandelow, B. (2010). A randomized, controlled trial of aerobic exercise in combination with paroxetine in the treatment of panic disorder. *The World Journal of Biological Psychiatry*, 11, 904–913.
- Weinberg, R., & Gould, D. (2018). *Foundations of sport and exercise psychology* (7th ed.). Human Kinetics.
- Williams, J. M., Mathews, A., & MacLeod, C. (1996). The emotional Stroop task and psychopathology. *Psychological Bulletin*, 120, 3–24.
- Williams, M., Hudson, J., & Lawson, R. (1999). Self-presentation in sport: Initial development of a scale for measuring athlete's competitive self-presentation concerns. *Social Behaviour and Personality: An International Journal*, 27, 487–502.
- Wilson, M., Wood, G., & Jordet, G. (2013). The BASES expert statement on the psychological preparation for football penalty shoot-outs. *The Sport and Exercise Scientist*, 38, 8–9.
- Wilson, M. R., Vine, S. J., & Wood, G. (2009). The influence of anxiety on visual attentional control in basketball free throw shooting. *Journal of Sport & Exercise Psychology*, 31, 152–168.
- Wilson, P., & Eklund, R. (1998). The relationship between competitive anxiety and self-presentational concerns. *Journal of Sport and Exercise Psychology*, 20, 81–97.
- Wine, J. (1971). Test anxiety and direction of attention. *Psychological Bulletin*, 76, 92–104.
- Wolf, S. A., Eys, M. A., & Kleinert, J. (2015). Predictors of the pre-competitive anxiety response: Relative impact and prospects for anxiety regulation. *International Journal of Sport and Exercise Psychology*, 13, 344–358.
- Woodman, T., & Hardy, L. (2003). The relative impact of cognitive anxiety and self-confidence upon sport performance: A meta-analysis. *Journal of Sports Sciences*, 21, 443–457.
- Yerkes, R. M., & Dodson, J. D. (1908). The relation of strength of stimulus to rapidity of habit-formation. *Journal of Comparative Neurology and Psychology*, 18, 459–482.
- Zuckerman, M. (2007). *Sensation seeking and risky behaviour*. American Psychological Association.