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Toward a three-dimensional conceptualization of performance anxiety: Rationale and initial measurement development

Wen-Nuan Kara Cheng [a,*], Lew Hardy [b], David Markland [b]

[a] Taipei Physical Education College, P.O. Box 81-851, Taipei 105, Taiwan
[b] School of Sport, Health and Exercise Sciences, Bangor University, George Building, Holyhead Road, Bangor, Gwynedd LL57 2PZ, UK

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ABSTRACT

Objectives: An integrated three-dimensional model of performance anxiety was constructed to offer an alternative conceptualization that may contribute to understanding of the complex anxiety–performance relationship. In particular, the adaptive potential (producing positive effects) of anxiety was acknowledged explicitly by including a regulatory dimension. This model is characterized by five subcomponents, with worry and self-focused attention representing cognitive anxiety, autonomous hyperactivity and somatic tension representing physiological anxiety, and perceived control representing the regulatory dimension of anxiety. The overview of the conceptual framework and the underlying rationale are presented.

Design: As a necessary first step towards model testing, an initial measure was developed and the factorial validity of the model was investigated.

Method: Confirmatory factor analysis was used in two independent samples ($N = 286$, 327) in a wide context of sports performance.

Results: A 25-item measure of performance anxiety was established. Findings of CFA revealed support for a three-dimensional first-order model.

Conclusions: Although the present model of performance anxiety was best presented as a three-dimensional first-order structure, the integrity of the conceptual framework is considered intact as such a factor structure distinctly reflects the three major processes (i.e., cognitive, physiological and regulatory) that are proposed to be activated in the anxiety dynamics from a broad cognitive perspective.

Anxiety is widely regarded as a complex psychological phenomenon, and is probably one of the most difficult emotions to define and diagnose. Not surprisingly, the relationship between anxiety and performance is far from straightforward. Although various conceptualizations of anxiety have been proposed across different fields of psychology, a consensus concerning the nature and definition of anxiety is still lacking. In sport psychology, the theoretical relationship between competitive anxiety and sports performance has been one of the most debated and investigated domains (Woodman & Hardy, 2001). Understanding of anxiety and performance has been furthered through advancement of sports anxiety models, for example, multidimensional anxiety theory (Martens, Burton, Vealey, Bump, & Smith, 1990), the catastrophe model (Hardy, 1990, 1996) and the control model (Jones, 1995). Yet empirical results have been inconsistent, mostly using the Competitive Sport Anxiety Inventory-2 (CSAI-2; Martens et al., 1990) that was based on the worry–emotionality model developed in the test anxiety literature (Liebert & Morris, 1967; Spielberger, 1980). Indeed, it has been suggested that theories of anxiety need at least to address the complexity and inconsistency of the findings (Eysenck & Calvo, 1992). Consequently, the authors have made research efforts to develop an alternative model of performance anxiety that may contribute to the understanding of the complex anxiety–performance relationship. To propose this model, the present paper contains two main sections: The first section presents the formation of the conceptual framework focusing on the underlying conceptual arguments and theoretical rationale. The second section reports empirical research regarding the measurement development and factorial validation of the model.

Overview of the conceptual model

The construct of performance anxiety refers to an unpleasant psychological state in reaction to perceived threat concerning the performance of a task under pressure. The chief rationale for re-conceptualizing the construct of performance anxiety was derived from the question: "Is anxiety, an unpleasant emotion,

* Corresponding author. Tel.: +886 966 200 694; fax: +886 3397 9681.
E-mail address: wnk.cheng@msa.hinet.net (W.-N.K. Cheng).

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always maladaptive in nature (producing only negative effects)?" Although a facilitative dimension of anxiety was identified in the early literature of text anxiety (Alpert & Haber, 1960; Wine, 1980), some sport psychology researchers later argued that "facilitative anxiety" (anxiety perceived as being facilitative to performance) was a mislabeling of other pleasant affective states, and positive effects on performance were attributed only to pleasant emotions, e.g., excitement (Burton & Naylor, 1997; Hanton, Mellalieu, & Hall, 2004; Jones, 1995; Jones & Hanton, 2001). Nevertheless, it remains doubtful whether pleasant emotions always lead to facilitative effects (Hanin, 1997; Hardy, 1998; Woodman & Hardy, 2001). Furthermore, many theorists infer that anxiety may include several affective elements, such as fear, shame, guilt (Janis, 1971), frustration (Gray, 1979), distress, anger, and even excitement (Izard, 1972a). The complexity of anxiety is highlighted by such inferences. In addition, one definition of anxiety in the Oxford Dictionary (1994) is "strong desire or eagerness for something" (apart from the conventional definition of "troubled feeling in the mind caused by fear and uncertainty about future"). Hence, a maladaptive conception of anxiety may risk an over-simplification of its complicated nature. Moreover, from an evolutionary perspective, such a conceptualization appears to be in conflict with the roots of anxiety, which stem from a defense mechanism that is meant to be functional, sending out warning signals that protect and prepare the individual to respond more effectively to perceived threat (Ohman, 2000). It also neglects the positive potential of anxiety on performance that may result from increased motivation (Eysenck, 1992), or from the energizing and focusing effects of anxiety (Carver & Scheier, 1986). Taken together, the adaptive nature of anxiety may have been under-represented by the conventional two components of worry and emotionality. In the present work, a more balanced viewpoint has been adopted to reflect not just the maladaptive, but also adaptive aspects of anxiety. More precisely, a third, regulatory dimension was incorporated as an integral part of anxiety to explicitly represent the coping capacity involved in the anxiety dynamics.

Another characteristic of this theoretical framework is the integration of more components than worry and emotionality, which corresponds mainly to the development of multidimensionality in test anxiety. Many researchers of test anxiety have identified several other important variables and argued that more components are necessary to better reflect the complexity of anxiety (Hagtvet & Benson, 1997; Hodapp & Benson, 1997; Sarason, 1984; Schwarzer & Jerusalem, 1992). In particular, more differentiated models have been proposed in which self-related cognitions such as irrelevant thoughts, lack of confidence, fear of failure, self-focused attention, self-efficacy, outcome expectancy, etc. have been incorporated as components of anxiety. For example, Sarason (1984) proposed an empirically derived model of test anxiety by expanding Spielberger's (1980) two-component model of test anxiety into four components, i.e., worry, test-irrelevant thinking, tension, and bodily symptoms. Also, the motivational construct, fear of failure, has been proposed to be an underlying anxiety construct, with empirical support (Hagtvet & Benson, 1997). Indeed, from a broad cognitive perspective, the scope of emotion (and anxiety in particular) overlaps with other psychological domains, such as cognition, attention, and motivation (Frijda, 2000; Johnson-Laird & Oatley, 2000; Ohman, 2000). Over and above theoretical concerns, a more differentiated model may be particularly meaningful in a practical sense, as a more focused and effective intervention program could be implemented when a more refined diagnosis of anxiety symptoms under performance stress is available.

Consequently, an alternative conceptualization of performance anxiety was attempted from a comprehensive viewpoint. This conceptual framework contains three main dimensions of anxiety that are characterized by five subcomponents: a cognitive dimension composed of worry and self-focused attention, a physiological dimension composed of autonomous hyperactivity and somatic tension, and a regulatory dimension indicated by perceived control. Given the complexity of performance anxiety, a more integrated approach may be of both theoretical and practical significance, and may offer some potential to unfold the dynamics of anxiety more sensibly. In the following paragraphs, definitions and more detailed rationales for each of the dimensions are given.

Rationale for the cognitive dimension

The cognitive dimension of anxiety refers to cognitive responses of anxiety that are negatively toned (unpleasant) due to perceived threat. The construct of worry has long been regarded as one of the major anxiety symptoms across many fields (Eysenck, 1992; Liebert & Morris, 1967; Spielberger, 1980). According to a convergent consensus of conceptualization, the authors define worry as a cognitive form of apprehension associated with possible unfavorable outcomes. In the present framework, however, the scope of cognitive anxiety is expanded to include an additional component of self-focused attention (hereafter labeled self-focus). We contend that people may manifest anxiety differently in different performance contexts and worry alone may be insufficient to cover the full range of cognitive anxiety. For example, anxious self-focus may increase attempts to consciously control movements (Baumeister, 1984), which is not obviously implicated in the content of worry. Although self-focus refers explicitly to an attentional shift towards the self, it has been viewed as more than simply the direction of attention (Wicklund, 1991). Accordingly, self-focus is defined as a self-evaluative state with an increased awareness of self-shortcomings concerning the performance of a task under stress. The main theoretical link between self-focus and anxiety is through the notion of self-evaluation. According to the theory of objective self-awareness (Duval & Wicklund, 1972), self-focus is assumed to lead to a self-evaluative state, which is one of the critical processes involved in anxiety (Gibbons, 1990; Izard, 1972b). As Izard (1972b) has argued, the state of anxiety is actually a complex combination of emotions including an element of self-evaluation as well as the concern and apprehension that self-evaluation produces. Self-evaluation cannot occur unless attention is focused upon the self, and thus self-focus has a direct link to anxiety through its impact on emotional awareness and through the self-evaluation it causes (Gibbons, 1990). Furthermore, another connection between self-focus and anxiety is through the conception of self-related cognition, which has been viewed as a necessary element of the anxiety experience (Gibbons, 1990; Sarason, 1984). In particular, Schwarzer and Jerusalem (1992) posited that the individual scans the environment for cues that are in some way related to the self, and anxious individuals can be characterized as being self-preoccupied, especially with regard to "personal lack" (Wicklund, 1991; e.g., weakness or shortcoming) which is particularly salient to anxious individuals. This proposition is consistent with the assumption that a cognitive bias to focus on internal threat-related stimuli is a vulnerability factor in trait anxiety (Calvo & Cano-Vindel, 1997). Above all, self-focus, rather than worry, has been favored and conceptualized by Carver and Scheier (1988) as a key aspect in their control-process perspective on anxiety. Based on the above lines of reasoning, self-focus was included as a component of cognitive anxiety in the present conceptualization.

Rationale for the physiological dimension

The physiological dimension of anxiety refers to physiological reactions that are invoked by autonomous nervous system in response to a stressor. This dimension has been an important characteristic for the diagnosis of anxiety across diverse contexts.

Some theorists such as Bandura (1988) even equate arousal with anxiety, disregarding the cognitive element of anxiety. As such, the importance of the physiological aspect of anxiety is fairly evident. However, the widely adopted construct of emotionality from the worry–emotionality model of test anxiety (Liebert & Morris, 1967; Spielberger, 1980) was uni-dimensional. Some researchers have argued that a single unitary arousal system is insufficient since different arousal states may exhibit differential impact on different aspects of performance (Hockey & Hamilton, 1983). The notions of multidimensional arousal, and specificity or patterning in bio-behavioral systems have also gained empirical support (Neiss, 1988). Taken together, physiological anxiety in the present conceptual framework is characterized by two subcomponents, i.e., autonomous hyperactivity and somatic tension. The subcomponent of autonomic hyperactivity is defined as physiological reactions involved with the involuntary muscle groups that are associated with the body's inner organs, such as the respiratory muscles, sweat glands, blood vessels, and so on. Typical example symptoms are breathlessness, cold sweat, and increased heart rate. The subcomponent of somatic tension refers to physiological reactions involved with the voluntary muscle groups that are motor-orientated. Typical symptoms are trembling, muscle tension and fatigue. This conceptualization covering a broad range of stress-related physiological symptoms is in accordance with anatomical structure (involuntary versus voluntary muscle structure), and mainly based on the criteria used for generalized anxiety disorder in the Diagnostic and Statistical Manual of Mental Disorder, third edition-revised (*DSM-III-R*; APA, 1987). It is also commonly adopted in various contexts of anxiety research, for example, clinical anxiety (Ohman, 2000) and test anxiety (Sarason, 1984).

Rationale for the regulatory dimension

The regulatory dimension of anxiety refers to cognitive representations of an underlying regulatory process involved in the dynamics of anxiety and concerned with coping capacity in reaction to perceived threat. Such a dimension, explicitly indicating an adaptive potential, was integrated into our model of anxiety from both theoretical and empirical considerations. Theoretically, many cognitive theorists of emotion highlight the adaptive role of emotion, and propose that a regulatory process is involved in the system of emotion (Frijda, 2000; Izard & Ackerman, 2000; Johnson-Laird & Oatley, 2000) and anxiety in particular (Mathews, 1992; Ohman, 2000). Furthermore, the notion of control has been suggested as playing a key role in anxiety variations in a number of theories of anxiety (Carver & Scheier, 1988; Eysenck & Calvo, 1992; Ohman, 2000). According to processing efficiency theory (Eysenck & Calvo, 1992), a control system involved in anxiety monitors and evaluates performance, and also plans and regulates the use of processing resources. Consequently, although processing efficiency may be impaired due to reduced available working memory capacity, performance may still be sustained or even enhanced due to increased motivation and allocation of additional resources to the task at hand.

The utilization of a control system also appears to be one of the main characteristics that differentiate anxiety from depression, as depressed individuals exhibit little use of the control system to cope adaptively with perceived stress (Eysenck, 1992; Mathews, 1992). Unsurprisingly, research has shown that depression is associated with passive disengagement, whereas anxiety is associated with active engagement in the environment (Eysenck, 1992). In addition, while conventional criteria for dysfunctional anxiety in the clinical domain were excessive levels of anxiety, more contemporary guidelines have emphasized uncontrollability (over worry) for the diagnosis of generalized anxiety disorder in the *DSM-IV* (APA, 1994). That is, diagnosis criteria for maladaptive anxiety concern not only its quantitative level but also its qualitative variation regarding regulatory capacity. Other theorists have argued from an evolutionary perspective (Ohman, 2000) that the anxiety response accomplishes its protective function by means of facilitating anticipatory threat detection (Eysenck, 1992) as well as mobilizing resources in a coordinated manner to provide energy and prepare for vigorous action (Calvo & Cano-Vindel, 1997). Although such an adaptive nature may be implied through conventional symptoms of worry and emotionality, as both have been proposed to be potentially functional (Eysenck, 1992; Thayer, 1989), the addition of a regulatory dimension appears to more explicitly reflect this intended adaptive capacity.

Conventionally, representations of regulatory processes were viewed as coping-related factors, with a distinct conceptualization on their own (unrelated to the construct of anxiety). In contrast, Mathews (1992) has argued within the framework of information processing that "highly anxious individuals are characterized by not only a combination of attentional vigilance, an interpretative bias favoring the selection of threatening meaning, but also by partially successful attempts to avoid further elaborative processing of that information" (p. 120). He suggested that a voluntary stage regarding coping was involved in the final process of the anxiety dynamics. Noteworthily, the regulatory dimension proposed in the present model is not a distinct coping effort or strategy, but a reflection of potential coping capacity involved in the dynamics of anxiety. This regulatory dimension of anxiety is represented by the construct of perceived control. Among numerous definitions of control (for a review, see Skinner, 1996), the notion of perceived control as a regulatory element in the present framework refers to the perception of one's capacities to be able to cope and attain goals under stress. This definition is consistent with Carver and Scheier's (1988) conceptualization in their control-process perspective on anxiety. They proposed that favorable versus unfavorable expectancy regarding coping and completion of an action was a critical variable, causing a fundamental variation in responses to and the effects of anxiety. More importantly, such conceptualization of perceived control apparently relates to the process of self-evaluation, considered one of the key factors underlying anxiety as addressed earlier (Gibbons, 1990; Izard, 1972b). It is therefore logical to posit from a more comprehensive viewpoint that anxious individuals in reaction to performance pressure may evaluate not only environmental and internal threats, but also their capacities for coping with them and meeting the demands of the task. Consequently, the element of perceived control appears to be one of the necessary features of performance anxiety in a broad context of performance–stress dynamics. Notwithstanding, this component may be positively-toned (e.g., feeling a sense of control rather than lack of control), and thus may have to be accompanied by other unpleasant anxiety elements (e.g., cognitive anxiety) to define the state of performance anxiety as a negatively-toned emotion.

There are other integrated models of anxiety that involve an adaptive capacity. For example, Rost and Schermer (1992) proposed a model of test anxiety that contained comprehensive dimensions of initiation, manifestation, coping, and stabilization of anxiety from a process-oriented perspective. In sport psychology, Jones (1995) has proposed a control model of competitive sports anxiety, adapted from Carver and Scheier's (1986, 1988) theory of self-regulation. He argued that intensity dimensions of anxiety were not sufficient to investigate the anxiety–performance relationship, and emphasized the directional dimension of anxiety in terms of symptom interpretation as the main determinant of performance. This proposal has gained much empirical support (Jones & Hanton, 2001; Jones, Hanton, & Swain, 1994; Jones, Swain, & Hardy, 1993). However, despite the fact that both Jones' directional dimension and the regulatory dimension of anxiety proposed in the present model relate to the notion of control, there are major differences

between them in at least two fundamental respects. First, Jones' directional dimension was not fully integrated as part of anxiety. More specifically, "facilitative anxiety" was regarded as merely a mislabeling of other pleasant affective states (Jones, 1995; Jones & Hanton, 2001). In contrast, the present model of performance anxiety views anxiety as potentially adaptive and argues it may therefore lead to positive effects on performance. Second, and more importantly, Jones' directional dimension is characterized by the interpretation of anxiety symptoms, whereas the regulatory dimension of anxiety presented here is represented by perceived control. A primary concern of the present authors is that symptom interpretation may be inapplicable under certain circumstances, as anxiety symptoms may not always be consciously accessible to individuals. For example, people may deny, neglect, or repress their anxiety symptoms as a coping style (Hippel et al., 2005) or they may simply be unaware of (or insensitive to) their own psychological states due to factors such as poor insight or introspection limitations (Egloff & Schmukle, 2002). Thus, it is more appropriate to indicate this regulatory dimension of anxiety directly by perceived control as proposed here, rather than indirectly via symptom interpretation.

In conclusion, we propose the additional regulatory dimension along with intensity-oriented cognitive and physiological dimensions as three major processes underpinning anxiety–performance dynamics. The aim of this re-conceptualization was to acknowledge the under-represented concept of adaptive potential in performance anxiety, which may lead to a better understanding of the complex nature of anxiety and its effects upon sports performance. According to the theoretical rationale presented here, it is plausible that the regulatory dimension together with the interactive effects of the three main dimensions of anxiety would better predict the anxiety–performance relationship. Moreover, the multidimensionality approach adopted in the present cognitive and physiological anxiety dimensions provides a broader perspective of these dimensions than has previously been used. Obviously, the introduction of this conceptual framework is merely a starting point. The validity of the model, and, particularly, precise predictions regarding the combined effects of the different components on performance need to be developed further and tested empirically. As a first step toward model testing, it was necessary to develop a measure according to the re-conceptualization of performance anxiety. The following section presents empirical research regarding the measurement development and factorial validation.

Measurement development and factorial validation

The objectives of the present research were to develop a preliminary measure based on the proposed conceptual framework and to assess the factor structure of the model through confirmatory factor analysis in two independent samples of sports performers. This model of performance anxiety contained three major dimensions, with cognitive anxiety reflected by worry and self-focus, physiological anxiety reflected by autonomous hyperactivity and somatic tension, and the regulatory dimension reflected by perceived control. Nevertheless, it is noted that each pair of subcomponents of cognitive and physiological anxiety appear to have some shared characteristics. In more detail, worry and self-focus are both defined as negatively toned and both relate to a self-evaluative state. Furthermore, some researchers (Schwarzer & Jerusalem, 1992) have proposed that (negative) self-focus may lead to worry, although direct causal evidence for this proposal is lacking. Similarly, both autonomous hyperactivity and somatic tension refer to physiological reactions in response to perceived threat, which implies that their underlying mechanism may likely overlap to some extent. Consequently, given that each pair of subcomponents included in the cognitive or physiological dimension was expected to correlate to some degree, the factor structure of the proposed model, with three dimensions characterized by five subcomponents, required empirical evaluation. More precisely, it was to confirm whether the factor structure was best represented as a hierarchical five-dimensional model or a three-dimensional first-order model (with worry and self-focus merged as a single dimension of cognitive anxiety, and autonomous hyperactivity and somatic tension merged as a single dimension of physiological anxiety).

Development of preliminary measure

An item pool with approximately 120 items was generated to assess worry, self-focus, autonomic hyperactivity, somatic tension, and perceived control, based on the definition of each subcomponent, and a variety of existing anxiety measures as well as an extensive review of the anxiety-related literature. Each item in the pool was thoroughly evaluated in terms of content validity, clarity of wordings, and sentence structure, according to the established guidelines for questionnaire design (Hippler, Schwarz, & Sudman, 1987). Additionally, several principles of instrument refinement (Smith & McCarthy, 1995) were applied to enhance psychometric strength. For example, the content of items were designed to express only a single idea in order to avoid possible multiple sources of variance (Clark & Watson, 1995), and reverse-worded items were avoided to prevent the potential creation of unintended dimensionality due to a method (response-style) effect (Gana, Martin, Canouet, Trouillet, & Meloni, 2002). In addition, it was intended that, once validated, the measure may be used for assessing pre-competitive anxiety in stressful conditions. Hence, to minimize possible intrusion on mental preparation before performance, a general principle regarding the total length of the inventory was that it would be no longer than 30 items. Finally, an initial 29-item measure was established from the item pool according to the consensus of the authors, with five items assessing worry, four for self-focus, six for autonomous hyperactivity, five for somatic tension, and nine for perceived control. A five-point Likert scale ranging from 1 (*totally disagree*) to 5 (*totally agree*) was used for the whole inventory. The instructional set included anonymity, confidentiality of responses, and anti-social desirability statements. This initial measure was pilot tested on 10 sports participants from the targeted population to ensure the comprehensibility of the inventory.

Method of data analysis

The present two studies employed confirmatory factor analysis (CFA) via LISREL 8.72 and PRELIS 2.72 (Joreskog & Sorbom, 2005). Maximum-likelihood minimization estimation was performed. A sequential approach to model testing (Joreskog, 1993; Markland & Ingledew, 1997) was adopted to provide a rigorous test of the convergent and discriminant validity of the measurement models. This approach progressively tests the model from single to multiple factors primarily for diagnostic purposes to prospectively reduce potential problems by deleting inadequate items (e.g., low factor loadings, troubling residual patterns). At the final stage of sequential CFA, a procedure known as parceling (Marsh, Antill, & Cunningham, 1989) was implemented due to the relatively small sample size. A parceled model was produced in order to obtain a stable solution, with the construction of item composites of the observed variables for each first-order factor to reduce the number of estimated parameters in the measurement model. Such composite variables are typically more normally distributed and more reliable than the original variables (Marsh et al., 1989). Global model fit indices were examined at each stage of sequential CFA,

along with detailed assessments of the completely standardized factor loadings, the standardized residuals, and the modification indices. In addition to the commonly adopted chi-square test, multiple criteria were used, including the Root Mean Square Error of Approximation (RMSEA; Steiger, 1990), the Comparative Fit Index (CFI; Bentler, 1990), and the Standardized Root Mean Square Residual (SRMR).

Study 1: Initial investigation of the measure

The objective of this study was to evaluate the psychometric properties of the initial 29-item instrument, including the characteristics and strength of the individual items, and the validity of the factor structure of the model.

Method

Participants

A total of 286 inventories were collected from a wide range of sports participants (35 sports types: 17 individual sports, $N = 129$; 18 team sports, $N = 157$) of various skill levels, ranging from international to recreational level. Average age was 23 years (SD = 6.0), including 128 females (M age = 22.6, SD = 5.3) and 158 males (M age = 22.9, SD = 6.0). The sports-related participants were drawn from UK universities via multiple channels, e.g., the athletic union, British Universities Sports Association. All participants were English-speaking.

Procedure

Retrospective data were collected. Consent for participating was obtained from all participants. The measure was administered individually or in small groups at practice sites in a secluded location close to training facilities, but not before competition or any major life events to avoid possible cognitive bias due to external or emotional distractions. Participants were briefed on the study objectives, and given instructions for completing the inventory. The participants were asked to focus on the most recent sports event they had performed in under pressure that could be remembered clearly, and to recall how they felt before that specific performance. A quarter of the data was collected within two days of the performance, another half were collected within one week, and the rest within two months.

Results

Initial inspection of the univariate normality of all items for skewness (values ranged from −.59 to 1.15) and kurtosis (values ranged from −1.05 to .65) revealed some violation, and the multivariate distributions were thus significantly non-normal. Hence, the Satorra–Bentler scaled chi-square test (Robust χ^2; Satorra & Bentler, 1988) was adopted to correct the χ^2 statistic for non-normality. During the process of sequential testing with CFA, one item was removed from worry, one from somatic tension, two from autonomic hyperactivity, and three from perceived control. A total of seven items was thus deleted from the 29-item measure due to relatively weak factor loadings, troubling residual patterns and high modification indices. With the elimination of items, all single- and two-factor models showed an acceptable fit (Table 1). On testing both two-factor models, the inter-factor correlations between paired first-order components were high, with .83 for worry and self-focus, and .92 for autonomous hyperactivity and somatic tension. However, Satorra–Bentler scaled χ^2 difference tests (S–B χ^2_{diff}; Satorra & Bentler, 2001) supported the discriminant validity for both pairs. The two-factor models, in which the correlation between the two factors was free to be estimated, were compared with re-specified models in which the inter-factor correlation was constrained to unity. The results were S–B $\chi^2_{diff}(1) = 9.14$, $p < .001$ for cognitive anxiety, and S–B $\chi^2_{diff}(1) = 4.35$, $p < .05$ for physiological anxiety, thereby demonstrating that constraining the correlations between factors to unity led to significantly worse fits.

Table 1
Fit indices for the one- and two-factor models in Studies 1–2

	Robust χ^2	df	*P*	RMSEA	CFI	SRMR
Study 1: one-factor models						
Worry	.01	2	.99	.00	1.00	.00
Self-focus	1.46	2	.45	.00	1.00	.02
Autonomous hyperactivity	1.29	2	.39	.00	1.00	.02
Somatic tension	2.39	2	.19	.03	1.00	.02
Perceived control	11.19	9	.05	.03	1.00	.03
Two-factor models						
Cognitive anxiety	23.59	19	.13	.03	.99	.03
Physiological anxiety	35.63	19	.001	.03	.99	.04
Study 2: one-factor models						
Worry	6.10	2	.01	.08	.99	.03
Self-focus	13.46	14	.49	.00	1.00	.03
Autonomous hyperactivity	2.77	2	.17	.03	1.00	.02
Somatic tension	4.53	2	.09	.06	.99	.03
Perceived control	14.02	9	.06	.04	1.00	.03
Two-factor models						
Cognitive anxiety	93.99	43	.00	.06	.98	.05
Physiological anxiety	22.61	19	.09	.02	1.00	.04

Note: Two-factor models refer to the cognitive dimension of anxiety that includes the paired subcomponents of worry and self-focus, and the physiological dimension of anxiety that includes the paired subcomponents of autonomous hyperactivity and somatic tension.

At the final stage of testing the full model, the method of parceling was employed and the retained 22 observed variables were reduced to 11 items. Each composite variable was constructed by randomly combing two items that indicated the same first-order subcomponent of anxiety. The parceled version of the hierarchical model with three second-order factors and five first-order subcomponents (with Robust $\chi^2(37) = 64.45$, $p < .001$; RMSEA = .05, CFI = .99, and SRMR = .05) was considered unsuccessful due to three improper estimates (coefficient values greater than 1.0; Hair, Anderson, Tatham, & Black, 1998) emerging between latent factors in the second and first levels in the structural model. Considering the high inter-factor correlations shown in the tests of the two-factor models between worry and self-focus, and between autonomous hyperactivity and somatic tension, an alternative parceled model retaining only three anxiety dimensions was constructed by merging worry and self-focus into a single factor as cognitive anxiety, and merging autonomous hyperactivity and somatic tension into one factor as physiological anxiety. This parceled three-dimensional first-order model revealed an acceptable fit to the data, with Robust $\chi^2(41) = 86.5$, $p < .001$; RMSEA = .06, CFI = .98, and SRMR = .06. A similar finding was obtained for a non-parceled version of the three-dimensional first-order model, with Robust $\chi^2(206) = 357.2$, $p < .001$; RMSEA = .05, CFI = .97, and SRMR = .07. The factor loadings of the final 22 items were all significant, ranging from .84 to .31, with 18 out of 22 (82%) items obtaining a loading higher than .50. Except for perceived control with six items, each of the remaining four subcomponents had four items. Cronbach's alpha reliability coefficients showed acceptable internal consistency for the three subscales of the cognitive, physiological and regulatory dimensions of anxiety ($\alpha = .78$, .83, and .83 respectively).

Study 2: Refinement of the measure

The objective of the second study was to refine the developed 22-item measure in Study 1 and to evaluate the psychological properties of that refined measure. The majority of the 22 items

were retained for further empirical evaluation, but some refinement was made in an attempt to improve the validity of the measure. The subscale of self-focus was expanded from four to eight items and two more items were added for perceived control to make it an eight-item subscale. Thus, this refined measure had 28 items, with the aim of representing each subscale more precisely. Each of the factors, i.e., worry, autonomous hyperactivity, and somatic tension had four items, and self-focus and perceived control had eight items each.

Method

Participants

A total of 327 inventories were collected from participants across a wide variety of sports (31 types: 15 individual sports, $N = 148$; 16 team sports, $N = 179$), with various skill levels, ranging from international to recreational level. The mean age of participants was 25.9 years (SD = 10.9), with 155 females ($M = 26.2$, SD = 10.8) and 172 males ($M = 25.6$, SD = 10.0). The sample was primarily from UK universities, similar to Study 1. All participants were English-speaking.

Procedure

Administration of the inventory was exactly the same as in Study 1. In order to enhance the accuracy of recall, all data were collected within one week following performance, with 47% collected within two days.

Results

Consistent with Study 1, Robust χ^2 was employed to prevent potential problems arising from violation of multivariate non-normality, which was detected using skewness (values ranged from −.54 to 1.32) and kurtosis (values ranged from −1.38 to .95) for assessing the univariate normality of all items. During sequential CFA, one item was removed from self-focus and two from perceived control. A total of three items was thus eliminated due to relatively weak factor loadings, troubling residual patterns, and high modification indices. After item deletion, all one- and two-factor models showed an acceptable fit (Table 1). The inter-factor correlations within paired first-order subcomponents were high, with .91 for worry and self-focus, and .90 for autonomous hyperactivity and somatic tension. However, discriminant validity of worry and self-focus was confirmed through the Satorra–Bentler scaled χ^2 difference test (S–B $\chi^2_{\text{diff}}(1) = 9.98$, $p < .05$). Yet the differentiation between the two physiological subcomponents was marginally rejected (S–B $\chi^2_{\text{diff}}(1) = 2.99$, $p > .05$).

At the final stage, the parceling method was adopted and each of the five subcomponents had two composite variables by randomly combining items that indicated the same first-order factor. The fit of the parceled hierarchical model with three second-order factors and five first-order factors (with Robust $\chi^2(28) = 42.32$, $p = .01$; RMSEA = .04, CFI = .99, and SRMR = .04) was considered again unsuccessful due to improper estimates, similar to those in Study 1. As expected, after merging worry and self-focus, and merging autonomous hyperactivity and somatic tension, respectively, into single factors, the parceled three-dimensional first-order model exhibited a good fit to the data, with Robust $\chi^2(32) = 47.9$, $p = .01$; RMSEA = .04, CFI = .99, and SRMR = .05 (Fig. 1). This was consistent with the results from a non-parceled version of the three-dimensional first-order model, with Robust $\chi^2(272) = 477.6$, $p < .001$; RMSEA = .05, CFI = .97, and SRMR = .07. The factor loadings for the final 25 items (Table 2) were all significant, ranging from .79 to .35, with 20 out of 25 (80%) items obtaining a loading higher than .50. Worry, autonomous hyperactivity, and somatic tension had four items each; self-focus had seven, and perceived control had six items. The three subscales of the cognitive, physiological and regulatory dimensions of anxiety showed acceptable internal consistency assessed by Cronbach's reliability coefficients ($\alpha = .86$, .75, and .85, respectively).

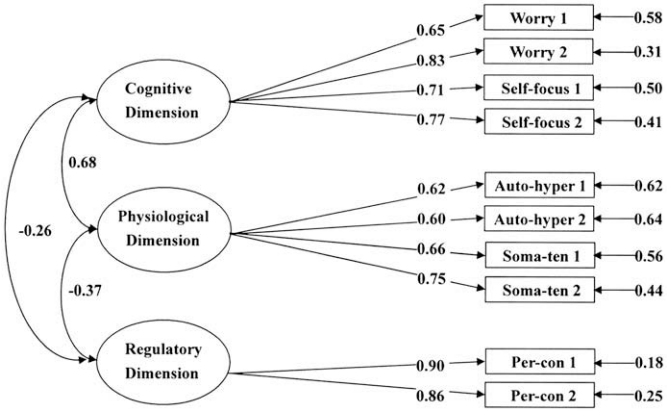

Fig. 1. Results of confirmatory factor analysis for the final parceled model in Study 2. Model fit indices were Robust $\chi^2(32) = 47.9$, $p = .01$; RMSEA = .04, CFI = .99, and SRMR = .05. All data shown were completely standardized solution. Observed variables were composite.

General discussion

This paper includes two main parts: The first part presents various conceptual arguments and rationale leading to an

Table 2
The scale content of 25 items and corresponding factor loadings (completely standardized solution)

Content of the 25 scale items	Factor loading
Subscale of cognitive anxiety	
Worry	
I am worried that I may not perform as well as I can.	.45
I am worried about making mistakes.	.66
I am worried about the uncertainty of what may happen.	.75
I am worried about the consequences of failure.	.58
Self-focus	
I tend to dwell on shortcomings in my performance.	.60
I find myself evaluating myself more critically than usual.	.52
I am very conscious of every movement I make.	.35
I am conscious that others will judge my performance.	.58
I am conscious that people might disapprove of my performance.	.71
I dwell on how I might fail to impress important others.	.72
I am very aware of the possibility of disappointing important others.	.75
Subscale of physiological anxiety	
Autonomic hyperactivity	
My heart is racing.	.53
My hands are clammy.	.52
My mouth feels dry.	.61
I feel the need to go to the toilet more often than usual.	.35
Somatic tension	
I have a slight tension headache	.69
I feel easily tired.	.61
My body feels tense.	.36
I feel restless.	.49
Subscale of regulatory dimension of anxiety	
Perceived control	
I am confident that I can stay focused during my performance.	.63
I believe in my ability to perform.	.79
I feel ready for my performance.	.72
I believe that I have the resources to meet this challenge.	.67
I believe my performance goal is achievable.	.58
I feel confident about my upcoming performance.	.79

alternative conceptual framework of performance anxiety. The second part reports empirical research efforts as a necessary first step towards model testing. The aims of the empirical research were the development of measurement based on the proposed conceptualization of performance anxiety, and examination of factorial validity via CFA using two independent samples in the context of sports performance. At a global level, the findings of testing the whole model supported a three-dimensional first-order model, rather than a hierarchical five-dimensional structure. This was likely due to high inter-factor correlations between worry and self-focus, and between autonomous hyperactivity and somatic tension leading to improper solutions. However, at a more detailed level on testing the two-factor models, the discriminant validity of these paired subcomponents was sustained in three of the four tests in Studies 1–2 by the Satorra–Bentler scaled χ^2 difference tests (with one test showing borderline results for differentiating physiological subcomponents). Taken together, these results suggest that it might be possible to empirically separate these two pairs of subcomponents in a germane context. For example, it might aid differentiation by increasing the length of each subscale, which, however, would limit the applicability of the instrument at a practical level. Alternatively, confirmatory factor analysis is not the only option for investigating such study questions. Multidimensionality of psychological factors may be revealed by their differential impact on different aspects of performance. Under such logic, a homogeneous study group (e.g., one or more similar sports within a more limited range of skill ability) using a prospective study design would be a sensible context to look into this issue. Consequently, the differentiation between worry and self-focus, and between autonomous hyperactivity and somatic tension is considered worth retaining at a descriptive level at this relatively early stage of model development. Future research is needed to further examine the discriminant validity of these paired subcomponents.

Through two studies of CFA, a 25-item measure of performance anxiety based on the proposed conceptual framework was preliminarily developed. Future investigations are desirable to provide additional psychometric data for the measure. Considering that both retrospective and prospective research has their advantages and weaknesses, retrospective designs were utilized for several reasons. First, the validity of retrospective recall has been verified by previous researchers, despite the possible effect of memory bias (Butt, Weinberg, & Horn, 2003; Hanin, 1986). Second, anxiety measures, if administered before a stressful performance, may result in response bias due to self-defense as a coping style (Hippel et al., 2005). Third, a retrospective study design would create fewer ethical concerns in terms of avoiding possible intrusion on mental preparation before competition. Although a certain amount of data (i.e., 25% of the sample) in Study 1 was recalled within two months of competition, all data collected in Study 2, from which the proposed 25-item measure of performance anxiety was established, was within two days (47%) or one week (53%) to enhance efficiency of recall. Despite the reported findings being generally promising, future prospective study is recommended to confirm the present results.

Although current data showed support for a three-dimensional first-order model, the integrity of the general conceptual framework is considered intact as such a factor structure distinctly reflects the three major processes (i.e., cognitive, physiological and regulatory) that are proposed to be activated in the dynamics of anxiety from a broad cognitive perspective. Nevertheless, some researchers might argue that the three factors (cognitive, somatic anxiety and self-confidence) in the CSAI-2 appear to correspond to the three main dimensions (cognitive, physiological anxiety and perceived control) in the proposed framework of performance anxiety. But fundamentally, these two models differ from a theoretical viewpoint. First, the scope of cognitive anxiety is clearly different in that additional component of self-focus is included in the anxiety model here. Most importantly, the present conceptualization of anxiety is the first theoretical model in sport psychology that explicitly highlights the potentially adaptive nature of anxiety and includes a regulatory dimension. In contrast, the CSAI-2, based on the two-component (worry–emotionality) model, clearly shows no concern for the coping capacity involved in anxiety. In more detail, the role of self-confidence in the CSAI-2 differs from perceived control in the present model in several ways. First, although self-confidence has been included as a subscale in the CSAI-2, it was not originally proposed as a component of anxiety (Martens et al., 1990), and was certainly not included as an expression of anxiety's adaptive capacity. Second, Martens et al. (1990) argued that self-confidence and worry represent opposite ends of a single bipolar construct, a conception that has been challenged by cumulative empirical investigations (Hardy, 1996; Hardy, Woodman, & Carrington, 2004; Woodman & Hardy, 2003). Furthermore, at the level of operational definition, factor analysis of the CSAI-2 operationalized self-confidence as having two themes, positive performance expectations and a sense of calmness (cf., Lane, Sewell, Terry, Bartram, & Nesti, 1999). The factor of positive performance expectations is generally consistent with the present component of perceived control in regard to the notion of goal attainment. However, the other component of emotional calmness (indicated by "I feel mentally relaxed.", "I feel at ease." etc.) is not included in perceived control in the proposed framework. It is considered to be in apparent conflict with the main feature of anxiety, i.e., unpleasant affectivity, and may be contaminated by other pleasant affective states. To be more specific, anxious individuals may feel worried, aroused, and yet have a certain sense of confidence/control over goal attainment at the same time. However, it seems unlikely that one could feel both anxious and mentally relaxed simultaneously when under pressure. In sum, it is obvious that the present theoretical model with the emphasis of the regulatory (coping) capacity involved in anxiety cannot be equated with the data-driven measurement model of the CSAI-2. Above all, with an inventory initially developed here, more research is required to examine the explanatory and predictive power of this new model of performance anxiety as the establishment of construct validity is an on-going process (Smith & McCarthy, 1995).

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