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Toward a three-dimensional conceptualization of performance anxiety conceptual model, measurement development and initial validations

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Toward a Three-Dimensional Conceptualization of Performance Anxiety:

Conceptual Model, Measurement Development, and Initial Validations

Ph.D. Thesis

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CONTENTS

Acknowledgements

I am drinking my usual blackcurrant tea in my favorite café, where I have visited as often as I could to write my papers, read references and even key in my data. And all this has come to an end……. I thought four years of study was a long time but just realized now that it was not—I am actually writing acknowledgements for my thesis work! There are certainly a few people that I need to thank for helping me do this research project.

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Thinking back, it was a big decision then for me to do this PhD, one of the biggest in my life I am sure. As I recall, my family and people around me at that time were more surprised or doubtful than accepting my idea of studying a doctorial degree abroad. This change of life path meant that I had to leave my teaching job, my family and friends for a while, and spend a lot of money. I also turned down the invitation and request of helping Olympic tae-kwon-do athletes from the head coach in Taiwan, who came to my office and asked me if I could delay my PhD study in Bangor for a year until they accomplished their mission in the 2004 Olympics in Greece. This was the most competitive sports team in Taiwan and I had worked with for so many years since I became a sports psychological consultant from a clinical psychologist. Not surprisingly, I missed the important occasion of witnessing and sharing the great joy of my athlete winning the Olympic gold in Greece—the first Olympic gold in Taiwan. That was probably the only moment that I felt regret about my decision. As my athlete, Shie-Sing, thanked my contribution to her Olympic medal in her autobiography despite my study leave of absence, I would like to thank her back here for making me feel involved in the striving for honor in the Olympics. Special thanks are also owed to the whole community of tae-kwon-do sports, including all coaches, athletes and

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Thesis Summary

This thesis contains two main sections. The first part presents the detailed formation of a conceptual framework of performance anxiety. The second part presents subsequent empirical studies related to the proposed conceptual model, including preliminary development of measurement, and empirical evidence of factorial and predictive validities of the model across two cultures, specifically English (British) and Chinese (Taiwanese).

Chapter 1 provides several major lines of arguments and issues that initiated the research endeavor on conceptualizing the construct of performance anxiety. Both theoretical and empirical concerns are highlighted and alternative perspectives on the complex construct of anxiety and the anxiety-performance dynamics are presented.

Chapter 2 critically reviews the conceptual arguments on the fundamental debate about whether anxiety is maladaptive in nature and always detrimental to performance. Detailed rationales, as well as definitions and assumptions, for each dimension of anxiety underlying the construction of the proposed conceptual model are introduced. Moreover, the development of a measure in English is also reported in this chapter, together with evidence of the factorial validity of the measurement and structural models using confirmatory factor analysis, with two independent British samples.

Chapter 3 describes the development of a measure in Chinese and a cross-cultural validation of the factorial structure of the performance anxiety model using three Taiwanese samples. The comparability of the measures in English and Chinese versions, and the advantage of cross-cultural validation on the factorial

structure of the model are addressed. As expected, the factorial validity obtained in the two English studies (Chapter 2) was further confirmed by the three Chinese studies in this chapter.

Chapter 4 reports the predictive validity of the conceptual model of performance anxiety. Three predictions according to the model were examined in the context of elite level of competitive tae-kwon-do sports performance in Taiwan. Results were generally as hypothesized and implications from both theoretical and applied perspectives are discussed.

The final chapter (Chapter 5) concludes the research work of this thesis. More specifically, this chapter provides a summary of the thesis and integrated discussion of the conceptual framework as well as six empirical studies. In more detail, theoretical and applied implications, strengths and limitations of the research, together with future directions for research are addressed.

Chapter 1

General Introduction

Introduction

The core of this entire research undertaking concerns the understanding of stress-related psychological states and performance. Anxiety has become an obvious target as it has been one of the main psychological phenomena associated with performance under pressure, e.g., competitive sports performance. However, anxiety is considered one of the most difficult emotions to define and diagnose, probably due to its complex nature and mixed (debilitative vs. facilitative) effects upon performance. Therefore, it is not surprising that a consensus regarding the nature and definition of anxiety is still lacking. The ubiquity and controversial status of anxiety have made it a central topic for research and reflection (Ohman, 2000).

In sport psychology, there remains debate on fundamental issues, e.g., the problems of definition that are ingrained in sports anxiety and performance research. For example, the notion of "facilitative anxiety" (producing positive effects) proposed in the sports domain (Hardy, 1990; Parfitt, Jones & Hardy, 1990; Jones, 1991) was initially inspired from the test anxiety literature (e.g., Albert & Haber, 1960; Wine, 1980). Anxiety responses were distinguished between positive and negative dimensions (as measured by the Achievement Anxiety Test), which together exhibited a significantly stronger prediction of academic performance than a conventional debilitating anxiety scale (Albert & Haber, 1960; Carrier, Higson, Klimoski & Peterson, 1984). Empirical data concerning anxiety effects on sports performance has also consistently shown not only debilitative but also facilitative effects upon performance (Jones & Cale, 1989; Parfitt & Hardy, 1993; Parfitt, Hardy & Pates, 1995; Edwards & Hardy, 1996; Woodman & Hardy, 2003). However, Jones and others later argued that "facilitative anxiety" was a mislabeling of other positive states and that

anxiety was always maladaptive, accounting for only debilitative effects on performance (Jones, Hanton & Swain, 1994; Jones, 1995; Burton & Naylor, 1997; Jones & Hanton, 2001; Hanton, Mellalieu & Hall, 2004). Despite the suggestion that the construct of sports anxiety measured by the Competitive State Anxiety Inventory (CSAI-2; Martens, Vealey & Burton, 1990) may be contaminated by other positive states (Burton & Naylor, 1997), it remains doubtful that positive emotional states would always lead to positive performance effects (Hanin, 1997; Hardy, 1998; Woodman & Hardy, 2001). In the same vein, although anxiety is unpleasant, would such an emotion always produce negative consequences? The present work was initiated by such fundamental arguments regarding whether anxiety is always maladaptive (producing merely negative effects) in nature.

Given that many conceptualizations and models of anxiety have been proposed across various fields of psychology, the conceptual arguments presented in this research endeavor were formed according to theoretical frameworks from a wide variety of disciplines, including sports anxiety, test anxiety, clinical anxiety, music anxiety, as well as anxiety in cognitive, social, and general psychology. From an extensive review of literature, several conceptual and empirical issues need to be considered first in more detail.

Origin of Anxiety

From an evolutionary perspective, Ohman (2000) argued that anxiety responses originate in an alarm system that is shaped by evolution in order to protect individuals from impending danger. More specifically, the root of anxiety stems from a defense mechanism that is meant to be adaptive, sending out warning signals to protect and

prepare individuals to respond more effectively to perceived threat (Ohman, 1996, 2000). Its protective function is accomplished by means of facilitating anticipatory threat detection (Eysenck, 1992) as well as mobilizing resources in a coordinated manner to provide energy and prepare for action (Calvo & Cano-Vindel, 1997; Calvo, Avero, Castillo & Miguel-Tobal, 2003). Furthermore, many theoretical positions have highlighted that a regulatory process or an adaptive capacity is involved in the system of emotion (Izard & Ackerman, 2000; Frijda, 2000; Johnson-Laird & Oatley, 2000) and anxiety in particular (Ohman, 2000; Eysenck & Calvo, 1992; Mathews, 1992), despite the fact that the notion of coping (or control) is conventionally viewed and studied as a distinct construct on its own. Consequently, the nature of anxiety is potentially adaptive, and it is thus questioned whether the effects of anxiety are always negative.

Processing Efficiency Theory

Eysenck and Calvo's (1992) processing efficiency theory is of direct relevance to the argument that the effects of anxiety upon performance may not always be detrimental. According to the processing efficiency theory, high-anxious individuals are more likely to deploy additional processing resources or effort to an ongoing task than those of low anxiety. In essence, anxious individuals tend to worry more than non-anxious individuals as they may be more concerned about improving performance in order to reduce threat. Moreover, because the resources of such anxious individuals are devoted to worry, self-concern, and so on, they are more likely to detect a mis-match between expected and actual performance, which again activates additional processing resources.

More importantly, Eysenck and Calvo (1992) proposed that there is a control (self-regulatory or executive) system involved in the anxiety-performance dynamics. This system responds to information regarding task performance that is below the expectations desired by anxious individuals, and reacts to such conditions by allocating extra resources to the task (i.e., increasing effort) or initiating new processing activities (i.e., strategies). Hockey (1986) also speculated on the possible operation of such a control system, and hypothesized two types of reactions which were initiated by the control system. On the one hand, it may be possible to cope with threat and/or worry directly by reducing worry and increasing available capacity of working memory (Baddeley, 1986). On the other hand, it may be possible to eliminate the negative effects of worry on task performance by applying additional processing resources or effort to the task.

In line with the above theoretical position, it is argued within the processing efficiency theory that the effects of anxiety on processing efficiency (i.e., the relationship between the effectiveness of performance and the effort or amount of processing resources invested) and on performance effectiveness (i.e., the quality of task performance) are frequently rather different. It is assumed that since anxious individuals generally make more use of the control system and so exert more effort, anxiety would typically impair processing efficiency more than performance effectiveness. More specifically, anxious individuals respond dynamically when they perceive threats in a stressful situation. They worry about possible aversive consequences, and strive to avoid them by applying further resources to the task. Consequently, highly anxious individuals attempt to gain control over perceived threat and improve performance until the effort appears to be of no value (Schwarzer,

Jerusalem & Stiksrud, 1984). This theoretical position provides support for the argument that the effects of anxiety upon performance are not always detrimental by recognizing a positive moderating influence that might weaken or remove the negative effects of reduced resources. It is therefore dubious to simply attribute negative effects to anxiety and positive effects to other positive states. A final remark made by Eysenck and Calvo (1992) is well taken: "the processing efficiency theory can be integrated into a general conceptualization of the anxiety-performance relationship as a dynamic process, in which there are interactions between cognitions and motives over time during task performance (e.g., Covington & Omelich, 1988; Schwarzer, 1986), with an appraisal function to monitor and evaluate current threat and task performance (Jerusalem, 1990), and a self-regulatory function aimed at coping with task demands and personal feelings of inefficiency (Rost & Schermer, 1989)." (p. 431).

Development of Multidimensionality

In as early as 1960s, anxiety was distinguished as two dimensions: state anxiety and trait anxiety (Spielberger, 1966). State anxiety was further conceptualized as having two separate components, i.e., worry and emotionality (Liebert & Morris, 1967). This position was subsequently widely adopted in sport psychology. Such an adoption of the multidimensional approach to anxiety led to an increasing amount of research on the investigation of the relationship between performance and the specific anxiety subcomponents (Jones, 1995). However, it would seem logically doubtful that the components of worry and emotionality are sufficient to reflect the complex nature of anxiety, and in particular to indicate its regulatory or adaptive aspect. Although the directional dimension of anxiety (i.e., symptom interpretation) in Jones' control model

(1991, 1995) may seem to be a relevant notion, this dimension is not regarded as part of anxiety in that facilitative effects of anxiety that result from positive interpretation of anxiety symptoms have been attributed to other positive states by Jones and colleagues (Jones, Hanton & Swain, 1994; Jones, 1995; Burton & Naylor, 1997; Jones & Hanton, 2001; Hanton, Mellalieu & Hall, 2004). Fundamentally, the adaptive potential of anxiety appears to be denied by Jones' theoretical framework on the direction of anxiety in competitive sports performance.

In test anxiety, the approach to multidimensionality of anxiety components was further developed. A body of literature has suggested that more than two components may be necessary to better understand the construct of anxiety (Sarason, 1984; Rost & Schermer, 1992a; Schwarzer & Jerusalem, 1992; Hodapp & Benson, 1997). More specifically, self-related cognitions (thoughts), rooted in social cognitive approaches to personality (Krampen, 1991), were seen as an ingredient of the anxiety experience (Schwarzer & Jerusalem, 1992; Gibbons, 1990). Indeed, it has been proposed that anxiety is not a single unified reaction to perceived threat, but rather a cluster of interrelated factors whose relationships with performance change as the individual progresses from one test to another (Covington, Omelich & Schwarzer, 1986). As a result, many self-related cognitions were called for, e.g., self-focused attention, fear of failure, irrelevant thoughts, self-efficacy, lack of confidence (Sarason, 1984; Rost & Schermer, 1992a; Schwarzer & Jerusalem, 1992; Hodapp & Benson, 1997; Hagvet & Benson, 1997). Regardless of theoretical concerns, such an approach of further differentiation may have practical significance, in that more precise interventions are possible if the differential diagnosis of anxiety symptoms can be made more refined. Notwithstanding this, deciding which additional constructs among such a variety of

suggested factors should be incorporated into the conceptualization of anxiety is a substantial conceptual task. In the present thesis, the prime objective was to reflect the complex construct of anxiety more precisely and to further the understanding and prediction of performance under pressure from an approach of comprehensive integration.

A Broad Cognitive Perspective

Although emotion and cognition are two separate constructs, it remains theoretically unresolved as to where the boundary between emotion and cognition should be drawn (Strongman, 1996). From a broad cognitive perspective, many researchers and theorists have suggested that emotion (and anxiety in particular) would overlap with other different psychological domains, e.g., cognition, attention, and motivation (Frijda, 2000; Ohman, 2000; Matthews et al., 2002; Mathews, 1992; Eysenck, 1992; Schwarzer & Jerusalem, 1992; Gibbons, 1990; Wine, 1980). However, it would certainly be a challenge at an empirical level to merge such wide ranging factors into one single construct. Nevertheless, the factorial validation of a construct also involves discriminant validity as well as convergent validity. How well the conceptually distinct components can be distinguished empirically has yet to be examined, given the fact that they represent the same underlying psychological construct and are thus expected to correlate to some extent. For example, to what degree can the factors of worry and self-focused attention that are proposed as indicators of cognitive anxiety be separated from an empirical perspective?

Empirical Inconsistency

It has been suggested that theories of anxiety and performance need to at least address the complexity and inconsistency of findings regarding the effects of anxiety on performance (Eysenck & Calvo, 1992). However, research findings in sports performance have generally equivocal findings (e.g., Jones, 1995; Hardy & Hagvet, 1996; Woodman & Hardy, 2001). For example, the performance variance accounted for by the two-component (worry and emotionality) model (Liebert & Morris, 1967; Morris, Davis & Hutchings, 1981; Spielberger, 1980), upon which most theoretical frameworks of sports performance anxiety have been based, e.g., multidimensional anxiety theory (Martens, Vealey & Burton, 1990) and the catastrophe model (Fazey & Hardy, 1988), has been generally less than satisfactory. Furthermore, empirical tests of the predictions of anxiety according to multidimensional anxiety theory have been generally inconsistent (Gould, Petlichkoff, Simons & Vevera, 1987; Swain & Jones, 1996; Edwards & Hardy, 1996; Krane & Williams, 1987; Martin & Gill, 1991; Krane, William & Feltz, 1992). Although directional interpretation of anxiety symptoms (Jones, 1991, 1995) has improved the prediction of the anxiety-performance relationship, data still remains somewhat inconclusive (Edwards & Hardy, 1996). Similarly, although examination of the interactive effects of cognitive and somatic anxiety (or physiological arousal) upon performance (Hardy, 1990, 1996) has shown some explanatory potential, the precise interactive effects obtained have not always matched the interaction predicted by the catastrophe model (Edwards & Hardy, 1996; Hardy, Woodman, & Carrington, 2004). Collectively, these findings suggest that it would be worthwhile considering a re-conceptualization of the anxiety construct not just to better reflect its complicated nature and underlying dynamic processes, but also to better predict the anxiety-performance relationship.

Measurement Issues

The issues on the measurement of sport anxiety also warrant some attention. The Competitive State Anxiety Inventory (CSAI-2; Martens et al., 1990) has been the most popular tool used in the research of sport performance anxiety. However, as well as demonstrating relatively weak predictive validity, the construct validity of the CSAI-2 has also been questioned (Lane, Sewell, Terry, Bartram & Nesti, 1999; Cox, Martens & Russell, 2003). Lane et al. (1999) performed a confirmatory factor analysis of the CSAI-2 with a total sample of 1,213 sports participants. The results of their analyses showed that all fit indices for the original CSAI-2 model were unacceptable according to the most commonly used model fit criteria. In addition, the role of self-confidence in anxiety has been debated since this factor emerged fortuitously from exploratory factor analysis during validation work on the CSAI-2.
Self-confidence was viewed as the bipolar opposite of worry by Martens et al. (1990). However, cumulative evidence has generally supported the relative independence of these two constructs (Gould, Petchlikoff & Weinberg, 1984; Jones, 1991; Hardy, 1996; Woodman & Hardy, 2003). The fact that such a popular measure as the CSAI-2 is based on a theoretically discordant model could well account for the ambiguous results obtained with it. Furthermore, at the level of operational definition, several researchers (Lane et al., 1999; Woodman and Hardy, 2001) suggested that the terminology used in the cognitive anxiety subscale of the CSAI-2 may have weakened the construct validity of the measure in that eight of the nine cognitive anxiety statements began with the initial phrase of "I am concerned" (instead of "I am worried"). It was argued that the wording of "concern" was ambiguous as it did not necessarily represent the notion of worry or cognitive anxiety, but rather a perception of the importance of the upcoming event. Consequently, it is important to develop a

new measure that is consistent with its underlying theoretical framework and the construct definition that it purports to measure.

In light of the above arguments and issues, the present research attempted to construct an alternative conceptualization of performance anxiety, based on the fundamental notion that although anxiety is unpleasant, its nature is relatively neutral (producing both negative and positive effects), as opposed to purely maladaptive (producing only negative effects). As a first step for empirical testing, preliminary measurement of anxiety with respect to the proposed conceptual framework was developed in English (Studies 1-2) and Chinese (Studies 3-5). Factorial validity of the measurement and structural models using confirmatory factor analysis were examined across two cultures (Studies 1-5). Furthermore, the final study (Study 6) investigated the predictive validity of this conceptualization in the context of Taiwanese competitive sports using moderated hierarchical regression analyses as an initial test for the proposed model of performance anxiety.

Thesis Format

The remainder of the thesis is composed of three main chapters that include a conceptual model and six empirical studies, structured as follows:

1. Rationale for and introduction of a conceptual model of performance anxiety, and two studies describing the development of an English measure and the factorial validity of that measure in the context of British sports performance.
2. Three studies describing the development of a Chinese measure and the factorial validity of that measure in the context of Taiwanese sports performance.
3. A predictive study of the performance anxiety model examining interactive as well as main effects of the proposed anxiety variables upon performance in the context of Taiwanese tae-kwon-do sports performance.

The main part of the thesis is written as a collection of three research papers that offer evidence of a range of research training from conceptualizing the construct of anxiety, one of the most investigated and debated psychological states in general as well as sports psychology, through developing the measurement that is necessary for subsequent empirical tests, and examining the predictive validity of the model. This approach helps to train the candidate to engage with the research process at an early stage with a view to publication. It is worth noting that the proposed conceptual framework of performance anxiety is introduced mainly in Chapter 2, but also summarized again in the beginning of Chapter 3 and 4 as these three chapters are in fact three separate papers to start with. It is thus necessary to re-address briefly the conceptual model in each of Chapter 3 and 4 despite a full coverage already presented in Chapter 2. Furthermore, the empirical work of the thesis involves two cultures,

English (British) and Chinese (Taiwanese). It is beyond the scope of this thesis to discuss cultural differences in detail, but such a cross-cultural approach allows the possibility of subsequent efforts for further developing and testing the conceptual framework in two of the most widely used languages in the world.

Chapter 2

Toward a Three-Dimensional Conceptualization of Performance Anxiety: Rationale and Initial Factorial Validation in the Context of Sports Performance

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Abstract

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. Performance anxiety refers to an unpleasant psychological state in reaction to perceived threat concerning the performance of a task under pressure. In particular, the adaptive potential (producing positive effects) of anxiety was acknowledged explicitly by including a regulatory dimension as a reflection of coping capacity involved in the dynamics of anxiety to extend the traditional focus on the intensity-oriented dimensions of cognitive and physiological anxiety. This model is characterized by five subcomponents, with worry and self-focused attention representing the cognitive dimension of anxiety, autonomous hyperactivity and somatic tension representing the physiological dimension of anxiety, and perceived control representing the regulatory dimension of anxiety. The rationale underlying the conceptual framework is presented. As a first step of empirical validation, initial measurement was developed. The factorial validity of the measurement and structural model was examined through confirmatory factor analysis in two independent samples (N=286, 327) in a wide context of sports performance. Results of CFA revealed preliminary support for a three-dimensional first order model, rather than a hierarchical five-dimensional structure. Implications and limitations of the research are discussed.

Overview of the Performance Anxiety Model

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 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). Research in anxiety and performance has been furthered in the sports domain through advancement of sports anxiety models, e.g., the catastrophe model (Hardy, 1990) and the control model (Jones, 1991). Yet empirical results have been inconsistent, mostly using the Competitive Sport Anxiety Inventory-2 (CSAI-2; Martens, Vealey & Burton, 1990) that was based on the worry-emotionality model (Liebert & Morris, 1967; Morris, Davis & Hutchings, 1981; 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). Therefore, the research effort was made to develop an alternative model of performance anxiety that may contribute to the understanding of the complex anxiety-performance relationship. The construct of performance anxiety refers to an unpleasant psychological state in reaction to perceived threat concerning the performance of a task under pressure. An integrated conceptual framework was constructed according to a variety of rationale in the relevant area.

The chief rationale for re-conceptualizing the construct of performance anxiety was derived from the question: "Is anxiety, an unpleasant emotion, always

maladaptive (producing merely negative effects) in nature?" In particular, the concept of anxiety, adopted by some sport psychology researchers, was assumed to be only debilitative (Jones, 1995; Burton & Naylor, 1997; Jones, Hanton & Swain, 1994; Jones & Hanton, 2001). Positive effects on performance were attributed only to positive emotions. Despite the argument that "facilitative anxiety" (producing positive effects) may be confounded with other positive emotions, it remains doubtful whether positive emotions would always lead to positive effects (Hanin, 1997; Hardy, 1998; Woodman & Hardy, 2001). For example, over-excitement may impact behavior just as negatively as maladaptive anxiety. Furthermore, many theorists infer that anxiety includes several affective elements, such as fear, shame, guilt (Janis, 1969), frustration (Gray, 1979), distress, anger, and even excitement (Izard, 1972a). The complexity of anxiety is highlighted by such inferences. In addition, the construct of anxiety in the Oxford Dictionary (1994) can also be defined as "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, it appears from an evolutionary perspective 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, 1996, 2000). It also neglects the positive potential of anxiety on performance that may result from increased effort (Eysenck, 1992), or from the energizing and focusing effects of anxiety on individuals (Carver & Scheier, 1986). Taken together, the adaptive nature (producing potential positive effects) of anxiety may have been under-represented by the conventional two components of worry and emotionality. A more balanced and neutral (producing both negative and

positive effects) viewpoint has been adopted to reflect not just the maladaptive, but also the adaptive aspects of anxiety. That is, 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 in this theoretical framework, the integration of more components than worry and emotionality, corresponds mainly to the development of multidimensionality in test anxiety. In the literature on test anxiety, many researchers have identified several other important variables and argued that more components are necessary to better reflect the complexity of anxiety (Sarason, 1984; Schwarzer & Jerusalem, 1992; Rost & Schermer, 1992a; Hagvet & Benson, 1997; Hodapp & Benson, 1997). In particular, more differentiated models have been proposed, in which self-related cognitions such as irrelevant thoughts, lack of confidence, fear of failure, self-focus, 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. Rost and Schermer (1992a) emphasized the need to expand the diagnosis of test anxiety to include components of experienced deficits in information processing and negative mood state. Also, the motivational construct, fear of failure, has been proposed to be an underlying anxiety construct, with empirical support (Hagvet & Benson, 1997). 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 differentiated diagnosis of anxiety symptoms is available. Consequently, the principle of further

differentiation of anxiety components was applied in the present framework to the conceptualization of performance anxiety.

It is, however, a challenge to combine the various theoretical constructs that have been derived from different psychological domains into a unified framework, considering the extensive inter-disciplinary debate on the boundaries between emotion and cognition (Strongman, 1996). Nevertheless, abundant rationale in favor of an integrated conceptualization has been provided. From a broad cognitive perspective, the scope of emotion — anxiety in particular — overlaps with various domains, such as cognition, attention, and motivation (Ohman, 2000; Matthews et al., 2002; Mathews, 1992; Eysenck, 1992; Schwarzer & Jerusalem, 1992; Gibbons, 1990). In its broadest sense, Oatley and Johnson-Laird (1987, 2000) have suggested that an emotion brings together cognition, evaluation, neuro-physiological processes, somatic changes, subjective feelings, and behavior. Indeed, Matthews et al. (2002) proposed an integrated model of the subjective stress state in performance settings in which three dimensions, labeled as worry, distress, and task-engagement, emerged via exploratory factor analysis from a variety of components of different domains (e.g., self-focus, self-esteem, task-related interference, task-irrelevant interference, concentration, tension, arousal, confidence/control, and motivation).

Another concern related to measurement issues. In sport psychology, empirical findings on anxiety, as measured by the CSAI-2 (Martens et al., 1990), have shown only modest predictive power generally accounting for less than 30% of the variance in performance (Hardy & Hagvet, 1996; Woodman & Hardy, 2001). Moreover, several studies (Lane, Sewell, Terry, Bartram & Nesti, 1999; Cox, Martens & Russell,

2003) examining the construct validity of the CSAI-2 have suggested that its factor structure may be flawed. In addition, Martens and associates (1990) fortuitously derived an unpredicted self-confidence factor from exploratory factor analysis in their validation work for the CSAI-2. The role of self-confidence in the conception of sports anxiety has therefore been debatable. Martens et al. (1990) proposed that self-confidence is merely the bipolar opposite of worry; however, cumulative evidence has generally supported their relative independence (Gould, Petchlikoff & Weinberg, 1984; Jones, 1991; Hardy, 1996; Woodman & Hardy, 2003). The fact that such a popular measure as the CSAI-2 is based on a theoretically discordant model could well account for the ambiguous results obtained with it. As Hardy and Hagvet (1996) have pointed out, the development of stress and performance research in sport psychology has been hampered by inadequate conceptualization and measurement of the key variables involved in the anxiety-performance relationship.

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, i.e., the cognitive dimension composed of worry and self-focused attention (labeled as self-focus hereafter), the physiological dimension composed of autonomous hyperactivity and somatic tension, and the regulatory dimension indicated by perceived control. A diagram of the conceptual model is presented in Figure 1. Compared to the worry-emotionality model of anxiety, this model has two main features—an additional regulatory dimension of anxiety and more differentiated subcomponents under the dimensions of cognitive and physiological anxiety. Given the complexity of performance anxiety, such 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 section, more detailed rationales for each of the dimensions are given.

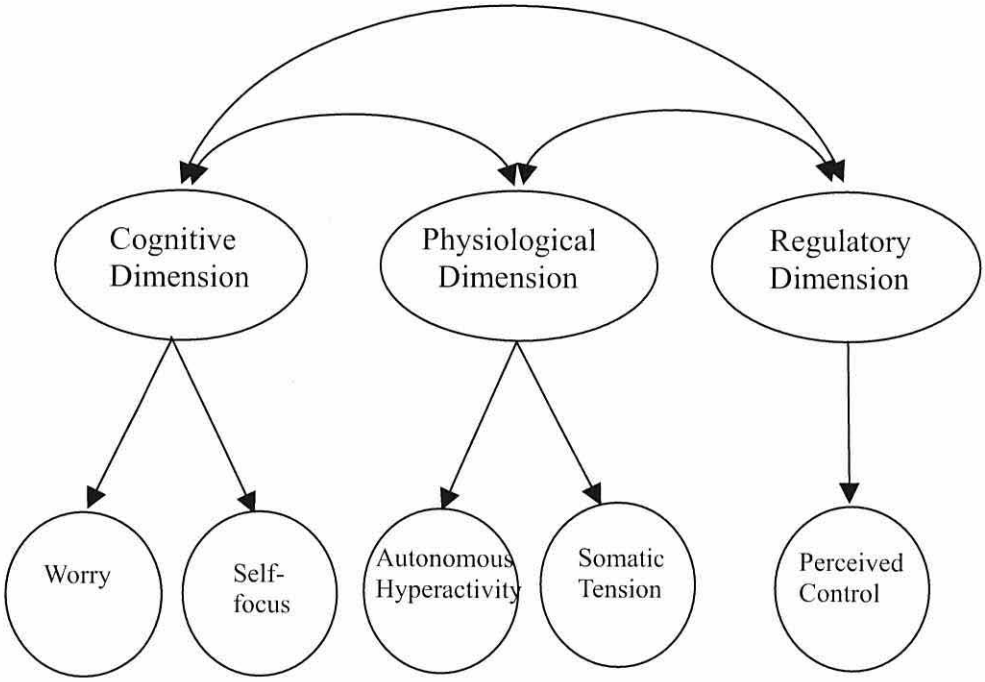

Figure 1. The diagram of the conceptual model of performance anxiety.

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 a component of anxiety for its obvious relevance to the cognitive process of anxiety across many fields (Liebert & Morris, 1967; Spielberger, 1980; Eysenck, 1992; APA, 1987; Fontaine, Mollard, Yao & Cottraux, 2001). The scope of cognitive anxiety in the present framework, however, is expanded to include an additional component of self-focused attention. The authors 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. Indeed, it has been emphasized that cognitions experienced by anxious individuals are not always manifested as worries (Dunn & Syrotuik, 2003). Moreover, conceptual propositions as well as empirical data concerning the relationship between self-focus and anxiety (or stress) have accumulated (Wicklund, 1991). The main theoretical link 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). Above all, self-focus, rather than worry, has been favored and conceptualized as a key aspect by Carver and Scheier (1988) from their control-process perspective on anxiety.

Another connection between self-focus and anxiety is through the conception of self-related cognition, founded in social cognitive approaches to personality (Krampen, 1991), which has been viewed as a necessary element of 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 their "personal lack" (Wicklund, 1991)

(e.g., weakness or shortcoming) that is salient or threatening to the 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). Furthermore, two types of self-focus have been proposed, private and public self-focus (Fenigstein, Scheier & Buss, 1975), and both were included in the component of self-focus utilized in the present model. The private aspect of self-focus refers to an awareness of self-scrutinizing based on one's internal standards, whereas the public aspect concerns an awareness of the self as a social object that is being evaluated by others, primarily in a critical manner. Empirically, the association between anxiety and self-focus, involving both types of self-focus, has been supported by several studies (Derakshan & Eysenck, 2001; Schwarzer & Jerusalem, 1992; Liao & Masters, 2002; Lewis & Linder, 1997).

Rationale for the Physiological Dimension

The physiological dimension of anxiety refers to physiological symptoms induced by the autonomous nervous system in response to a stressor, which has been an important characteristic for the diagnosis of anxiety across diverse contexts. It has also been proposed as one of the central features in distinguishing between anxiety and depression, according to the tripartite model of depression and anxiety, with promising empirical support (Clark & Watson, 1991). 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 two-component model of test anxiety (Liebert & Morris, 1967; Speiberger, 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; Sanders, 1983). The notions of multidimensional arousal, and specificity and patterning in bio-behavioral systems have gained much attention and empirical support (Neiss, 1988). Indeed, there were attempts to further differentiate factors within the construct. In test anxiety, for example, Sarason (1984) proposed two components, bodily arousal and tension, to reflect emotionality. Taken together, physiological anxiety in the present conceptual framework is consistent with the approach of further differentiation, and is characterized by two subcomponents, i.e., autonomous hyperactivity and somatic tension. This conceptualization is in accordance with anatomical structure, mainly adopted and modified from the perspective of clinical anxiety (Ohman, 2000), e.g., the criteria used for generalized anxiety disorder in the Diagnostic and Statistical Manual of Mental Disorder, third edition-revised (*DSM-III-R*; APA, 1987).

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 a part of anxiety from both theoretical and empirical considerations. Many cognitive theorists of emotion highlight the adaptive role of emotion, and propose that a regulatory process (with diverse terminologies such as expectancy system, coping process, etc.) is involved in the system of emotion (Frijda, 2000; Ohman, 2000; Johnson-Laird & Oatley, 2000). In particular, the notion of control has been suggested as playing a key in anxiety variations in theories of anxiety (Eysenck & Calvo, 1992; Carver & Scheier, 1988; Ohman, 2000). According

to the processing efficiency theory (Eysenck & Calvo, 1992; Eysenck, 1992), a control system involved in anxiety monitors and evaluates performance, and also plans and regulates the use of processing resources. Anxious individuals make use of the control system to exert more effort to compensate for performance deficits. Consequently, although processing efficiency may be impaired due to reduced available working memory capacity, performance may still be sustained due to increased cognitive effort and allocation of additional resources to the task at hand.

The utilization of a control system also appears to be one of the main characteristic features to differentiate anxiety from depression, as depressed individuals exhibit little application of the control system to cope adaptively with perceived stress (Eysenck, 1992). Unsurprisingly, research has shown that depression is associated with passive disengagement, whereas anxiety is associated with active engagement in the environment (Schwarzer, Jeruselem & Stiksrud, 1984; 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, that the anxiety response evolved as part of a defensive mechanism against potential danger (Ohman, 1996, 2000), and that it 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; Calvo, Avero, Castillo & Miguel-Tobal, 2003). Although such an adaptive nature may be implied through conventional symptoms of worry and emotionality, as both have been proposed to be potentially functional (Borkovec & Inz, 1990; Eysenck, 1992; Thayer, 1989); the addition of a regulatory dimension appears to more explicitly reflect the adaptive capacity involved in anxiety, so that the potentially positive effects of anxiety can be better realized.

Conventionally, representations of the underlying regulatory processes were viewed as coping-related factors, with distinct conceptualization on its own. Mathews (1992), in contrast, has conceptualized anxiety within the framework of information processing that is insightful and adopted here:

> 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. Furthermore, rather than thinking of this characteristic pattern as one method of coping with anxiety, it can be seen as a cognitive mechanism involved in maintaining or perhaps causing the anxiety itself. (Mathews, 1992, p. 120)

Taken together, there is strong evidence to support the inclusion of a regulatory dimension in the proposed model of performance anxiety. Along similar lines, there have been other integrated models of anxiety that involved an adaptive capacity. For example, Rost and Schermer (1992b) 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, Hardy and Whitehead (1984) constructed a measure of rock climbing anxiety with three subscales. One of these was an "activation" dimension, which referred to cognitive and physiological activity geared towards preparing a planned response to the anticipated situation (Pribram & McGuinness, 1975). This dimension again corresponds to the notion of a regulatory dimension of anxiety. More recently, 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, Swain & Hardy, 1993; Jones, Hanton & Swain, 1994; Jones, Swain & Harwood, 1996; Jones & Hanton, 2001).

It is worth noting that although both Jones' directional dimension and the regulatory dimension of anxiety proposed in the present model relate directly 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 positive affective states (Jones, Hanton & Swain, 1994; 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. Second, Jones' directional dimension is characterized by the interpretation of anxiety symptoms, whereas the regulatory dimension of anxiety here is represented by

perceived control. The primary concern 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, Hippel, Conway, Preacher, Schooler & Radvanske, 2005; Mendolia, 2002). Or they may simply be unaware of or insensitive to their own psychological states due to factors such as poor insight or introspective limits (Egloff & Schmukle, 2002; Greenwald, Banaji, Rudman, Farnham, Nosek & Mellott, 2002). Thus, it may be more logical to indicate this regulatory dimension of anxiety directly by perceived control as proposed here, rather than indirectly via symptom interpretation.

The construct of perceived control refers mainly to perceived capabilities of coping and attaining the performance goal under stress. Much research points to the importance of perceived controllability and unpredictability as factors involved in anxiety (Eysenck, 1992). Carver and Scheier (1988) proposed from their control-process perspective on anxiety that favorable vs. 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, the construct of perceived control relates apparently 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 may evaluate not only environmental and internal threats, but also their capacities of coping with them and of meeting the demand of the task in reaction to performance stress. In sum, the element of perceived control appears to be one of necessary features of performance anxiety in the context of

performance-stress dynamics.

Lastly, the variable of self-confidence deserves particular attention for its conceptual link to perceived control with respect to perceived efficacy for goal-attainment. Several researchers have emphasized the role that self-confidence may play in the buffer effect and the facilitation of performance under stress or anxiety (Carver & Scheier, 1986, 1988; Jones et al., 1993; Hardy, 1996). In particular, within the framework of a butterfly catastrophe model, Hardy (1996) has proposed that higher levels of self-confidence might allow performers to tolerate higher levels of anxiety (physiological arousal in particular). However, it is unsurprising that theorists hold different views on the relationship between anxiety and efficacy expectancy. For example, Bandura (1977, 1988) argued that anxiety was a consequence of lack of self-efficacy. In direct contrast, Eysenck (1978, 1992) argued that self-efficacy was a by-product of anxiety. Others, such as Schwarzer and Jerusalem (1992), suggested that self-efficacy should be integrated into anxiety. Indeed, calls have been made to incorporate constructs such as self-confidence, self-efficacy, and lack of confidence as components of anxiety across a number of fields of study (Schwarzer & Jerusalem, 1992; Hodapp & Benson, 1997; Wolfe, 1989). For example, self-efficacy was involved in Schwarzer and Jerusalem's (1992) anxiety model of expectancy-worry-behavior relationship. In addition, Wolfe (1989) proposed a four-factor model, composed of apprehension, confidence, self-consciousness, and arousal, where confidence appeared as an ingredient of anxiety in the context of music performance. Furthermore, Hodapp and Benson (1997) reported that a model of test anxiety comprising three factors, i.e., worry, emotionality, and lack of confidence, fitted their data best in confirmatory factor analysis.

In the sports domain, research has shown that self-confidence is important ever since it emerged as a factor in the validation of the CSAI-2 (Martens et al., 1990), and was documented to be a better predictor of performance than worry or emotionality (Woodman & Hardy, 2003; Craft, Magyar, Becker & Feltz, 2003; Jones et al., 1993; Hardy, 1996). However, it should be noted from a theoretical viewpoint that the construct of self-confidence in the CSAI-2 differs from perceived control in the present model in several ways, despite their conceptual (definitional) similarity. 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 certainly not as an expression of its adaptive capacity. Second, Martens et al. (1990) have argued that self-confidence and worry represent opposite ends of a single bipolar construct, a conception that was challenged by cumulative empirical investigations (Gould et al., 1984; Jones, 1991; Hardy, 1996; Woodman & Hardy, 2003; Hardy, Woodman & Carrington, 2004). Third, at the level of operational definition, self-confidence in the CSAI-2 was operationalized as having two themes, positive performance expectations and a sense of calmness, revealed by factor analysis (Prapavessis, Cox & Brooks, 1996; Lane et al., 1999). The factor of positive performance expectations is generally consistent with the component of perceived control referring to the notion of goal-attainment. However, the other factor of emotional calmness (indicated by "I feel mentally relaxed.", "I feel at ease." etc.) is not included in perceived control in the present framework. It is considered to be in apparent conflict with the main feature of anxiety, i.e., negative affectivity, and may be contaminated by other positive affective states. To be more specific, anxious individuals may feel worried, aroused, and have a certain sense of confidence/control

over goal-attainment at the same time. Yet, it seems unlikely that one feels both anxious and mentally relaxed simultaneously under pressure. In sum, these conceptual and empirical accounts and arguments on self-confidence in relation to performance anxiety provide further support for the inclusion of the component of perceived control as an expression of the proposed regulatory dimension of anxiety.

Construct Definitions and Assumptions

Each construct is defined by the authors within the proposed framework of performance anxiety according to extensive literature review, despite variations in conceptualization that may exist among theorists under different contexts. Relevant assumptions underpinning the proposed elements of anxiety are also addressed.

Worry. According to a convergent consensus of conceptualization, it is defined as a cognitive form of apprehension associated with possible unfavorable outcomes. Although worry can be dysfunctional especially when excessive, as available working memory capacity is reduced (Eysenck & Calvo, 1992), several theorists argue that worry can also be functional because it may lead to increased problem-solving attempts (Borkovec & Inz, 1990; Eysenck, 1992) or increased attempts at discrepancy-reduction (Carver & Schiever, 1998). Moreover, the processing efficiency theory (Eysenck & Calvo, 1992) makes the assertion that worry serves a motivational function via a control system, which leads to the allocation of additional processing resources (such as effort), and the initiation of processing activities (e.g., strategies) aimed at improving performance.

Self-focused Attention. Although self-focused attention refers explicitly to an

attentional shift to the self, it has been viewed as more than simply the direction of attention (Wicklund, 1991; Wicklund & Gollwitzer, 1987). Furthermore, because anxiety is by definition an unpleasant emotion caused by perceived threat, self-focus is coupled with negative affectivity as a component of anxiety. Accordingly, self-focus is defined as an attentional shift to the self, leading to a self-evaluative state with an increased awareness of self-shortcomings concerning the performance of a task under stress. Consistent with the effects of worry, the role of self-focus can be functional, proposed by a number of researchers (with supporting empirical evidence), such as an enhancement of renewed effort, persistence, and even task performance (Carver & Scheier, 1988, 1998; Gibbons, 1990). Further, the variations in the effects of self-focus may depend upon expectations of coping and goal-attainment (Carver & Scheier, 1986, 1988).

Autonomic 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 breathing muscles of lungs, sweat glands, blood vessels, and so on. Typical example symptoms are breathlessness, cold sweat, increased heart rate, etc. 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, fatigue, etc. In terms of the effects of physiological anxiety, it has been proposed with supporting evidence that the consequences of arousal on sports performance may not always be detrimental (Parfitt & Hardy, 1993; Hardy, 1996). For example, physiological anxiety has been shown to enhance anaerobic power in simple tasks (Parfitt, Hardy & Pates, 1995) and improve simple reaction times (Jones & Cale,

1989; Parfitt & Hardy, 1993). Furthermore, arousal was identified as having an energetic aspect in addition to a tense dimension (Thayer, 1989), which is in line with the reasoning that arousal may be facilitative on performance. The variation in the effects of physiological anxiety has been suggested to depend on self-confidence (Hardy, 1996) and symptom interpretation (Jones, 1995).

Perceived Control. Among numerous definitions of control (for a review, see Skinner, 1996), the component of perceived control as a regulatory element in the present framework refers to the perception of one's capacities (involving ability and resource) of being able to cope and of goal-attainment under stress. This definition is consistent with Carver and Scheier's (1988) conceptualization in their control-process perspective on anxiety. Accordingly, the content of perceived control involves multiple facets, including performance ability, coping capacity, and goal-attainment. It is noteworthy that this anxiety component is different from the cognitive and physiological components in the sense that perceived control may be positively-toned and therefore may not represent unpleasant symptoms of anxiety intensity. Furthermore, several theorists posit from a theoretical perspective that negative effects of high anxiety on performance can be countered by increased application of available resources or enhanced effort depending on one's expectancy for success (Eysenck, 1992; Carver & Scheier, 1986). Indeed, cumulative empirical research has revealed that better performance can be associated with both high (cognitive/physiological) anxiety and high confidence in sports performance (Jones et al., 1993; Edwards & Hardy, 1996; Hardy, 1996; Hardy, Woodman & Carrington, 2004). Consequently, it is plausible to hypothesize that perceived control may play a crucial role in the dynamic anxiety-performance relationship.

Initial Tests of Factorial Structure

As a necessary first step toward model testing, a preliminary measure was developed based on the proposed conceptual framework and factorial validity was evaluated through confirmatory factor analysis (CFA) in two independent samples in a broad context of sports performance. According to the proposed conceptualization, the factorial structure of performance anxiety was hierarchical, with three second-order factors (representing the cognitive, physiological and regulatory dimensions of anxiety), and five first-order factors (as indicators of the three anxiety dimensions). However, given that each pair of first-order subcomponents reflecting the same second-order dimension will correlate, it is necessary to examine the discriminant validities of worry and self-focus in cognitive anxiety, and autonomous hyperactivity and somatic tension in physiological anxiety. Consequently, it is to be confirmed whether the factorial structure is best presented as a hierarchical five-dimensional model (see Figure 1) or a three-dimensional first order model (by merging worry and self-focus as a single dimension of cognitive anxiety, and merging autonomous hyperactivity and somatic tension as one dimension of physiological anxiety).

Preliminary Item Generation

An initial item pool with approximate 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 validated anxiety measures as well as an extensive review of the anxiety-related literature. Each question in the item pool was thoroughly evaluated in terms of face validity, clarity of wording, and sentence structure, according to the established guidelines for questionnaire design

(Hippler, Schwarz & Sudman, 1987). In addition, social desirability is considered the major validity problem with self-report instruments (Runkel & McGrath, 1972). To avoid potential bias (e.g., self-defense), a neutral title, "Psychological Performance States Inventory", was chosen for the measure. The instructional set included anonymity, confidentiality of responses, and anti-social desirability statements.

Following extensive scrutiny, an initial 29-item measure was established from the total item pool, 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. This initial measure was pilot tested on ten sports participants from the targeted population to ensure the clarity of wording and 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. The 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 progressively tests the model from one to multiple factors and low to high levels primarily for diagnostic purposes to prospectively reduce potential problems by deleting inadequate items. At the final stage of sequential CFA, a procedure known as the parceling method (Marsh, Antill & Cunningham, 1989) was implemented due to relatively small sample size. A parceled model was produced with the construction of

composite items from observed variables for each first-order factor in order to obtain a stable estimation by reducing the number of estimated parameters in the measurement model. The global model fit indices were examined, along with detailed assessment of fit by the completely standardized factor loadings, the standardized residuals, and the modification indices. The chi-square (χ^2) statistic is the principal means of assessing model fit, and a χ^2/df ratio of less than 2.0 has been generally suggested as indicator of an adequate fit. However, the arguments on how the χ^2 test is best interpreted among researchers have led to the development of other criteria for assessing the fit of a model, and the strategy of reporting a range of fit indices has been used by most researchers. Consequently, other than the Satorra-Bentler scaled chi-square (Robust χ^2; Satorra & Bentler, 1988), multiple criteria were used, including the Root Mean Square Error of Approximation (RMSEA; Steiger, 1990), the Non-normed Fit Index (NNFI; Tucker & Lewis, 1973), the Comparative Fit Index (CFI; Bentler, 1990), and the Standardized Root Mean Square Residual (SRMR). The cutoff standards for a good fit are adopted somewhat differently among researchers. Contemporary criteria appear to be more stringent that RMSEA values of .06 and SRMR values of .08 or less, and NNFI and CFI values of .95 or greater are required for a good fit (Hu & Bentler, 1999).

Study 1: Initial Test 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 factorial structure of the measurement and structural model.

Method

Participants. A total of 286 valid inventories were collected from a wide range of sports (about 35 types), and various skill levels, ranging from international or national (23.4%), through club, school, or regional (44.8%), to recreational level (31.8%). 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, including the university's department of sport science (41.6%), the athletic union, British Universities Sports Association (40.2%), and regional sports centers (18.2%). All participants were English-speaking.

Procedure. Retrospective data were collected. Consent for participating was obtained from all participants. The study objective and the instructions for the inventory were briefed, and administration of the inventory took approximate 10 minutes, although no time limit was set. The participants were asked to focus on the most recent sports event performed under pressure that could be remembered clearly, and to recall how they felt before that specific sports performance. A quarter of the data was collected within two days following the performance, half collected within one week, and the rest within two months.

Results

Although CFA requires relatively large samples, it is difficult to provide a definite rule. In general, the recommended minimum ratio of cases to parameters is 5:1, and preferably 10:1 for non-normally distributed data (Bentler & Chou, 1987). In the current investigation, the sample size (N = 286) was adequate for separate tests of

single- and two-factor models, with case to parameter ratios ranging from 35.8:1 to 16.8:1. On testing the full model, the ratio of the final parceled model was 11.4:1, appropriate for a reliable estimation. 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 Robust χ^2 was adopted, a method of correcting the χ^2 statistic for non-normality (Chou & Bentler, 1995). Nevertheless, some caution may be warranted in interpreting these results.

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 original 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 a good fit (Table 1). On testing both two-factor models, the inter-factor correlations within paired first-order components were high, with .83 for worry and self-focus, and .92 for autonomous hyperactivity and somatic tension. However, both of their discriminant validity was supported by the Satorra-Bentler scaled χ^2 difference test (S-B χ^2_{diff}; Satorra & Bentler, 2001). The two-factor models, in which the coefficient between two factors was free to be estimated, were compared with their respecified models, in which the inter-factor coefficient was constrained to 1.0. 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, showing both two-factor models fitted significantly better than their respecified (single factor) models.

Table 1. Fit Indices and Cronbach's Alpha (α) for the One- and Two-factor Models in Studies 1- 2.

	Robust χ^2	*df*	*p*	RMSEA	NNFI	CFI	SRMR	α
Study 1								
One-Factor Models								
Worry	.01	2	.99	.00	1.00	1.00	.00	.76
Self-focus	1.46	2	.45	.00	1.00	1.00	.02	.57
Autonomous Hyperactivity	1.29	2	.39	.00	1.00	1.00	.02	.75
Somatic Tension	2.39	2	.19	.03	1.00	1.00	.02	.71
Perceived Control	11.19	9	.05	.03	1.00	1.00	.03	.83
Two-Factor Models								
Cognitive Anxiety	23.59	19	.13	.03	.99	.99	.03	.78
Physiological Anxiety	35.63	19	.001	.03	.98	.99	.04	.83
Study 2								
One-Factor Models								
Worry	6.10	2	.01	.08	.96	.99	.03	.73
Self-focus	13.46	14	.49	.00	1.00	1.00	.03	.80
Autonomous Hyperactivity	2.77	2	.17	.03	.98	1.00	.02	.60
Somatic Tension	4.53	2	.09	.06	.96	.99	.03	.62
Perceived Control	14.02	9	.06	.04	.99	1.00	.03	.85
Two-Factor Models								
Cognitive Anxiety	93.99	43	.00	.06	.98	.98	.05	.86
Physiological Anxiety	22.61	19	.09	.02	.99	1.00	.04	.75

At the final stage of testing the full model, the method of parceling was employed and the original 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 a hierarchical model with three second-order factors and five first-order subcomponents (with Robust $\chi^2(37) = 64.45$, $p < .001$; RMSEA = .05, NNFI = .98, CFI = .99, and SRMR = .05) was considered unsuccessful due to three improper estimates (coefficient values greater than 1.0) (Hair, Anderson, Tuthem & Black, 1998) emerging between latent factors in the second and first levels in the structural model. Considering the high inter-factor correlations shown from the tests of 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, NNFI = .97, CFI = .98, and SRMR = .06. A similar finding was obtained for a non-parceled version of the three-dimensional model, with Robust $\chi^2(206) = 357.2$, $p < .001$; RMSEA = .05, NNFI = .97, CFI = .97, and SRMR = .07. The correlations between the three dimensions were .69 for the cognitive and physiological aspects of anxiety, -.49 for the cognitive and regulatory aspects of anxiety, and -.54 for the physiological and regulatory aspects of anxiety. The factor loadings of the final retained 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 the subscale of perceived control with six items, each of the subcomponents had four items.

Internal consistency. The internal consistency of all measurement models of five subcomponents following item deletion was assessed by Cronbach's (1951) alpha reliability coefficient (Table 1). The three subscales of the cognitive, physiological and regulatory dimensions of anxiety showed acceptable internal consistency, with alphas ranging from .78 to .83.

Study 2: Refinement of the Measure

The objective of the second study was to refine the developed 22-item measure and to replicate the findings of Study 1. The majority of the 22 items were retained for further empirical evaluation, but some refinement was made to improve the validity of the measure including slight modifications to wording and the addition of new items to the subscales of self-focus and perceived control. The aim of these additions was to better reflect the definitions and distinctiveness of the subcomponents. The subscale of self-focus was expanded from 4 to 8 items to make the subscale more balanced, with each of the private and public aspects containing four items. Two more items were added for perceived control to make it an 8-item subscale. Thus, the measure was refined to have 28 items. Each of 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 valid inventories were collected across a wide variety of sports (about 31 types), with various skill levels, ranging from international or national (39.4%), through club, school or regional (46.2%), to recreational level (14.4%). 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, obtained via university athletic unions and the British Universities Sports Association (49.6%), local athletic training teams (35.7%), and regional sports centers (14.7%). All participants were English-speaking.

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

Results

The sample size ($N = 327$) was considered adequate for separate tests of single- and two-factor models, with ratios of cases to parameters ranging from 40.9:1 to 14.2:1. For testing the final model, the ratio of the parceled model was 14.2:1, which was proper for a stable estimation. 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 (private) 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 a good fit (Table 1), except for worry which had a relatively large Robust $\chi^2(2) = 6.1$, $p = 0.01$, and RMSEA =.08 (but NNFI = .96, CFI = .99, and SRMR = .03). 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 $\chi^2_{diff}(1) = 9.98$, $p < .05$). Yet the empirical differentiation between the two physiological subcomponents was marginally rejected (S-B $\chi^2_{diff}(1) = 2.99$, $p > .05$).

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, NNFI = .99, CFI = .99, and SRMR = .04) was considered unsuccessful due to two improper estimates emerging between latent factors at the first and second level, similar to that 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 an excellent fit to the data, with Robust $\chi^2(32) = 47.9$, $p = .01$; RMSEA = .04, NNFI = .99, CFI = .99, and SRMR = .05 (Figure 2). This was consistent with the result from a non-parceled version of the three-dimensional model, with Robust $\chi^2(272) = 477.6$, $p < .001$; RMSEA = .05, NNFI = .97, CFI = .97, and SRMR = .07. The inter-factor correlations between the three anxiety dimensions were .68 for the cognitive and physiological aspects, -.26 for the cognitive and regulatory aspects, and -.37 for the physiological and regulatory aspects (see Figure 2). The factor loadings for the final retained 25 items were all significant, ranging from .79 to .35, with 20 out of 25 (80%) items obtaining a loading higher than .50. Table 2 presents the scale content of the 25 items (see appendix A for details of the inventory) and their corresponding factor loadings. Worry, autonomous hyperactivity, and somatic tension had four items each;

self-focus had seven, and perceived control had six items.

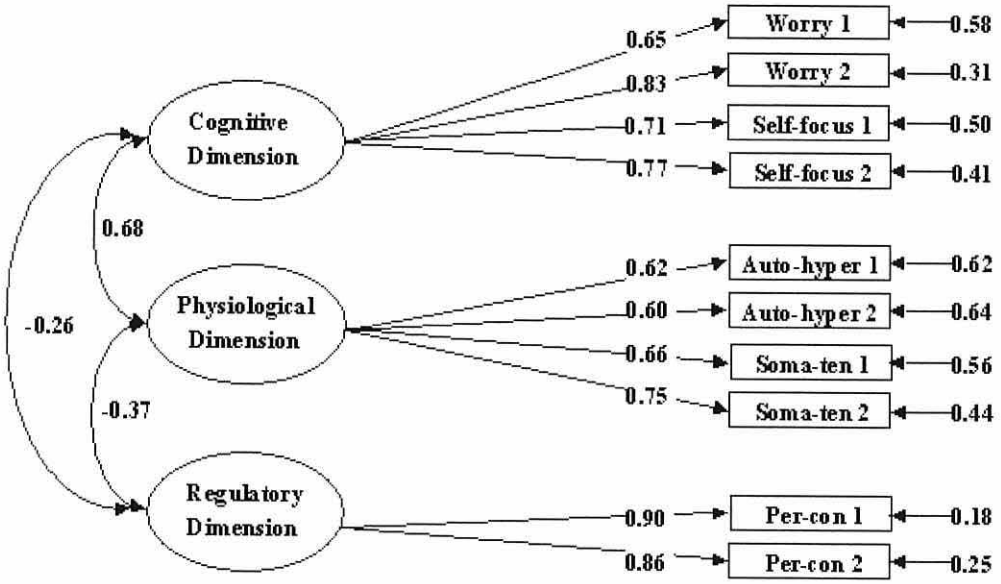

Figure 2. Results of confirmatory factor analysis for the final parceled model in Study 2. Model fit indices were Robust $\chi^2(32) = 47.9$, $p = .01$; RMSEA = .04, NNFI = .99, CFI = .99, and SRMR = .05. All data shown were completely standardized solution. Observed variables were composite.

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

Content of the Scale Item	Factor Loading
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
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
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

Internal consistency. All measurement models of the five subcomponents following item deletion were assessed by Cronbach's alpha (Table 1). The three subscales of the cognitive, physiological and regulatory dimensions of anxiety showed acceptable internal consistency, with alphas ranged from .75 to .86.

Discussion

The aim of this research was preliminary development of measurement based on the proposed conceptual framework of performance anxiety and examination of factorial validity of the measurement and structural models.

The initial tests on factorial validity supported a three-dimensional first order model, rather than a hierarchical five-dimensional structure. The hierarchical relationship between factors at the second and first levels thus was not established. This was a result of high inter-factor correlations between worry and self-focus, and between autonomous hyperactivity and somatic tension. However, on close inspection of worry and self-focus, the results of weak differentiation are unsurprising, as these two conceptualizations appear to have some shared characteristics when it comes to representing cognitive anxiety. For example, as anxiety components, they are both defined as negatively toned and related to a self-evaluative state. Moreover, worry has been hypothesized to be associated with cognitive or mental avoidance (Borkovec & Inz, 1990; Stober, Tepperwien & Staak, 2000), which has also been suggested to be one of the effects of self-focus (Wicklund & Gollwitzer, 1987; Carver & Scheier, 1988). Nevertheless, both have been proposed to be potentially functional resulting in various positive consequences (Borkovec & Inz, 1990; Eysenck, 1992; Carver & Scheier, 1988, 1998). Furthermore, some researchers (Borkovec, Robinson,

Pruzinsky & Depree, 1983; Schwarzer & Jerusalem, 1992) have proposed that (negative) self-focus may lead to worry, although direct causal evidence for this proposal is lacking. Therefore, it can be anticipated that worry and self-focus would correlate to a certain extent especially under stressful circumstances. However, these two constructs of worry and self-focus are undoubtedly two distinct concepts. It is considered worthy of the inclusion of self-focus, as the rationale for self-focus playing a part in anxiety is abundant, as addressed in the earlier section. Additionally, it has been noted that self-focus may cause extra effects that are not included in the conventional (worry-emotionality) model of anxiety (Wicklund, 1991) which may contribute to more variance in performance being explained. For example, anxious self-focus may increase attempts to consciously control movements (Baumeister, 1984; Masters, 1992), which is not obviously implicated in the content of worry.

By the same token, the empirical separation between autonomous hyperactivity and somatic tension was not expected to be easy. They both refer to physiological reactions originating from the autonomous nervous system in response to perceived threat, which implies that their underlying mechanism may likely overlap to some extent. In addition, each physiological subcomponent was assessed by only 4 items for practical reasons. It is empirically difficult for such a short subscale to achieve discriminative power. Nevertheless, it may be advantageous to retain their differentiation only at a descriptive level at this relatively early stage of model development, so that more tests can be employed while the integrity of the three-dimensional model is intact. Further investigation may aid in unfolding the differential patterns between these anxiety subcomponents via contextual variables (e.g., task difficulty, skill level, sports type, temporal change, etc.), provided that

individual differences may exist in manifestation of anxiety, and these differentiated subcomponents of anxiety might show differential impact on various aspects of performance in more specific contexts.

In conclusion, a 25-item measure based on the theoretical proposition was developed with significantly sizable factor loadings and reasonable internal consistency. This measure lends itself to the examination of both the singular and interactive effects of different components of anxiety within a wide sports contexts and skill levels. More studies are necessary to further assess its psychometric properties. In particular, a large sample should be used to confirm the present results. Moreover, the measure was validated in the sports domain, most favorably for participants aged around 24.5 (SD = 8.5), its generalizability to other performance settings and other age groups (e.g., under age of 16) has yet to be examined. In addition, given that the conceptual model is best presented as three (rather than five) dimensional, whether the empirical differentiation can be revealed between worry and self-focus and between autonomous hyperactivity and somatic tension remains to be studied.

Lastly, considering both retrospective and prospective investigations on pre-performance anxiety have their advantages and weaknesses, retrospective data was utilized for several reasons. First, the validity of retrospective recall has been verified by previous researchers, despite the possible recall effect of memory bias (Hanin, 1986; Randle & Weinberg, 1997; Butt, Weinberg & Horn, 2003). Second, anxiety measures, if administered before a stressful performance, can result in response bias due to various variables, such as social desirability, self-defense as a

coping style, or unwillingness to reveal true psychological states, especially feelings of fear and doubt (Martens et al., 1990). Third, a retrospective study design created least ethical concerns in terms of avoiding possible intrusion on mental preparation before competition, given several hundreds of participants were involved during an initial stage of measurement development. It was worth noting that a certain amount of data (i.e., 25% of the sample) in Study 1 that was recalled within two months may be questioned. However, 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 promising, future prospective study is desirable to confirm the present results. Above all, as the establishment of construct validity is an on going process (Schwab, 1980; Smith & MaCarthy, 1995), subsequent empirical tests are undoubtedly required to examine the explanatory and predictive power of the three-dimensional model of performance anxiety.

Chapter 3

Toward a Three-Dimensional Conceptualization of Performance Anxiety: Measurement Development in Chinese and Factorial Validity in the Context of Taiwanese Sports Performance

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Abstract

This article presents the initial stage of measurement development, based on a three-dimensional conceptualization of performance anxiety that is characterized by five subcomponents, with worry and self-focused attention representing the cognitive dimension of anxiety, autonomous hyperactivity and somatic tension representing the physiological dimension of anxiety, and perceived control representing the regulatory dimension of anxiety (Cheng, Hardy & Markland, 2007a, in submission). A measure of performance anxiety was developed in Chinese, and the factorial validity of the measurement and structural models were examined by confirmatory factor analysis through three studies (N = 203, 450, 236), with both genders of sports participants from a variety of Taiwanese sports and a broad range of skill levels. Results of model fit indices revealed support for a three-dimensional first order model, rather than a hierarchical five-dimensional structure, underlying the construct of performance anxiety. This performance anxiety measure of the Chinese version with three subscales and a total of 21 items exhibited significant sizable factor loadings and acceptable internal consistency.

A three-dimensional conceptualization of performance anxiety was recently proposed, based on both conceptual and empirical considerations (for details, see Cheng, Hardy & Markland, 2007a, in submission). Performance anxiety refers to an unpleasant psychological state in reaction to perceived threat concerning the performance of a task under pressure. The main feature of this conceptual model is that in addition to the conventional cognitive and physiological anxiety, a third regulatory dimension of anxiety was incorporated into the framework of performance anxiety, explicitly reflecting an underlying regulatory process involved in the dynamics of anxiety. Apart from the additional regulatory element of anxiety that is represented by the component of perceived control, the range of cognitive anxiety has been broadened to include self-focused attention (hereafter referred to as self-focus) as well as worry, and physiological anxiety has been differentiated into autonomous hyperactivity and somatic tension. Such an integrated framework offers a more comprehensive perspective, which may better reflect the perplexed nature of anxiety and the complex anxiety-performance dynamics.

The chief rationale for this model was derived from the concern: "Although anxiety is unpleasant, is anxiety always maladaptive (producing negative effects) in nature?" The conventional conception of anxiety seems to have more emphasized its maladaptive role in performance. In particular, anxiety in the sports domain was viewed as a maladaptive emotion that produced simply debilitative effects on performance by some researchers (Jones, Hanton & Swain, 1994; Jones, 1995; Burton & Naylor, 1997; Jones & Hanton, 2001; Hanton, Mellalieu & Hall, 2004). Although it is possible that "facilitative anxiety" (producing positive effects) in sports performance, measured by the CSAI-2 (Martens, Vealey & Burton, 1990), could be

confounded with other positive emotions (Burton & Naylor, 1997; Jones, Hanton & Swain, 1994; Jones & Hanton, 2001), doubt still remains whether positive emotions would always lead to positive consequences (Hanin, 1997; Hardy, 1998; Woodman & Hardy, 2001). Furthermore, cumulative research has supported the notion that anxiety could be facilitative in the contexts of test, music and sports performance (Albert & Haber, 1960; Wolfe, 1989; Parfitt & Hardy, 1993; Parfitt, Hardy & Pates, 1995; Hardy, 1996; Parfitt & Pates, 1999; Hardy, Woodman & Carrington, 2004).

Therefore, the authors contend that labeling anxiety as merely a debilitative emotion may risk an over-simplification of the complex nature of anxiety by narrowing its boundary of definition. Indeed, the origin of anxiety as part of a defense mechanism was meant to be functional from an evolutionary perspective (Ohman, 1996, 2000). More specifically, anxiety was hypothesized to fulfill its adaptive function by means of facilitating threat detection (Eysenck, 1992) as well as mobilizing resources to protect individuals and prepare for actions (Calvo & Cano-Vindel, 1997). In the processing efficiency theory of anxiety, Eysenck and Calvo (1992) have proposed that the potential positive effects of anxiety on performance may result from increased effort or motivation via a control system involved in anxiety to monitor and evaluate performance, and to plan and regulate the use of processing resources. Collectively, a regulatory dimension (i.e., perceived control) was incorporated into a part of anxiety in the present framework of performance anxiety to explicitly express its underlying adaptive capacity (producing potential positive effects to help individuals adapt better in the face of threat).

In addition, this model has adopted the approach of multidimensionality proposed in test anxiety that more anxiety components were called for to better understand the construct of anxiety (Sarason, 1984; Rost & Schermer, 1992a; Schwarzer & Jerusalem, 1992; Hodapp & Benson, 1997). In line with a broad cognitive perspective (Oatley & Johnson-Laird, 1987; Ohman, 2000; Mathews, 1992; Eysenck, 1992), many integrated models of anxiety that go beyond the two components of worry and emotionality (Libert & Morris, 1967; Morris, Davis & Hutchings, 1981) have been proposed across fields of psychology (e.g., Rost & Schermer, 1992b; Hagvet & Benson, 1997; Schwarzer & Jerusalem, 1992). Taken together, the present framework of performance anxiety is such a comprehensive one that along the addition of the regulatory dimension of anxiety, the cognitive dimension has included not only worry but also self-focus, and the physiological dimension has been differentiated into autonomous hyperactivity and somatic tension.

Empirically, findings in sport psychology from studies that have utilized the Competitive Sport Anxiety Inventory-2 (CSAI-2; Martens, Vealey & Burton, 1990), based on the Worry-Emotionality model of anxiety (Liebert & Morris, 1967; Morris, Davis & Hutchings, 1981; Spielberger, 1980), have not been entirely satisfactory. In particular, the proportions of variance in performance accounted for have been lower than expected (Hardy & Hagvet, 1996; Woodman & Hardy, 2001). Moreover, the construct validity of the CSAI-2 has been questioned (Lane, Sewell, Terry, Bartram & Nesti, 1999; Cox, Martens & Russell, 2003), and the role of self-confidence in the CSAI-2 has been debated (Martens et al, 1990; Jones, 1991; Woodman & Hardy, 2003). A very popular measure such as the CSAI-2, founded on a discordant theoretical model, would likely yield inconsistent results. Consequently, a measure

based on a more coherent conceptualization is clearly worthy of construction.

Previously, a preliminary measure of performance anxiety was developed in English (Cheng, Hardy & Markland, 2007a, in submission), assessing the three-dimensional conceptualization of performance anxiety characterized by five subcomponents, with worry and self-focus indicating the cognitive aspect of anxiety, autonomous hyperactivity and somatic tension representing the physiological aspect of anxiety, and perceived control reflecting the regulatory aspect of anxiety. The present paper presents three studies that describe the development of a Chinese measurement based on this conceptual framework as well as its accordant measure of performance anxiety established earlier in English. The factorial validity was tested through confirmatory factor analysis (CFA) in the domain of Taiwanese sports performance, involving a broad range of sports and skill ability, aiming to encompass a heterogeneous group in order to enhance the generalizability of the results. According to the conceptual model of performance anxiety and the prior CFA studies via the English data, this cross-cultural research of factorial validation was to test whether the measurement and structural models were best presented as a hierarchical five-dimensional or a first-order three-dimensional model (by merging worry and self-focus as a single dimension of cognitive anxiety, and merging autonomous hyperactivity and somatic tension as one dimension of physiological anxiety).

The hypotheses were: (a) each pair of first-order subcomponents reflecting the same second-order dimension would correlate positively to echo their shared underlying construct (Cheng, Hardy & Markland, 2007a, in submission); (b) the two second-order dimensions of cognitive and physiological anxiety would correlate

positively as shown in the previous relevant studies (Martens et al, 1990; Cox et al., 2003; Cheng, Hardy & Markland, 2007a, in submission); and (c) the correlations between the regulatory dimension of anxiety and the other two dimensions of cognitive and physiological anxiety would range in a broader fashion, as the nature of the regulatory dimension is different from that of cognitive and physiological anxiety. This regulatory ingredient was assumed to have potential to protect from or neutralize the maladaptive effects of cognitive/physiological anxiety. As such, there may be at least two logical correlation patterns. First, the regulatory dimension would conventionally correlate negatively with the two dimensions of cognitive and physiological anxiety. For example, lack of perceived control would be associated with high cognitive/physiological anxiety, and vice versa, which is in line with previous relevant findings (Martens et al., 1990; Carver & Scheier, 1998; Bong & Skaalvik, 2003; Cox et al., 2003; Cheng, Hardy & Markland, 2007a, in submission). Second, the patterns of correlation could vary and may turn toward a positive direction because of the hypothesized qualitative coping potential involved in the regulatory dimension of anxiety. That is, high perceived control could be associated with high cognitive/physiological anxiety. As suggested by several researchers (e.g., Eysenck & Calvo, 1992; Carver & Scheier, 1986), the negative effects of anxiety on performance can be countered by increased application of available resources or enhanced effort depending on one's expectancy for success. This is also in line with the findings in sports performance that high anxiety (measured by the CSAI-2) may be associated with high self-confidence (Edwards & Hardy, 1996; Hardy, 1996; Woodman & Hardy, 2003; Hardy, Woodman & Carrington, 2004).

To start with, the five subcomponents that represent the three dimensions of performance anxiety construct were operationalized with regard to their definitions established from an extensive literature review. Definitions for each construct are summarized below.

Worry: a cognitive form of apprehension associated with possible unfavorable outcomes.

Self-focused attention: an attentional shift to the self, leading to a self-evaluative state with an increased awareness of self-shortcomings concerning the performance of a task under pressure.

Autonomic hyperactivity: physiological reactions involved with the involuntary muscle groups that are associated with the body's inner organs.

Somatic tension: physiological reactions involved with the voluntary muscle groups that are motor-oriented.

Perceived control: perception of one's capabilities (involving ability and resource) of being able to cope and of goal-attainment regarding the performance of a task under stress.

Initial Development of the Measure

Previously, an initial item pool with approximate 120 English items was generated as a base for measurement development to assess worry, self-focus, autonomic hyperactivity, somatic tension, and perceived control, based on the definition of each subcomponent, and a variety of validated anxiety measures as well as an extensive review of the anxiety-related literature. The content of each subcomponent was operationalized fairly broadly. For example, the themes for worry included fear of failure, worry about making mistakes, and worry about uncertainty.

Likewise, two aspects of self-focus were included (Feigstein, Scheier & Buss, 1975). Private self-focus referred to an awareness of self-scrutinizing, based on one's own standards; whereas public self-focus was defined as an awareness of the self as a social object that is being evaluated by others, primarily in a critical manner. A range of content was included, such as an increased awareness of negative self-evaluation, scrutiny of motor movement, being watched and judged, etc. Typical manifestations of physiological anxiety in the item pool were perceived breathlessness, cold sweat, increased heart rate, and dry mouth, etc. for autonomous hyperactivity; and perceived trembling, muscle tension, fatigue, etc., for somatic tension. Lastly, the content areas of perceived control included perceived performance ability, likely goal attainment, coping capacity, etc.

Each question in the item pool was thoroughly evaluated in terms of face validity, clarity of wording, and sentence structure, according to the established guidelines for questionnaire design (Converse & Presser, 1986; Hippler, Schwarz & Sudman, 1987). Additionally, several principles of instrument refinement (Smith & MaCarthy, 1995) were applied to the development process to ensure psychometric strength. These included the design of items expressing only a single idea in order to avoid possible multiple sources of variance (Clark & Watson, 1995), appropriate item difficulty (symptom severity) to enhance discriminating power in the target population, and the adequateness of item quantity so as to obtain a balance between the reliability and efficiency of the measurement (Smith & MaCarthy, 1995). Further, 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).

Based on the English version of performance anxiety measure established from previous research in the context of British sports (Cheng, Hardy & Markland, 2007a, in submission), several steps were taken to construct the Chinese version of the measure. First, the measure of the 25-item English version was inspected for culture-specific content; none was found. Second, translation and back translation procedures (Hambleton & Kanjee, 1995) were utilized by bilinguals to achieve linguistic equivalence. Third, a total of five more items was included to the Chinese version to increase scale validity concerning possible cultural difference. One item was added to the private aspect of self-focus, and four items to the subscale of physiological anxiety, with the subcomponents of autonomous hyperactivity and somatic tension gaining two more items each. By these means, an adapted 30-item Chinese measure using a five-point Likert scale ranging from 1 (*totally disagree*) to 5 (*totally agree*) was established, with four items for worry, eight items for self-focus, and six items for each of the subcomponents of autonomous hyperactivity, somatic tension, and perceived control. Despite these additions, the measures of both versions were considered compatible as the inventory items of English and Chinese were all well operationalized in accordance with the definition of their corresponding anxiety components. More importantly, both measures were directly developed by the same authors, who also proposed the conceptual model of performance anxiety and the construct definition of each component, with a coordinated consideration and understanding of both cultures, which should have effectively maximized the measurement equivalence of both versions at any level. In addition, this initial measure was piloted on fifteen sports participants from the targeted population to ensure the clarity of wording and comprehensibility of the inventory.

Study 1: Initial Test of the Measure

The objective of this study was to evaluate the psychometric properties of the initial 30-item Chinese measure, including the characteristics and strength of the individual items, and the validity of the factorial structure of the measurement and structural models. Noteworthily, it was beyond the scope of this report to engage in a detailed discussion of cultural comparison. However, cross-validation of a structural model across cultures has been suggested to be a strong test of the validity of a model (Van de Vijver & Leung, 1997; Sue & Chang, 2003), and was recommended as one way to ascertain conceptual equivalence of measures across cultures (Leung & Wong, 2003; Butcher, Cheung & Lim, 2003). Moreover, it was considered advantageous to investigate the generalizability of the present three-dimensional model of performance anxiety across cultures to extend its applicability and further boost its development.

Method

Analysis. Confirmatory factor analysis was employed to assess construct validity using LISREL 8.72 and PRELIS 2.72 (Joreskog & Sorbom, 2005). Maximum-likelihood minimization estimation was performed. In addition, the 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 progressively tests the model from one to multiple factors and low to high levels primarily for diagnostic purposes to prospectively reduce potential problems by deleting inadequate items.

The first stage of sequential CFA involved testing five separate single-factor models corresponding to the five subcomponents of worry, self-focus, autonomous

hyperactivity, somatic tension, and perceived control. The objective of this stage was to assess the convergent validity of the items reflecting each subcomponent. Large factor loadings for the items on their intended factor give evidence of convergent validity of the items. As such, items with low factor loadings were eliminated from the model.

In the second stage of the analysis, two two-factor models for the dimensions of cognitive and physiological anxiety were formed by pairing the subcomponents that were hypothesized to load on the same dimension. The purpose of this stage was to identify any ambiguous items by standardized residuals and/or modification indices, as well as to investigate the discriminant validity of the paired subcomponents by the Satorra-Bentler scaled χ^2 difference test (S-B χ^2_{diff}; Satorra & Bentler, 2001). Accordingly, no items were allowed to cross-load on a non-intended factor, but factors were allowed to correlate.

Finally, the whole model was tested. At this final stage, a procedure known as the parceling method (Marsh, Antill & Cunningham, 1989) was implemented as necessary to reduce the number of estimated parameters to obtain a stable estimation due to the relatively small sample size. A parceled model was produced with the construction of composite scores by randomly combining items that indicated the same first-order subcomponent. The aim of this stage was to examine the factorial structure of the whole model and the discriminant validity of the three anxiety dimensions. Goodness of fit was assessed at each stage. The global model fit indices were examined, along with detailed assessment of fit by the completely standardized factor loadings, the standardized residuals, and the modification indices for the

covariance of the measurement errors. In terms of the assessment of global fit, the chi-square (χ^2) statistic is the principal means of assessing model fit as a formal significance test of the covariance structure hypothesis. However, Joreskog and Sorbum (1989) have suggested that χ^2 be used more subjectively as an indication of fit, rather than as a test statistic, with large χ^2 values relative to the degrees of freedom indicating a poor fit and small values a good fit. A χ^2/df ratio of less than 2.0 has been further recommended as indicator of an adequate fit, but there remains little agreement on how small this ratio needs to be to be acceptable (Marsh & Hocevar, 1985). Consequently, the arguments on how the χ^2 test is best interpreted among researchers have led to the development of other criteria for assessing the fit of a model, and the strategy of reporting a range of fit indices has gained support from recent studies (Beauducel & Wittmann, 2005; Fan & Sivo, 2005).

Taken together, throughout the studies reported in this paper, multiple criteria were used in the assessment of global fit as well as the Satorra-Bentler scaled chi-square (Robust χ^2; Satorra & Bentler, 1988). These criteria were the Root Mean Square Error of Approximation (RMSEA; Steiger, 1990), the Non-normed Fit Index (NNFI; Tucker & Lewis, 1973), the Comparative Fit Index (CFI; Bentler, 1990), and the Standardized Root Mean Square Residual (SRMR). The cutoff standards required for a good fit is the subject of much debate in the literature. In general, it has been reported that RMSEA values of .05 or less indicate a close fit whilst values greater than .10 represent unacceptable fit (Browne & Cudeck, 1993). Additionally, RMSEA values of .08 or less have also been suggested to be acceptable (McDonald & Ho, 2002), together with SRMR values of less than .10 and NNFI values of greater than .90. However, more stringent criteria have been recommended that RMSEA

values of .06 and SRMR values of .08 or less, and NNFI and CFI values of .95 or greater are required for a good fit (Hu & Bentler, 1999).

Participants. A Chinese sample of 203 university-based participants was drawn in Taiwan, from a wide range of sports (approximately 30 types), and with various skill levels, ranging from international or national (39.9%), through club, school, or regional (34.5%), to recreational level (25.5%). The average age of participants was 22.1 years (SD = 5.7), with 106 females (M = 20.6, SD = 3.2) and 97 males (M = 23.7, SD = 7.3).

Procedure. Participants were briefed on the objective of the study and the instructions for the inventory. Consent for participating was obtained from all participants. They were asked to focus on the most recent sports event performed under pressure that could be remembered clearly, and to recall how they felt before that specific sports performance. Administration of the inventory took approximately 10 minutes, although no time limit was set. They were encouraged to ask any questions that occurred to them while filling out the inventory. Retrospective data was collected for: (a) enhancing compatibility with the previous English studies (Cheng et al., 2007a, in submission), and (b) preventing intrusions on pre-game preparation and potential response bias due to pressure. The recalled timeframe was from within two days (30%), one week (40%), or two months (30%). The subjective rating of perceived performance importance was also collected from the participants and exhibited a mean of 7.41 (SD = 2.23) on a 10-point Likert scale, ranged from 1 (*not important at all*) to 10 (*very important*).

Results

Although structural equation modeling (SEM) requires relatively large samples in order to have stable estimates, it is difficult to provide a reliable rule for an adequate sample size, as it depends on a number of factors (Tabachnick & Fidell, 2001). In general, a sample of 200 is considered fair and 300 as good (Comrey & Lee, 1992). In the majority of small to moderate models, a sample size of about 200 is also regarded as adequate (Boomsma, 1983). Moreover, the recommended minimum ratio of cases to estimated parameters is 5:1, and preferably 10:1 for non-normally distributed data (Bentler & Chou, 1987). The present sample ($N = 203$) was considered adequate for the tests of one- and two-factor models, with ratios of cases to estimated parameters ranging from 25.4:1 to 10.7:1. Furthermore, the parceled final model with a ratio of 13.5:1 was also appropriate to achieve stable estimations.

Initial inspection of the univariate normality of all items for skewness (values ranged from -.59 to .34) and kurtosis (values ranged from -1.09 to .05) revealed some violation, and the multivariate distributions were thus significantly non-normal. Although usually parameter estimates are not seriously affected, such a violation tends to inflate χ^2 and deflate standard errors. Hence, the Robust χ^2 was adopted, a method of correcting the χ^2 statistic for non-normality which takes into account multivariate kurtosis and has been shown to perform better than other estimation methods under various distributional assumptions (Chou & Bentler, 1995; Hu & Bentler, 1995). Nevertheless, some caution may be warranted in interpreting these results.

Under sequential CFA, three items were removed from the self-focus subscale (two from private self-focus and one from public self-focus), and four items were dropped from the physiological subscale (two items from each physiological subcomponent). Therefore, a total of seven items was deleted from the original 30-item measure due to low factor loadings, problematic residual patterns, and/or high modification indices. The fit indices of the one- and two-factor models following item deletion were good (Table 1). When examining both two-factor models, discriminant validity was tested by the Satorra-Bentler scaled χ^2 difference test (S-B χ^2_{diff}) respectively. The correlation ($r = .88$) between autonomous hyperactivity and somatic tension demonstrated an empirical distinction (S-B $\chi^2_{diff}(1) = 4.49$, $p < .05$), with data showing that a two-factor model fitted significantly better than a respecified one-factor model in which the covariance between two factors was constrained to 1.0. Unsurprisingly, the high correlation ($r = .96$) between worry and self-focus failed to be differentiated (S-B $\chi^2_{diff}(1) = 1.15$, $p > .05$).

Table 1. Fit Indices and Cronbach's Alpha (α) for the One- and Two-factor Models in Studies 1-3.

	Robust χ^2	*df*	*p*	RMSEA	NNFI	CFI	SRMR	α
Study 1								
One-Factor Models								
Worry	4.40	2	.08	.08	.97	.99	.03	.74
Self-focus	2.70	5	.55	.00	1.00	1.00	.02	.75
Autonomous Hyperactivity	1.39	2	.04	.00	1.00	1.00	.02	.69
Somatic Tension	.04	2	.97	.00	1.00	1.00	.00	.70
Perceived Control	13.52	9	.04	.05	.99	.99	.03	.82
Two-Factor Models								
Cognitive Anxiety	24.45	26	.22	.00	1.00	1.00	.04	.85
Physiological Anxiety	25.01	19	.02	.04	.99	.99	.04	.81
Study 2								
One-Factor Models								
Worry	.99	2	.57	.00	1.00	1.00	.01	.76
Self-focus	11.39	9	.07	.02	1.00	1.00	.03	.77
Autonomous Hyperactivity	8.15	2	.01	.08	.96	.98	.03	.69
Somatic Tension	.41	2	.80	.00	1.00	1.00	.01	.68
Perceived Control	5.14	2	.06	.06	.98	1.00	.02	.78
Two-Factor Models								
Cognitive Anxiety	49.46	34	.00	.03	.99	.99	.03	.85
Physiological Anxiety	36.20	13	.00	.06	.97	.98	.04	.81
Study 3								
One-Factor Models								
Worry	.64	2	.70	.00	1.00	1.00	.01	.78
Self-focus	5.95	9	.51	.00	1.00	1.00	.03	.80
Autonomous Hyperactivity	2.73	2	.19	.04	.99	1.00	.02	.71
Somatic Tension	.51	2	.76	.00	1.00	1.00	.02	.68
Perceived Control	4.24	2	.12	.07	.98	.99	.02	.80
Two-Factor Models								
Cognitive Anxiety	30.00	34	.31	.00	1.00	1.00	.03	.87
Physiological Anxiety	12.92	13	.12	.00	1.00	1.00	.03	.82

At the final stage, the observed variables of the full model were parceled to reduce the estimated parameters to obtain a stable estimation. Given the relatively small sample, six composite variables were constructed by randomly combing items that indicated the same first-order subcomponent of anxiety. This parceled model with a hierarchical structure of three second-order dimensions and five first-order subcomponents failed to fit as one of the estimated parameters was not identifiable. According to the high inter-factor correlation shown from the tests of two-factor models between worry and self-focus, and between autonomous hyperactivity and somatic tension, an alternative parceled model was constructed, retaining only three dimensions by merging each of the paired subcomponents into single factors for the cognitive and physiological dimensions. This first-order three-dimensional model fitted well with Robust $\chi^2(6) = 4.1$, $p = .57$; RMSEA = .00, NNFI = 1.0, CFI = 1.0, and SRMR = .02 (Figure 1), which was not substantially different from the findings for a non-parceled version of the three-dimensional model, with Robust $\chi^2(227) = 349.8$, $p < .001$; RMSEA = .05, NNFI = .96, CFI = .97, and SRMR = .07.

The factor loadings of the final retained 23 items were all significant, ranging from .76 to .41, with 19 (83%) items achieving a loading higher than .50. Worry, autonomous hyperactivity, and somatic tension had four items each; self-focus had five, and perceived control had six items. Descriptive data including subscale means and standard deviations for the cognitive, physiological, and regulatory (i.e., perceived control) dimensions and the four differentiated subcomponents (worry, self-focus, autonomous hyperactivity and somatic tension) of anxiety are reported in Table 2. The inter-factor correlations between the three dimensions of anxiety in the parceled three-dimensional model were .74 between the cognitive and physiological

dimensions, -.26 between the cognitive and regulatory dimensions, and -.30 between the physiological and regulatory dimensions (see Figure 1).

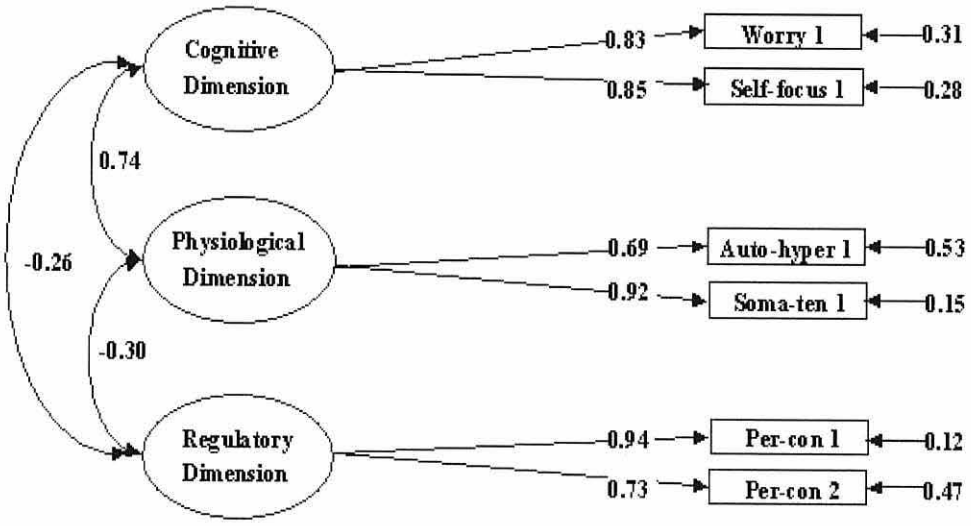

Figure 1. Results of confirmatory factor analysis for the final parceled model in Study 1. Model fit indices were Robust $\chi^2(6) = 4.1$, $p = .57$; RMSEA = .00, NNFI = 1.0, CFI = 1.0, and SRMR = .02. All data shown were completely standardized solution. Observed variables were composite.

Table 2. Descriptive Statistics for the Subscales of Performance Anxiety Measure in Studies 1-3.

Subscale Means and *SD*s (in Parentheses)	**Study 1** ($N = 203$)	**Study 2** ($N = 450$)	**Study 3** ($N = 236$)
Three Subscales			
Cognitive dimension	3.29 (1.07)	3.43 (1.02)	3.44 (1.05)
Physiological dimension	2.86 (1.12)	2.87 (1.13)	2.88 (1.12)
Regulatory dimension (Perceived control)	3.57 (0.99)	3.56 (0.94)	3.14 (1.09)
Four Subcomponents			
Worry	3.38 (1.10)	3.53 (1.09)	3.51 (1.10)
Self-focus	3.19 (1.04)	3.37 (0.97)	3.36 (1.00)
Autonomous hyperactivity	2.73 (1.18)	2.81 (1.16)	2.83 (1.16)
Somatic tension	2.99 (1.07)	2.95 (1.09)	2.96 (1.08)

Internal consistency. All measurement models of the five subcomponents following item deletion were examined by Cronbach's (1951) alpha reliability coefficient (Table 1). The three subscales of cognitive, physiological and regulatory dimensions of anxiety showed good internal consistency, with alphas ranged from .81 to .85.

Study 2: Refinement of the Measure

The objective of this study was to conduct a mild refinement to the instrument initially developed in Study 1, and to further validate its factorial structure of the measurement and structural models in an independent Taiwanese sample. To improve the validity of the 23-item measure, a total of two more items was added to the subcomponent of self-focus (one for each private/public aspect). The refined measure thus contained 25 items, with four items for worry, autonomous hyperactivity, and somatic tension; six for perceived control, and seven for self-focus (three private self-focus items and four public self-focus items).

Method

Participants. A diverse university-based sample of 686 participants (F = 289, M = 397) was drawn from several physical education colleges in Taiwan, with about 35 sports and various levels of skill ability. To enhance the test of the validity of the refined measure, a procedure of built-in cross-validation was applied, adapted from the widely used split-half cross-validation (Everett, 1983). This sample was randomly split with a ratio of 2:1 by SPSS 11.0. The first sub-sample of 450 cases was used as a calibration sample in the present study, and the second sub-sample of 236 cases was used as a validation sample for the next study. The current calibration sample involved various sports (approximately 34 types), and diverse skill levels, ranging from international or national (66.2%), through school or regional (16.2%), to recreational level (17.6%). The mean age of the participants was 20.2 years (SD = 2.0), with 199 females (M = 20.1, SD = 1.6) and 251 males (M = 20.3, SD = 2.3).

Procedure. Consistent with the procedure in Study 1, retrospective data was

collected from within two days (25%), one week (40.6%), or two months (23.3%). Moreover, the mean rating for the subjective perception of performance importance was 8.02 (SD = 2.01) on a 10-point Likert scale. Data were analyzed in the same way as in Study 1.

Results

The present sample (N = 450) was adequate to test the full model structure with a ratio of case to estimated parameter of 10:1, without the need for using the parceling method. The assessment of univariate normality of all items for skewness (values ranged from -.60 to .29) and kurtosis (values ranged from -.98 to -.06) indicated some violation. Therefore, Robust χ^2 was employed to adjust for the non-normality of multivariate distributions as in Study 1.

During sequential CFA, one item was dropped from self-focus, one from somatic tension, and two from perceived control. As a result, four items in total were reduced from the 25-item measure due to relatively weak factor loadings, problematic residual patterns, and high modification indices. Following item deletion, all one- and two-factor models exhibited a fair fit (Table 1), with the exception of the single-factor model of autonomous hyperactivity, which had a large Robust $\chi^2(2) = 8.15$, $p = .01$; and RMSEA = .08 (but NNFI = .96, CFI = .98, and SRMR = .03). The inter-factor correlations were high between worry and self-focus (r = .87), and between autonomous hyperactivity and somatic tension (r = .94). Through the S-B χ^2 difference tests, the discriminant validity of worry and self-focus was confirmed (S-B $\chi^2_{diff}(1) = 14.37$, $p < .001$), but the distinction of autonomous hyperactivity and somatic tension was rejected (S-B $\chi^2_{diff}(1) = 2.33$, $p > .05$).

The final (non-parceled) model with a hierarchical structure containing both the three second-order dimensions and the five first-order subcomponents (Robust $\chi^2(182) = 379.83$, $p < .001$; RMSEA = .05, NNFI = .97, CFI = .97, and SRMR = .06) failed to fit due to two improper estimates emerged between latent factors in the first and second level, similar to the previous English CFA studies (Cheng et al., 2007a, in submission). An alternative (non-parceled) model was constructed, retaining only three dimensions by merging worry and self-focus, and merging autonomous hyperactivity and somatic tension into single factors respectively. The fit indices of this first-order three-dimensional model were Robust $\chi^2(186) = 459.4$, $p < .001$; RMSEA = .057, NNFI = .96, CFI = .97, and SRMR = .06 (Figure 2). This χ^2 statistic was relatively large (relative to the degrees of freedom); however, the other fit indices indicated a good fit. Collectively, these combined results suggested an acceptable fit of the data to the three-dimensional model.

The factor loadings of the final retained 21 items in the three-dimensional model were all significant, ranging from .75 to .43, with 19 (90.5%) items having a loading higher than .50 (see Figure 2). Except for self-focus with six items and somatic tension with three items, each of the remaining three subcomponents had four items (see appendix B for this Chinese measure in Chinese, and appendix C for an English translation of all item content of the Chinese measure as well as corresponding factor loadings). Descriptive data including item means and standard deviations for the three dimensions and the four subcomponents of anxiety are reported in Table 2. It was noteworthy that the inter-factor correlation between the cognitive and regulatory dimensions (r = -.07) was not significantly different from 0.0, while the patterns of the

two other correlations (r = .74 for the cognitive and physiological dimensions, and r = -.30 for the physiological and regulatory dimensions) (see Figure 2) remained generally consistent with those obtained in Study 1 and previous English studies (Cheng et al, 2007a, in submission).

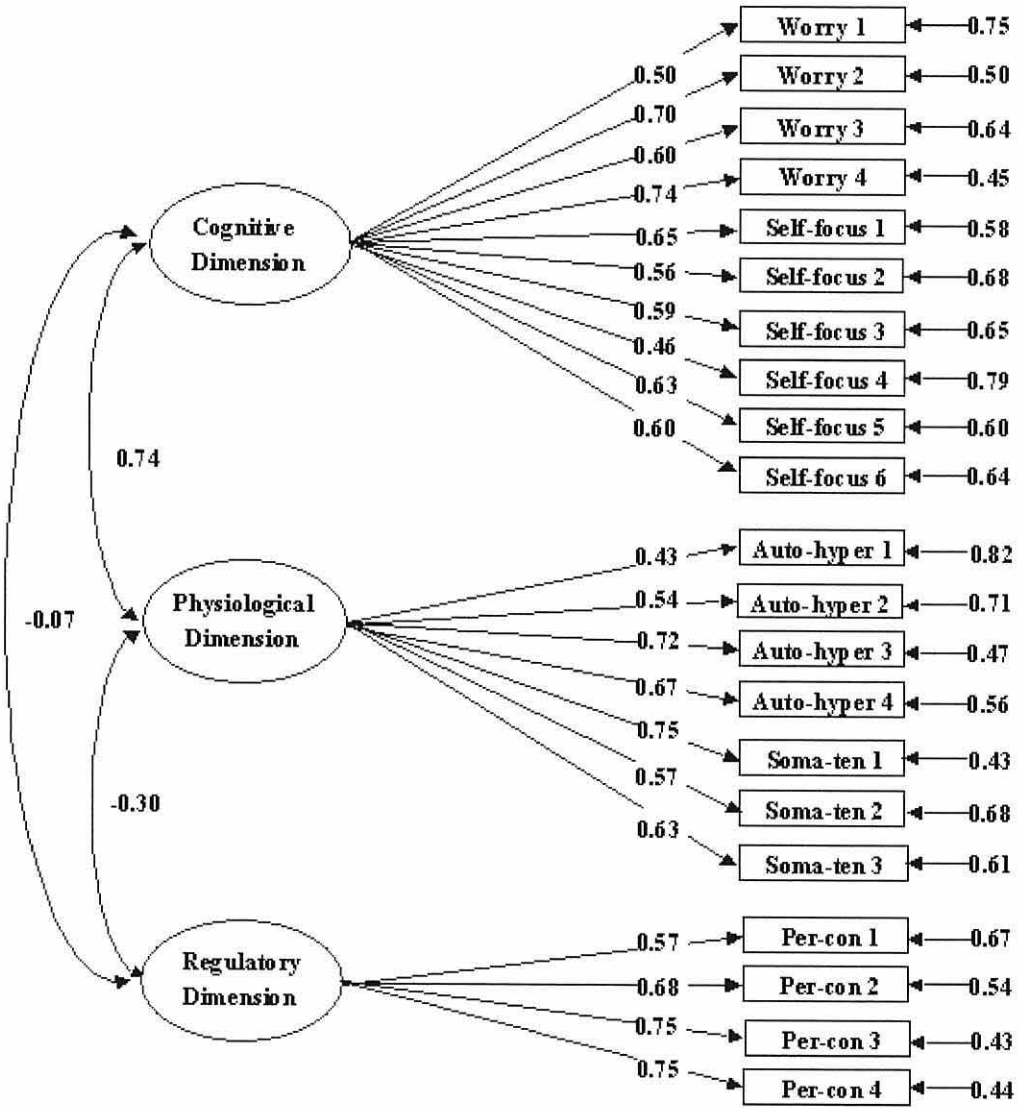

Figure 2. Results of confirmatory factor analysis for the final (non-parceled) model in Study 2. Model fit indices were Robust $\chi^2(186) = 459.4$, $p = .00$; RMSEA = .057, NNFI = .96, CFI = .97, and SRMR = .06. All data shown were completely standardized solution.

Internal consistency. All measurement models of the five subcomponents following item deletion were examined by Cronbach's alpha coefficient (Table 1). The three subscales of the cognitive, physiological and regulatory dimensions of anxiety showed acceptable internal consistency, with alphas ranged from .78 to .85.

Study 3: Replication of the Measure

The objective of this study was to cross-validate the 21-item measure of performance anxiety using an independent Taiwanese sample. The psychometric properties as well as the factorial validity were to be examined under a loose replication strategy (Diamantopoulos & Siguaw, 2000), where the validation sample was analyzed using the same model specification as in the calibration sample, while all parameters were allowed to be freely estimated.

Method

Participants. A cross-validation sample ($N = 236$) was obtained from a random split of the larger sample ($N = 686$) in Study 2. The characteristics of the present sample corresponded well to that of the calibration sample, which consisted of a variety of sports (approximately 30 types), and diverse skill levels, ranging from international or national (59.7%), through school or regional (23.4%), to recreational level (16.9%). The mean age of the participants was 20.3 years ($SD = 1.8$), composed of 90 females ($M = 20.0$, $SD = 1.5$) and 146 males ($M = 20.5$, $SD = 2.0$).

Procedure. Data was retrospective, with the recalled timeframe within two days (27.6%), one week (43.0%), or two months (18.4%). Furthermore, the mean rating of the subjective perception of performance importance was 8.01 ($SD = 2.22$),

almost identical to that in the calibration sample in Study 2. Data were analyzed in the same fashion as in Studies 1-2.

Results

The sample size was appropriate, with ratios of cases to the number of estimated parameters ranging from 59:1 to 11.2:1 for the tests of one- and two-factor models, and a ratio of 11.2:1 for the parceled final model. Robust χ^2 was used as the previous studies for the adjustment of some non-normality of multivariate distributions, which was revealed by assessing skewness (values ranged from -.61 to .26) and kurtosis (values ranged from -.97 to .05) for the univariate normality of all items.

During sequential CFA, all one- and two-factor models fitted reasonably well to the data (Table 1). High correlations were found between worry and self-focus (r = .93), and between autonomous hyperactivity and somatic tension (r = .96). The discriminant validity of two physiological subcomponents was not supported (with S-B $\chi^2_{diff}(1) = 1.12, p > .05$), but that of worry and self-focus was supported (with S-B $\chi^2_{diff}(1) = 11.72, p < .001$).

On testing the final model, the model was parceled due to the relatively small sample. Nine composite items were constructed by randomly combining the observed variables that indicated the same first-order factor. The hierarchical structure with three second-order dimensions and five first-order subcomponents of this parceled model failed to fit due to one of the estimated parameters was not identifiable, similar to Study 1. An alternative parceled model with only three dimensions revealed a good fit, with Robust $\chi^2(24) = 41.4, p < .001$; RMSEA =.056, NNFI = .98, CFI = .99, and

SRMR = .047 (Figure 3). This result was further confirmed by the model fit from a non-parceled version of the three-dimensional model, with Robust $\chi^2(186) = 303.4$, $p < .001$; RMSEA = .05, NNFI = .97, CFI = .98, and SRMR = .076.

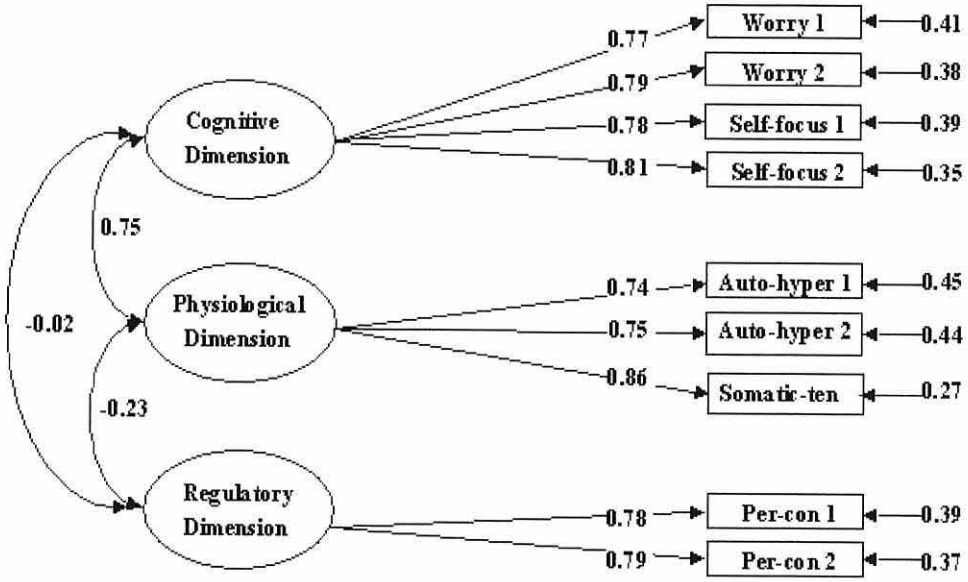

Figure 3. Results of confirmatory factor analysis for the final parceled model in Study 3. Model fit indices were Robust $\chi^2(24) = 41.4$, $p = .00$; RMSEA = .056, NNFI = .98, CFI = .99, and SRMR = .047. All data shown were completely standardized solution. Observed variables were composite.

The factor loadings of the final 21 items were all significant, ranging from .81 to .42, with 19 (90.5%) items having a loading higher than .50. Descriptive data including item means and standard deviations for the three dimensions and the four subcomponents of anxiety are reported in Table 2. The inter-factor correlations between the cognitive and physiological dimensions (r = .75), and between the physiological and regulatory dimensions (r = -.23) were consistent with the patterns in Studies 1-2; yet the correlation between the cognitive and regulatory dimensions (r = -.02) was again not significantly different from 0.0 (see Figure 3). Therefore, the correlation pattern in the three dimensions of anxiety found in Study 2 was generally replicated in this study.

Internal consistency. All measurement models of the five subcomponents following item deletion were examined by Cronbach's reliability coefficient (Table 1). The three subscales of the cognitive, physiological and regulatory dimensions of anxiety showed acceptable internal consistency, with alphas ranged from .75 to .86.

Discussion

Based on a three-dimensional conceptualization of performance anxiety, the present paper reports the development of a Chinese measure of performance anxiety and its factorial validation of the measurement and structural models in the context of Taiwanese sports.

Consistent with the previous CFA findings in the English studies (Cheng et al., 2007a, in submission), a first-order three-dimensional structure was supported for the factorial validity of the Chinese version of measurement and structural models.

Discriminant validity was fairly weak for worry and self-focus as well as for autonomous hyperactivity and somatic tension across the three studies, given the inter-factor correlations were high between the paired cognitive subcomponents (from .87 to .96), and between the paired physiological subcomponents (from .88 to .96). This explained why the hierarchical five-dimensional model was not supported in the present three studies. To sum, this conceptual model is best presented as three (rather than five) dimensional. The differentiation of worry vs. self-focus and autonomous hyperactivity vs. somatic tension remains only at a descriptive level while the integrity of the three-dimensional model is intact under this relatively early stage of model development. Undoubtedly, more studies are necessary to test if they can be separated empirically. Future investigations under more specific contexts (e.g., specified task demand, skill level, sports type, etc.) might reveal differential patterns between these anxiety subcomponents as various groups of performers might manifest anxiety responses differently, and various anxiety components might impact dissimilarly on different aspects of performance in varied conditions.

It is noteworthy that while the correlation patterns between the cognitive and physiological dimensions (ranging from .68 to .74), and between the regulatory and physiological dimensions (ranging from -.54 to -.23) were generally consistent across the previous two English studies (Cheng et al., 2007a, in submission) and the present three Chinese studies, the correlation between the regulatory and cognitive dimensions shifted substantially from -.49 in the previous first English study, through -.26 in the second English study and the present Chinese Study 1, to become not significantly different from 0.0 in the Chinese Studies 2-3 here (r = -.07 and -.02, respectively). However, such result of near-zero correlation did not contradict the

assumptions underlying the proposed framework. As hypothesized in the earlier section, the regulatory dimension, reflecting an underlying coping capacity involved in the dynamics of anxiety, may potentially prevent high cognitive and physiological anxiety from being maladaptive. For example, anxious individuals may exhibit high cognitive/physiological anxiety together with either low or high level of perceived control. Therefore, the intercorrelation between the regulatory and cognitive/physiological dimensions would potentially range broadly, from negative (e.g., Martens et al., 1990; Carver & Scheier, 1998; Bong & Skaalvik, 2003; Cox et al., 2003), to positive (e.g., Edwards et al., 1996; Woodman & Hardy, 2003; Hardy et al., 2004). Consequently, it is statistically logical that such opposed actions (with both negative and positive directions) could just produce a joint impact that leads to a near-zero correlation (Aron & Aron, 2003), as demonstrated here. Nevertheless, more research is needed to substantiate the above line of reasoning.

A subsequent question was why such a correlation pattern was revealed specifically in the present Studies 2 and 3? If cultural difference was a major issue in this case, one would expect to have obtained a similar finding in the first cross-cultural study (Chinese Study 1), but this study showed a correlation pattern resembling that obtained from the previous British research (i.e., the second English study) (Cheng et al., 2007a, in submission). In an inspection on the sample features of the two previous English studies and the three Chinese studies here, there appears to be a difference between the samples in the Chinese Studies 2-3 and those in Chinese Study 1 and the previous English studies, despite the effort to make all sample characteristics correspond as closely as possible. Discrepancies were observable mainly in skill level, regarded as a crucial individual difference variable (Jones,

Hanton & Swain, 1994; Swain & Jones, 1996), and the subjective rating of performance importance, suggested as an important antecedent of anxiety (Lowe & McGrath, 1971). Both variables showed a similar trend across all English and Chinese studies, noticeably higher in the present Chinese Studies 2-3 (percentages of skill ability above national level for the previous two English samples, labeled as Samples 1-2; and the present three Chinese samples, labeled as Samples 3-5 = 23.4%, 39.4%, 39.9%, 66.2%, 59.7%; and means of the rating on performance importance for these Samples 1-5 = 7.44, 7.51, 7.41, 8.02, 8.01; *SD*s = 1.97, 2.00, 2.23, 2.01, 2.22). As expected, the Kruskal-Wallis test showed a significant difference ($\chi^2(4) = 156.93$, $p < .001$) in skill level across Samples 1-5. There was no significant difference from the chi-square test for independence within Samples 4-5 ($\chi^2(1) = 2.54$, $p = .11$) and within Samples 2-3 ($\chi^2(1) = .00$, $p = .99$), but a significant difference was revealed within Samples 3-4 ($\chi^2(1) = 38.72$, $p < .001$). Furthermore, one-way ANOVA showed a significant difference ($F(1, 1445) = 6.55$, $p < .001$) in mean rating on performance importance across the five studies. Post-hoc comparisons using Tukey HSD indicated that Samples 4-5 differed significantly ($p < .05$) from Samples 1-3. Consequently, it is likely that such variables as skill level and perceived importance of performance, etc. may have played some roles in altering the correlation pattern between the regulatory and cognitive dimensions. One possible explanation for the results may be that more skilled performers who are used to more stressful situations may have better regulatory potential than less skilled performers to qualitatively neutralize (e.g., tolerate or dissociate) high cognitive anxiety. Therefore, negative correlations would appear in Samples 1-3 (with less skilled performers), whereas near-zero correlations would appear in Samples 4-5 (with more skilled performers). More research is clearly needed to examine the mechanism of the regulatory dimension of anxiety further and

how it may relate to the cognitive and physiological dimensions differently.

It was a challenge to achieve convergent validity for the items on each subscale, as the majority of theoretically-derived items for each of the five subcomponents involved rather heterogeneous content in order to increase the representability of each subscale. Indeed, Hagvet and Benson (1997) have pointed out that this could result in unexpected multidimensionality of the construct. For example, Dunn defined sports competitive worry as a multidimensional construct by referring to a variety of content domains, i.e., performance failure, negative evaluation, injury or physical danger and situational uncertainty (Dunn & Syrotuik, 2003; Dunn, 1999). However, it remains debatable whether diversified content is sufficient to represent multidimensionality from a theoretical perspective. In the present paper, each of the five subcomponents of performance anxiety, operationalized by involving a range of content areas, was considered by the authors to be unidimensional. This was principally with reference to the viewpoint that multidimensionality is more justifiable when the multiple dimensions of a construct differ in their internal underlying psychological processes, rather than in their external sources of content (Eysenck, 1992). As additional empirical support for the above argument, the convergent validity of items with diverse content for each of the five subscales was supported across the three Chinese studies and the previous two English studies (Cheng et al., 2007a, in submission). The most obvious example was the one-factor model of self-focus, which included the two aspects of private and public self-focus (Fenigstein et al., 1975) that were argued to differ only at a content level (Wicklund & Gollwitzer, 1987), and consistently showed a good fit to the data. Nevertheless, such an approach may require caution as it might cost internal consistency, factor loadings or convergent validity of the items.

In conclusion, the factorial structure of a three-dimensional first order model of performance anxiety was supported through three CFA studies via cross-cultural tests on Taiwanese sports. The validity of the structural model was considered to be strengthened particularly through cross-validation across cultures (Van de Vijver & Leung, 1997; Sue & Chang, 2003). Furthermore, the 21-item Chinese measure of performance anxiety exhibited significant factor loadings and reasonable internal consistency. This measure appeared comparable to the English version of the measure established in the previous research (Cheng et al., 2007a, in submission) in representing the proposed model of performance anxiety as they were developed by the same researchers who also constructed the conceptual framework, with an understanding and consideration of two cultures. More importantly, the replication of major factor structure was confirmed between two measures, suggested as a necessary indication for conceptual equivalence of measures across cultures (Leung & Wong, 2003; Butcher et al., 2003). Nevertheless, more data are necessary to further investigate the psychometric properties of this Chinese instrument of performance anxiety. Although the present measure was validated across a wide range of sports contexts and skill levels, most favorably for participants aged around 20.8 (SD = 3.3), its generalizability to other performance settings and other age groups of performers (e.g., under age of 17) has yet to be examined. Lastly, the data of pre-competitive anxiety were collected retrospectively, given the validity of recall has been verified (Hanin, 1980, 1986; Gould, Tuffey, Hardy & Lochbaum, 1993; Randle & Weinberg, 1997; Butt, Weinberg & Horn, 2003; Harger & Raglin, 1994). Possible undesirable effects associated with prospective study, i.e., intrusion on pre-game preparation and response bias that may be due to social desirability or self-defense as a coping style (Martens et al., 1990; Mendolia, 2002; Hippel, Hippel, Conway, Preacher, Schooler &

Radvanske, 2005), may be reduced. In addition, a retrospective design may create least ethical concerns provided that a substantial amount of participants (N = 889) were involved in these studies at this initial stage of measurement development. However, it is worth noting that a certain portion (approximately 18.4% to 30%) of data in the three studies were recalled within two months and may thus be less reliable. Consequently, despite the present findings being reasonably promising, future prospective research is desirable to confirm current results.

Above all, this newly developed measure may be of both theoretical and practical value. Theoretically, it is based on an integrated conceptualization that reflects a comprehensive view of performance anxiety, in which the adaptive potential of anxiety is acknowledged explicitly by incorporating a regulatory dimension. Apart from conceptual considerations, the present measure lends itself to the examination of both the singular and interactive effects of different components of anxiety within various sports contexts. Although current evidence can only advocate the use of the cognitive, physiological, and regulatory subscales of anxiety at the global level, further differentiated subscales for worry, self-focus, autonomous hyperactivity, and somatic tension might be applicable given a germane context. Further research is undoubtedly required to provide additional psychometric validation; and, in particular, to examine the explanatory and predictive power of the three-dimensional model of performance anxiety, as the establishment of construct validity is an ongoing process (Schwab, 1980; Smith & MaCarthy, 1995; Cronbach, 1971).

Chapter 4

Predictive Validity of a Three-Dimensional Model of Performance Anxiety: A Preliminary Test in the Context of Tae-kwon-do Sport Performance

Abstract

This study examines the predictive validity of a three-dimensional model of performance anxiety (Cheng, Hardy & Markland, 2007a, in submission), with interactive as well as main effects of three anxiety factors, i.e., cognitive anxiety, physiological anxiety, and the regulatory dimension of anxiety (perceived control). Pre-competitive anxiety ratings were obtained from both genders of elite level of Chinese (Taiwanese) tae-kwon-do sports performers (N=99). A self-assessed performance measure based on six criteria for optimal tae-kwon-do performance was developed and administered retrospectively in order to investigate the prediction of anxiety variables on performance. The component of perceived control accounted for an additional 20.4% of performance variance over and above that accounted for by cognitive and physiological anxiety. A significant interaction between perceived control and physiological anxiety, accounting for an additional 11.6% of performance variance, also emerged. In total, the whole model explained 36.9% of performance variance. Overall, this study revealed some initial support for the predictions based on the three-dimensional conceptualization of performance anxiety.

In sport psychology, anxiety has been one of the main topics studied when examining performance in the stress-related contexts. Advances have been made in both conceptualization and measurement of performance anxiety. For example, the unidimensional conceptualization of anxiety was superceded by a multidimensional model in multidimensional anxiety theory (Martens, Vealey & Burtons, 1990). Furthermore, examinations of the interactive effect of anxiety variables in the catastrophe model (Hardy, 1990, 1996), and the directional dimension of anxiety (Jones, 1991, 1995) have improved the prediction of the anxiety-performance relationship. However, there remains debate regarding fundamental issues, e.g., the problems of definition that are ingrained in the context of anxiety research. In particular, empirical data concerning anxiety effects on sports performance has shown anxiety to be not only debilitative but also facilitative (Jones & Cale, 1989; Parfitt & Hardy, 1993; Parfitt, Hardy & Pates, 1995; Edwards & Hardy, 1996; Woodman & Hardy, 2003). From a conceptual perspective, some researchers in sport psychology (Jones, Hanton & Swain, 1994; Jones, 1995; Burton & Naylor, 1997; Jones & Hanton, 2001; Hanton, Mellalieu & Hall, 2004) have argued that anxiety is always maladaptive (producing negative effects), and have attributed positive effects associated with anxiety to other positive states. Although anxiety can be very unpleasant, it remains questionable whether such a complex emotion can only lead to negative consequences with regard to performance (Hanin, 1997; Hardy, 1998; Woodman & Hardy, 2001).

Consequently, a three-dimensional model of performance anxiety was proposed to offer an alternative perspective to the understanding of the complex anxiety-performance relationship, based on several lines of conceptual argument (for

details, see Cheng, Hardy & Markland, 2007a, in submission). The construct of performance anxiety is defined as an unpleasant psychological state in reaction to perceived threat concerning the performance of a task under pressure. From a theoretical perspective, although anxiety is an unpleasant emotion, this integrated conceptualization of performance anxiety views anxiety as relatively neutral (producing not only negative but also positive effects) as opposed to purely maladaptive (producing merely negative effects). A regulatory dimension of anxiety was added to the two intensity-oriented dimensions of cognitive and physiological anxiety, as an explicit reflection of the regulatory capacity involved in the dynamics of anxiety. Consequently, the model comprises three main anxiety dimensions: the cognitive dimension, consisting of worry and self-focused attention (labeled as self-focus hereafter); the physiological dimension, consisting of autonomous hyperactivity and somatic tension; and the regulatory dimension, represented by perceived control.

As an initial stage of model development, psychometric evidence by confirmatory factor analysis (CFA) showed support for the factorial validity of the measurement and structural models as a three-dimensional first order model, rather than a hierarchical five-dimensional structure. This support was obtained through five independent samples (involving English and Chinese participants) across a wide range of sports and skill levels. According to these findings from CFA, this newly proposed comprehensive framework of performance anxiety is best presented by three factors, i.e., cognitive anxiety, physiological anxiety, and the regulatory dimension of anxiety (perceived control). The differentiation between the cognitive subcomponents of worry and self-focus, and between the physiological subcomponents of autonomous

hyperactivity and somatic tension thus remains only at a descriptive level until significant empirical separation is revealed (For more details, see Cheng, Hardy & Markland, 2007a, in submission; 2007b, in preparation).

Research using the Competitive State Anxiety Inventory-2 (CSAI-2; Martens et al., 1990) to investigate anxiety-performance dynamics has shown some equivocal results. In particular, the performance variance accounted for by cognitive anxiety (worry) and somatic anxiety has been less than expected. It is thus unsurprising that the predictive power of cognitive and somatic anxiety has been relatively low and inconsistent. More specifically, multidimensional anxiety theory (Martens et al., 1990) predicted that cognitive anxiety and self-confidence would be stronger predictors of performance as symptoms of somatic anxiety were found to decrease at the onset of competition. However, empirical studies using the CSAI-2 showed contradictory results (Gould, Petlichkoff, Simons & Vevera, 1987; Edwards & Hardy, 1996; Swain & Jones, 1996), and some even failed to show any significant relationship at all (Krane & Williams, 1987; Martin & Gill, 1991; Krane, William & Feltz, 1992). Despite the incompatibility in these findings, the subscale of self-confidence in the CSAI-2 appeared to be the most reliable predictor of performance (Woodman & Hardy, 2003; Hardy, 1996; Craft, Magyar, Becker & Feltz, 2003; Jones, Swain & Hardy, 1993; Swain & Jones, 1996).

Apart from the fact that self-confidence has a fairly direct link with perceived control as both are concerned with goal-attainment, research on the interpretation of anxiety symptoms (Jones, 1991, 1995) is also consistent with the above line of reasoning. The directional perceptions of anxiety, i.e., symptom interpretation as

facilitative or debilitative was proposed to provide further understanding of the competitive state anxiety response (Jones & Swain, 1992; Jones, Swain & Hardy, 1993; Jones & Swain, 1995; Swain & Jones, 1996). The directional interpretation of anxiety is clearly relevant here as Jones' model was derived from Carver and Scheier's (1986, 1988) control-process perspective on anxiety. The interpretation of anxiety symptoms was proposed to be a reflection of perceived control (Jones, 1995) or moderated by perceived control (Hanton & Connaughton, 2002; Hanton, O'Brien & Mellalieu, 2003). Moreover, Swain and Jones (1996) showed that the direction of cognitive and somatic anxiety accounted for 23.4% and 17% of performance variance respectively, whereas the intensity of cognitive anxiety accounted for 18.4% (in an inverted-U relationship) and the intensity of somatic anxiety accounted for only 2%. Collectively, perceived control in the current three-dimensional model is hypothesized to be a crucial element in predicting anxiety-performance relationship as this component may relate more closely than other anxiety components to the effects of anxiety on performance. It is anticipated that the complicated relationship between anxiety and performance would better be revealed with this additional anxiety component of perceived control.

Another important issue contributing to the prediction of the anxiety-performance relationship is the interactive influence of anxiety subcomponents upon performance. As long ago as the 1960s, research in test anxiety revealed interactive effects for worry and emotionality upon performance (Liebert & Morris, 1967; Doctor & Altman, 1969). In sport anxiety, Fazey and Hardy (1988) proposed a cusp catastrophe model of anxiety and performance. One of the main characteristics of this model was the consideration of interactive effects of anxiety

subcomponents. Hardy (1990) has argued that multidimensional anxiety theory assumes that the effects of the different subcomponents are addictive, and it is a fundamental problem as the theory attempts to examine a four-dimensional relationship between cognitive anxiety, somatic anxiety, self-confidence and performance in a series of two-dimensional relationships. It is suggested that interactive effects of anxiety variables may offer insight and explain further the anxiety-performance relationship (Jones, 1995; Edwards & Hardy, 1996; Hardy, 1996).

The cusp catastrophe model has offered the only specific prediction on the interactive pattern of anxiety variables, i.e., cognitive anxiety (worry) and physiological arousal. More specifically, a divergent form of interaction (see Figure 1) was hypothesized that low physiological anxiety would be associated with better performance than high physiological anxiety, and this discrepancy in performance between low and high physiological anxiety would increase as cognitive anxiety increases. However, this specific interaction pattern has not always been confirmed (Edwards & Hardy, 1996; Hardy, Woodman & Carrington, 2004). In more detail, Edwards et al. (1996) investigated 45 female netball players competing at the level of university, regional or local league, and found a significant cross-over interaction of cognitive and physiological arousal (Figure 2). This result showed that low physiological arousal may not be associated with better performance than high physiological arousal, particularly as cognitive anxiety decreases, which is inconsistent with the prediction by the catastrophe model. Furthermore, a recent study (Hardy et al, 2004) examined eight male golfers of medium handicaps (M = 12, SD = 5) and obtained two interactive patterns of cognitive anxiety x somatic anxiety under

the conditions of high and low self-confidence. In the condition of low self-confidence, a divergent interaction of cognitive and somatic anxiety (see Figure 3) emerged in the fashion as predicted by the catastrophe model. However, in the condition of high self-confidence, another divergent, although very different, interactive pattern (see Figure 4) was revealed that high (rather than low) somatic anxiety was generally associated with better performance, and the difference in performance became larger as cognitive anxiety increases, which again is inconsistent with the prediction of the catastrophe model.

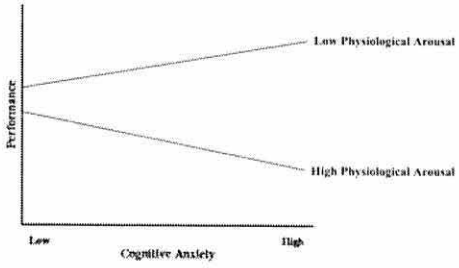

Figure 1 - Interaction of cognitive anxiety and physiological arousal

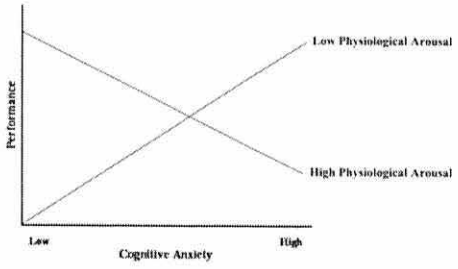

Figure 2 - Interaction of cognitive anxiety and physiological arousal

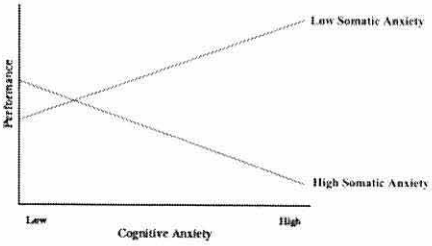

Figure 3 - Interaction of cognitive anxiety and somatic anxiety under the condition of low self-confidence

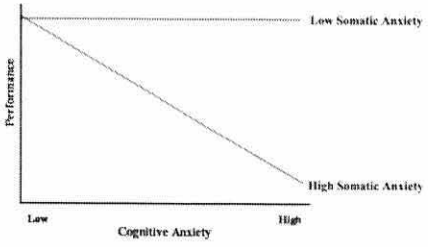

Figure 4 - Interaction of cognitive anxiety and somatic anxiety under the condition of high self-confidence

Taken together, the interactive effect of anxiety variables appeared to be more diversified than expected. Contextual variables (e.g., sport type, skill level, competition importance, etc.) are likely to play an influential role in predicting the anxiety-performance relationship. Perhaps it is not realistic to predict the complex anxiety-performance relationship through merely a single specific pattern of interaction across all diversified contexts. It may be more logical to expect that there would be variations in the interactive patterns of anxiety variables if the context is different. Given the complexity of the present model, it allows for the possibilities of three 2-way (cognitive anxiety x physiological anxiety, cognitive anxiety x perceived control, or physiological x perceived control) and one 3-way (cognitive anxiety x physiological anxiety x perceived control) interactions. In keeping with the potential of interactive effects of anxiety in predicting anxiety-performance, it is anticipated that the interactions of anxiety variables would significantly account for additional performance variance over and above main effects of anxiety. However, these four possible interactions may not all emerge to be significant predictors as contextual variables would likely to be crucial. Nevertheless, the current tae-kwon-do sport under investigation is a contact sport that requires instant physical strength/power and the coordination of large-unit (as opposed to fine) motor control, and also concerns possible physical harm. Under a sport of such a nature, physiological anxiety might impact on performance more than cognitive anxiety. Consequently, it is anticipated that a divergent form of significant interaction involving physiological anxiety and perceived control would probably occur in the context of this study. Generally, high perceived control would be associated with better performance than low perceived control despite the level of physiological anxiety, but the specific pattern in relation to the impact of physiological anxiety under high and low perceived control upon

performance is not predicted as previous research showed inconsistent data in different contexts (Edwards & Hardy, 1996; Hardy et al., 2004). As a result, the exact form regarding the predicted divergent interaction of anxiety variables remains of some exploratory nature in this initial model testing.

In sum, the objective of the present study was to examine the preliminary predictive validity of the three-dimensional model of performance anxiety. The following hypotheses were tested:

1. Perceived control would account for significant additional variance in performance over and above that accounted for by the cognitive and physiological components of anxiety.
2. The interactive effects upon performance among anxiety subcomponents would significantly account for additional performance variance over and above main effects of anxiety.
3. Although the four possible (three 2-way and one 3-way) interactive effects of anxiety variables may not all emerge to be significant, it was hypothesized that a significant divergent form of interaction involving physiological anxiety and perceived control may occur in the present context of tae-kwon-do sports. Nevertheless, other than the assumption that high perceived control would generally be associated with better performance than low perceived control despite the level of physiological anxiety, the specific interactive pattern of perceived control x physiological anxiety upon elite level of Taiwanese tae-kwon-do sports performance remains exploratory.

To enhance the present investigation of predictive validity, some methodological issues were considered. In particular, an individual, contact, and subjectively scored sport, i.e., tae-kwon-do, was targeted for several reasons. First, such a sport type has been suggested to evoke greater changes in and higher levels of pre-competitive anxiety than team, non-contact and objectively scored sports (Martens et al., 1990). Second, the overall duration of a complete tae-kwon-do contest is relatively short (about 10 minutes) so that the variation in anxiety levels between pre- and within-competition should be minimized. Given that it is practically impossible to measure anxiety during performance, the anxiety state measured before such a sports competition may show a better predictive power with regard to subsequent performance than would be the case with other sports of longer duration. Furthermore, in order to produce better prediction, a sensitive performance measure was utilized, as absolute performance outcome (e.g., win/loss) is rather global and lacks precision (Gould et al., 1987; Parfitt, Jones & Hardy, 1990; Jones, 1995; Butt, Weinberg & Horn, 2003; Hardy, Woodman & Carrington, 2004; Hardy & Hutchinson, 2007). Hence, following Hardy and Hutchinson's (2007) recommendation, a composite measure of optimal tae-kwon-do performance was developed and utilized in this investigation to tap better the sensitive relationship between anxiety and performance.

Method

Participants

The participants were all university-based tae-kwon-do athletes, who attended the major contest of Taiwan University Sports, which was the most important and largest-scale annual competition for all university sports in Taiwan. There were two (highly- vs. less-skilled) levels of sports ability involved in this tae-kwon-do

competition. Only those competing at the highly-skilled level were included in the present study, which comprised the students who majored in tae-kwon-do and trained daily for several hours. Considering that skill level is a performance-related individual difference variable that may exert a significant effect in the context of anxiety and performance (Jones, Swain & Hardy, 1993; Jones, Hanton & Swain, 1994; Jones & Swain, 1995), this subgroup of a very high standard was targeted because these athletes would be more aware of their stress states and have a better capacity to assess their own performance than would performers at a less-skilled level, who were only amateur, club performers of tae-kwon-do and practiced for only a few hours weekly. A total of 99 participants from sports majoring departments of seven universities in Taiwan, with both genders (N for Male = 54, Female = 45), were included in this study. Approximately 37.4% of the participants were international competitors, and many of them (n = 15) have won medals in the world-class contests. The mean age of participants was 20.51 years (SD = 1.72), which was compatible between two genders (Male = 20.61, SD = 1.88; Female = 20.78, SD = 1.51). All participants and the team coaches were contacted and briefed on the objective of the study by the first author two weeks prior to the competition. Consent to take part in the study was confirmed by each participant.

Measures

Two measures were employed in the present study: a prospective measure of three-dimensional state performance anxiety and a retrospective self-assessment of tae-kwon-do sport performance.

Anxiety Measure. The measure of performance anxiety based on the three-dimensional framework was developed previously in both English and Chinese, with support for factorial validity of both versions (for more details, see Cheng, Hardy & Markland, 2007a, in submission; 2007b, in preparation). The Chinese version of the measure was used in this investigation with a total of 21 items (see appendix B for this Chinese measure in Chinese, and appendix C for an English translation of the measure items). The cognitive dimension comprised 10 items (with 4 items for worry and 6 for self-focus), the physiological dimension had 7 items (with 4 for autonomous hyperactivity and 3 for somatic tension), and the regulatory dimension (i.e., perceived control) had 4 items. All items were measured on a five-point Likert scale, from 1 (*totally disagree*) to 5 (*totally agree*). The internal consistency of the three subscales was assessed by Cronbach's (1951) alpha reliability coefficient. Good internal consistency was revealed, with alpha ranging from .78 to .87 in the previous validation studies (Cheng, Hardy & Markland, 2007a, 2007b), and ranging from .85 to .86 in the present sample.

Performance Measure. A self-assessment measure of tae-kwon-do sport performance was developed for the present study (cf., Hardy & Hutchinson, 2007). A total of six performance criteria were included after consulting with the former 2004 Olympic coach for the Taiwan tae-kwon-do team that won two gold and one silver Olympic medals, as well as several senior head coaches and internationally-licensed referees in Taiwan. The study participants were asked to retrospectively rate their level of performance with respect to their current capacity and personal expectations. Their level of performance was rated on a 10-point Likert scale, from 1 (*least satisfactory*) to 10 (*highly satisfactory*). The six self-assessed performance dimensions

were: (a) attacking aggressively and effectively, (b) fighting back efficiently, (c) putting personal effort into optimal performance, (d) employing effective competitive strategies, (e) physical energy and strength, and (f) reacting appropriately to all competitive situations. The total score of this composite measure of overall playing performance, ranging from 6 to 60, was used as the predictor/dependent variable for analysis. In addition, this six-item measure showed good internal consistency, as assessed by Cronbach's alpha ($\alpha = .85$) for the present sample.

Procedure

All participants were briefed regarding their involvement in the field study two weeks before the contest, and briefed again on the procedure one day before their competition. The tae-kwon-do games lasted for four days with matches from round one up to round five if performers continue to win. Round one was specifically targeted so that data could be collected from all participants. They were asked to complete the measure of anxiety 30 minutes before their first round match. Within 30 minutes after they finished their match, the self-assessed performance measure was administered. Confidential treatment of the participants' responses was guaranteed. All questionnaires were anonymous, and administered by a small group of trained research assistants, who were familiar with tae-kwon-do and therefore had a better capacity for building good rapport with participants under the stressful circumstances.

Data Analysis

To investigate the predictive validity of the three-dimensional model upon performance, moderated hierarchical multiple regression was used. To prevent false correlations, t-tests were conducted prior to the regression analyses to examine

possible gender effects (Jones, Swain & Cale, 1991; Edwards et al., 1996; Swain et al., 1996) in the independent (the scores of the three subscales of performance anxiety measure) and dependent variables (tae-kwon-do performance scores). The data from the three anxiety subscales were then centered before forming the cross-product terms in order to remove the potential problem of multicollineality in interactive models (Cronbach, 1987; Jaccard, Turrisi & Won, 1990). A total of seven independent variables were then entered separately in seven blocks, in the order of the three main effects (cognitive anxiety, physiological anxiety, and perceived control), followed by the 3 two-way interactive terms (cognitive anxiety x physiological anxiety, perceived control x cognitive anxiety, and perceived control x physiological anxiety), and finally the three-way interactive term (perceived control x physiological anxiety x cognitive anxiety).

Results

Correlational analysis was initially utilized to identify zero-order relationships among variables. Table 1 shows the intercorrelations among the scores of the anxiety subscales and tae-kwon-do self-assessed performance score. The largest correlation among independent variables was of a moderate size, between the cognitive and physiological dimensions ($r = .56$, $p < .001$). The component of perceived control was negatively related to the physiological component ($r = -.37$, $p < .001$), and non-significantly related to the cognitive component ($r = -.13$, $p = .10$). With regard to the correlations between performance and the anxiety subcomponents, perceived control was most strongly related to performance ($r = .46$, $p < .001$).

Table 1. Intercorrelations of Three Subscales of Performance Anxiety and Performance.

	2	3	4
1. Performance	.460**	-.090	.035
2. Perceived control		-.370**	-.129
3. Physiological anxiety			.560**
4. Cognitive anxiety			

**$p < .001$.

No significant gender difference was detected using t-tests in any of the independent and dependent variables. All the data were thus standardized (Cronbach, 1987; Jaccard, Turrisi & Won, 1990) within the whole sample prior to performing a moderated hierarchical regression analysis to prevent multicollineality in interactive terms. The total performance variance explained by the whole model was 36.9%, $F(7, 91) = 7.59$, $p < .001$. A summary of the results from seven sub-models is presented in Table 2, including the total performance variance accounted for (R^2) by each of the seven models, and the additional performance variance accounted for ($R^{2\ change}$) by each predictor (i.e., three single variables, three two-way interactive variables, and one three-way interactive variable).

Table 2. Summary of Moderated Hierarchical Regression Models Predicting Performance.

Model	Predictor added into the model	R	R^2	$R^{2\ change}$	F change
1	Cognitive anxiety	.035	.001	.001	.118
2	Physiological anxiety	.137	.019	.018	1.722
3	Perceived control	.472	.222	.204**	24.872**
4	Cognitive anxiety **x** Physiological anxiety	.485	.235	.013	1.594
5	Perceived control **x** Cognitive anxiety	.488	.238	.003	.361
6	Perceived control **x** Physiological anxiety	.595	.354	.116**	16.517**
7	Perceived control **x** Physiological anxiety **x** Cognitive anxiety	.607	.369	.014	2.067

**p <.001

The component of perceived control accounted for an additional 20.4% of performance variance, $F(1, 95) = 24.87$, $p < .001$, over and above the variance accounted for by cognitive and physiological anxiety. Cognitive anxiety accounted for only 0.3% of the performance variance, $F(1, 97) = .12$, $p = .732$; and physiological anxiety explained only an additional 1.8%, $F(1, 96) = 1.72$, $p = .193$, over and above cognitive anxiety. Support was therefore found for the first hypothesis that the component of perceived control would significantly account for additional variance in

performance over and above that accounted for by cognitive and physiological anxiety.

The interactive effect of perceived control x physiological anxiety accounted for an additional 11.6% of performance anxiety, $F(1, 92) = 16.52$, $p < .001$, over and above three main effects and the other two two-way interactive effects of the anxiety variables. In detail, the remaining two-way interactions respectively accounted for only an additional 1.3% of performance variance, $F(1, 94) = 1.59$, $p = .210$ (cognitive anxiety x physiological anxiety) and 0.3% of performance variance, $F(1, 93) = .36$, $p = .549$ (perceived control x cognitive anxiety). Finally, a unique 1.4% of performance variance was explained by the three-way interaction of perceived control x physiological x cognitive anxiety, $F(1, 91) = 2.07$, $p = .154$. Nevertheless, results showed support for the second hypothesis that the interactive effects of anxiety variables would significantly account for additional performance variance over and above main effects of anxiety.

In addition, Table 3 presents the beta coefficients for seven predictors included in the final model. Significant beta coefficients in the final model included perceived control ($\beta = .406$, $t = 3.935$, $p < .001$), cognitive anxiety ($\beta = .317$, $t = 2.728$, $p = .008$), and the interaction of perceived control x physiological anxiety ($\beta = -.384$, $t = -3.598$, $p = .001$). The results imply that all three anxiety variables, i.e., perceived control, physiological anxiety and cognitive anxiety, may potentially impact on the prediction of performance, despite the finding that cognitive anxiety explained rather little performance variance in the present context.

Table 3. Betas of Seven Predictors in the Final Model of Moderated Hierarchical Regression Analysis.

Seven predictors in the final model	Beta
Cognitive anxiety	.317*
Physiological anxiety	-.052
Perceived control	.406**
Cognitive anxiety **x** Physiological anxiety	.095
Perceived control **x** Cognitive anxiety	.086
Perceived control **x** Physiological anxiety	-.384**
Perceived control **x** Physiological anxiety **x** Cognitive anxiety	.159

*$p < .01$. **$p < .001$

Among the four possible two- and three-way interactions, only one interaction emerged, i.e., perceived control x physiological anxiety, as the only significant predictor of elite tae-kwon-do performance (Figure 5). Consequently, some support was revealed for the third hypothesis that a significant divergent interaction involving perceived control and physiological anxiety may occur under this particular study context.

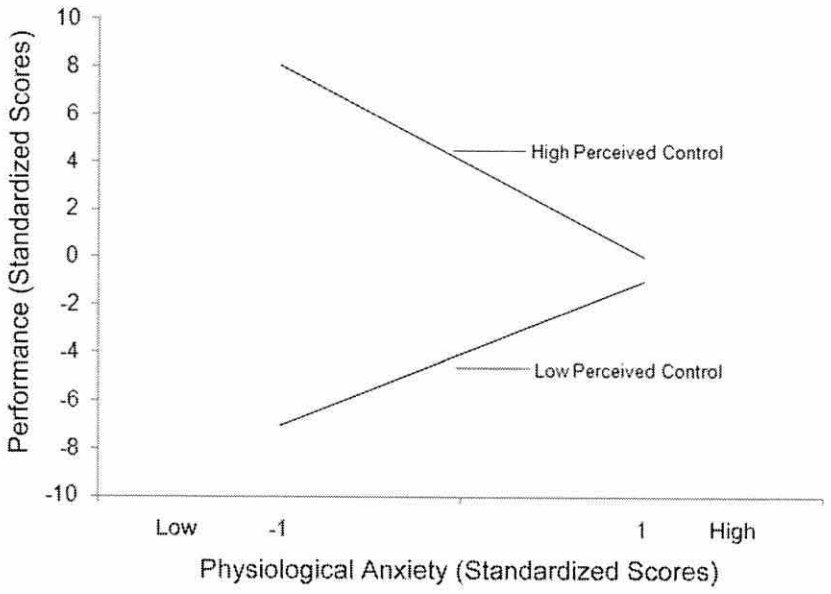

Figure 5 - Interaction of Perceived Control and Physiological Anxiety

Discussion

This study aimed at examining the predictive validity of the proposed three-dimensional model of performance anxiety. The main characteristic of this model is that a regulatory dimension, represented by perceived control, is included to explicitly reflect an adaptive capacity underlying anxiety in addition to the conventionally intensity-oriented components of cognitive and physiological anxiety. In keeping with the assumptions of this conceptual framework, three hypotheses were tested in this investigation: (a) perceived control would significantly account for additional variance in performance over and above that accounted for by cognitive and physiological anxiety, (b) the interactive effects upon performance among anxiety variables would significantly account for additional performance variance over and above main effects of anxiety, and (c) a significant divergent form of interaction

involving physiological anxiety and perceived control may occur in the present context of tae-kwon-do sports performance, although the interactive pattern was not further specified. The current findings revealed initial support for the first two predictions, and some support was also found for the third hypothesis.

Prior empirical research concerning competitive anxiety and performance predicted a relatively small amount of performance variance (Edwards & Hardy, 1996; Martens et al., 1990; Jones, 1995; Woodman & Hardy, 2001). In general, previous studies have accounted for less than 20% of performance variance using the factors of worry, somatic anxiety and self-confidence as measured by the CSAI-2, and less than 25% explained by the directional interpretation of anxiety symptoms using the CSAI-2d (Swain & Jones, 1996; Edwards & Hardy, 1996). In the present study, a total of 36.9% of performance variance was accounted for by the three-dimensional model with 7 predictors (three single components of perceived control, physiological anxiety, and cognitive anxiety; three two-way interactions, as well as one three-way interaction). The current data may imply that the perplexed relationship of anxiety and performance would be better predicted by a more sophisticated model, such as the proposed three-dimensional framework with two- and three-way interactive effects as well as single (main) effects of anxiety variables.

Consistent with the first hypothesis, perceived control accounted for an additional 20.4% of performance variance ($p < .001$), over and above cognitive and physiological anxiety, and appeared to be the best predictor, with the biggest and most significant beta of all in the final model (see Table 3). This is also in line with previous research that the control-related constructs of self-confidence and directional

anxiety may be better predictors in performance (Woodman & Hardy, 2003; Craft et al, 2003; Jones et al., 1993; Edwards & Hardy, 1996; Jones, 1995; Swain & Jones, 1996; Hardy, 1996; Butt, Weinberg & Horn, 2003). These findings are of direct relevance to the construct of perceived control as it was measured in the present study in that self-confidence concerns goal-attainment, and directional anxiety is an indicator of, or moderated by perceived control (Jones, 1995; Hanton & Connaughton, 2002; Hanton, O'Brien & Mellalieu, 2003). Empirically, it appears that the predictive power of anxiety on performance would be relatively low without considering the element of perceived control.

From zero-order correlational analysis, the correlation patterns among the three anxiety dimensions, ranged from .56 to -.13 (see Table 1). These prospective data were consistent with the previous retrospective CFA studies (Cheng, Hardy & Markland, 2007b, in preparation). In particular, the near zero correlation between perceived control and cognitive anxiety in Chinese Samples 2-3 that were characterized by high-skilled level was revealed again in this sample of elite athletes. On the intercorrelation between performance and anxiety dimensions, perceived control was positively related to performance ($r = .46, p < .001$). This suggests that high perceived control can be more facilitative to performance than low perceived control, in line with the assumption of this three-dimensional model and the suggestion that self-confidence may protect against potential debilitative anxiety effects (Hardy, 1990, 1996; Jones et al., 1994). A similar trend was revealed in the two-way interactive effect of perceived control and physiological anxiety (see Figure 5). The data showed that high perceived control was associated with better performance than low perceived control despite the level of physiological anxiety

being high or low; notwithstanding this fact, such differences may diminish as physiological anxiety increases (and low perceived control might eventually even be associated with better performance than high perceived control). Although this is rather counterintuitive, there are some potential explanations.

First, from a perspective of repressive coping style, individuals (repressors) may exhibit repressive behavior as a defensive strategy, and may regulate their emotional responsiveness to psychologically distance themselves from perceived situational threats to self-concept, in not only negative but also positive emotional contexts (Mendolia, 2002). Therefore, it may be that reporting perceived control as low could result in a potential calming effect from not only lowering down the expectation (and eagerness) for success, but also from accepting the possibility of failure. To be more specific, when performers come to truly accept the possibility of failure, they may regain their focus on tasks at hand as they may perceive that there is nothing to lose, which may lead to stabilized or even enhanced performance.

Second, the effect of over-confidence may offer another interpretation. Some evidence was revealed regarding a potentially negative relationship between self-confidence and performance (Gould et al., 1987; Swain & Jones, 1996). It was suggested that over-confidence may lead to low motivation, and in particular, may cause insufficient concentration or effort (Swain & Jones, 1996). These may imply that the relationship of perceived control and performance may not be as straightforward as it may seem, given the close link between self-confidence and perceived control in the present model. As physiological anxiety increases, the beneficial effects of high perceived control upon performance appear to diminish,

possibly due to a repressive coping mechanism or over-confidence effect. Interestingly, this highlights one of the fundamental arguments addressed earlier that "positive states" (e.g., perceived control, self-confidence or excitement) may not always lead to positive effects on performance (Cheng, Hardy & Markland, 2007a, in submission).

The interactive effect of perceived control and physiological anxiety was the only significant interaction, accounting for an additional 11.6% of performance variance over and above all main effects and the remaining two-way interactive effects. This was consistent with the second and third hypotheses. Furthermore, as addressed earlier regarding the third hypothesis, a diverting form of interaction involving perceived control and physiological anxiety was predicted in this particular context of tae-kwon-do sport, but the interactive pattern of physiological anxiety x perceived control was not further specified for some reasons. First, contextual variables (e.g., sport type/task demand, skill level, etc.) were likely to affect the patterns of interactive effects of anxiety variables upon performance. Second, empirical data has showed inconsistent forms of interaction (e.g., cognitive anxiety x physiological anxiety) upon performance in different contexts (Edwards & Hardy, 1996; Hardy et al., 2004). More specifically, the effects (facilitative vs. debilitative) of physiological anxiety upon performance under different conditions of cognitive anxiety or self-confidence were not consistent across contexts. Consequently, it was considered logical that the specific interactive form involving perceived control x physiological anxiety in this study context remained to be explored.

Unsurprisingly, the interactive pattern revealed in this study (see Figure 5) was obviously different from the previous findings under different study contexts (see Figures 1-4). In particular, the present results showed that although high perceived control would generally be associated with better performance than low perceived control despite the level of physiological anxiety, its beneficial effect upon performance would decrease as physiological anxiety increases. In addition, it seemed particularly damaging to performance when physiological anxiety and perceived control were both low. Speculatively, the factor of motivation may offer some possible explanation. It may be that individuals who lack perceived control and are less aroused (low physiological anxiety) may be least motivated to mobilize resources (e.g., effort) to perform the task at hand, which could lead to impaired performance. More research is certainly desirable to substantiate the above reasoning.

Based on previous methodological criticisms (Gould et al. 1987; Jones, 1995; Edwards & Hardy, 1996), several design factors were included in this study to better examine the complex anxiety-performance dynamics. First, a fundamental problem was identified with multidimensional anxiety theory in that it attempts to explain a four-dimensional relationship between cognitive anxiety, physiological anxiety, self-confidence and performance in a series of two-dimensional relationship (Hardy, 1990). This study examined a series of interactive as well as single (main) effects in the same regression model so that an integrated trend could be revealed.

Second, although the definition of performance still lacks of consensus, it was considered that the absolute outcome measure (win vs. loss) was not the best criterion as a dependent variable (Parfitt et al., 1990; Jones, 1995). Some composite forms of

performance assessment have been suggested (Sonstroem & Bernardo, 1982; Hagvet & Ren-Ben, 1992; Edwards & Hardy, 1996; Gould et al., 1987; Burton, 1988; Hardy et al., 2004; Hardy & Hutchinson, 2007). A composite performance measure was therefore developed for this study, using six criteria that pertain to optimal tae-kwon-do performance, in order to improve the evaluation of the impact of anxiety on performance. Nevertheless, a self-assessed measure of performance may be argued as being subjective and possibly affected by personal emotional states or social desirability. This appears not to be an issue in the present study as the correlation patterns between performance and each of the anxiety variables (i.e., perceived control, physiological and cognitive anxiety) were not consistent as would be expected in such circumstances. Moreover, affective confounding cannot account for the existence of the significant interaction of perceived control x physiological anxiety upon performance.

Third, as task demands (Hanton, Jones & Mullen, 2000; Swain & Jones, 1996; Martens et al. 1990) and competition or skill level (Jones et al., 1993; Jones et al., 1994; Jones & Swain, 1995; Hanton & Jones, 1995, 1997) may have different impact on anxiety-performance relationship, only one specific sport and elite level performers, from international (approximately 37.4 % of participants) to national (62.6%), were targeted in the present study. Furthermore, pre-competitive anxiety was measured due to practical impossibility of assessing during-competitive anxiety. The sport of tae-kwon-do was considered advantageous as this was an individual contact sport with rather short duration so that the temporal variation in anxiety states may be minimized.

Lastly, it was worth noting the limitation of the present research. The findings of this study were obtained solely from Chinese (Taiwanese) participants as an initial model testing. Cultural differences have emerged in other disciplines of sport psychology (Duda, 1986; Duda & Allison, 1989), and thus have been suggested to be a potential variable that may impact the anxiety-performance relationship (Edwards & Hardy, 1996). Consequently, future cross-cultural studies particularly utilizing English speaking participants from Western society are necessary as part of the ongoing processes of the model development and measurement validation.

In conclusion, the present findings provide initial support for the predictive validity of the three-dimensional model in the context of competitive Taiwanese tae-kwon-do performance. The addition of a regulatory dimension, perceived control, as part of performance anxiety has been shown to be useful for the prediction of the anxiety-performance relationship. Apart from perceived control, the interactive effect of perceived control x physiological anxiety was also influential as hypothesized in this study. Considering contextual variables are likely to influence the patterns of interactions of anxiety variables upon performance, the particular pattern of interaction in the present context of highly-elite level of tae-kwon-do sports was exploratory in nature. Future research is needed to confirm the current results under the same context. It is certainly favorable to further test this model across different contexts given that variations of interactive patterns would likely emerge. The prediction of the anxiety-performance relationship may be enhanced by the establishment of the differential patterns of anxiety effects upon performance across contexts. Undoubtedly, the three-dimensional conception of performance anxiety is more complicated than previous two dimensional conceptualizations. But as Jones

(1995) has pointed out; although researchers in sport psychology have had a preference for using simple anxiety models, these models may not be very helpful in understanding performance under stress. It is necessary to develop more sophisticated models in order to extend understanding of the complex anxiety-performance phenomena. Indeed, Eysenck and Calvo (1992) suggested that future theories of anxiety and performance need at least to address the complexity and inconsistency of previous findings. Given the fact that more complicated models of anxiety have already been proposed in other areas of psychology (e.g., Schwarzer & Jerusalem, 1992; Rost & Schermer, 1992b; Carver & Scheier, 1988; Ohman, 2000; Matthews et al., 2002), and empirical data in sport anxiety research has not been fully satisfactory, the present three-dimensional framework has shown some preliminary potential with regard to explanatory and predictive power. This model allows for the possibilities of two- and three-way interactions as well as main effects of anxiety variables upon performance. At an applied level, interventions would be more effective by taking into consideration the element of perceived control and the interaction of perceived control and physiological anxiety (particularly for the elite level of tae-kwon-do performers). To sum, this model broadens the conceptualization of performance anxiety by incorporating a regulatory-oriented dimension into anxiety in the domain of sports psychology. The effects of anxiety upon performance appear to be better unfolded through the factor of perceived control and the interplay of anxiety elements. Of particular importance, more tests of this model under various contexts are necessary to further the understanding of the intricate anxiety-performance dynamics.

Chapter 5

General Discussion

Summary of Thesis

The objective of this final chapter is to summarize the highlights of the thesis including the conceptual work and empirical findings. The theoretical and applied implications of the research are addressed. Furthermore, strengths and limitations of the thesis are discussed. Finally, recommendations for future directions and relevant research questions are provided.

Chapter 1 and Chapter 2 describe the conceptual arguments of fundamental concern and offer a definition of the anxiety construct. Several lines of reason underlying the re-conceptualization of performance anxiety are presented in detail.

It is recognizable that both conceptual and methodological advances have been made in examining the anxiety-performance relationship. It is worth giving further consideration to some theoretical propositions that have shown potential to better approach the complex performance anxiety phenomena in the sports domain, i.e., the role of self-confidence raised in multidimensional anxiety theory (Martens et al., 1990), the interactive effects of anxiety variables emphasized in the catastrophe model (Hardy, 1996), and the notion of directional interpretation of anxiety proposed in Jones' control model (Jones, 1995). More specifically, multidimensional anxiety theory has enabled researchers to move anxiety research beyond the uni-dimensional inverted-U arousal hypothesis. The catastrophe model has taken a step forward towards revealing that the interactive effects of cognitive and physiological (or somatic) anxiety may offer a better explanation of anxiety effects than main effect models of performance anxiety. Finally, the directional interpretation dimension is important in pointing out that the intensity of anxiety symptoms is not sufficient to

predict anxiety-performance dynamics, and that the notion of control deserves serious consideration. However, there remain equivocal findings, as well as theoretical debates regarding the definition of anxiety and the causes of facilitative performance effects. Consequently, the effort to develop an integrated conceptualization of performance anxiety was attempted from an extensive review of literature on theories of anxiety and performance in the sport and other fields of psychology.

One rationale underlying the proposed conceptual model of performance anxiety is that the nature of anxiety can be adaptive, as opposed to the proposition made by some researchers in sport psychology that anxiety is merely maladaptive (producing negative effects) and positive effects on performance are derived only from other mislabeled positive emotional states (Jones, Hanton & Swain, 1994; Jones, 1995; Burton & Naylor, 1997; Jones & Hanton, 2001; Hanton, Mellalieu & Hall, 2004). As addressed in detail earlier (Chapter 2), the inclusion of the additional element of perceived control as a representation of the regulatory dimension in anxiety is in accordance with much of the previous literature. Furthermore, based on the development of multidimensionality in test anxiety, cognitive anxiety has been broadened to incorporate self-focused attention consistent with several lines of conceptual argument (Wicklund, 1991; Gibbons, 1990; Carver & Scheier, 1988; Schwarzer & Jerusalem, 1992) and empirical evidence (Derakshan & Eysenck, 2001; Liao & Masters, 2002; Lewis & Linder, 1997). In the same vein, physiological anxiety has included two subcomponents of autonomous hyperactivity and somatic tension, according to anatomical structure, mainly adopted from a clinical perspective (Ohman, 2000), e.g., the criteria used for generalized anxiety disorder in

the DSM-III-R (APA, 1987). Taken together, this comprehensive model of performance anxiety is based on a broad cognitive perspective of emotion. The proposed framework contains three main dimensions, with the cognitive dimension of anxiety composed of worry and self-focus, the physiological dimension of anxiety composed of autonomous hyperactivity and somatic tension, and the regulatory dimension of anxiety represented by perceived control.

The second half of Chapter 2 as well as Chapter 3 presents the measurement development as a first step towards subsequent tests of the conceptual framework. The measurement of performance anxiety, consistent with the theoretical model, was developed and initially validated through confirmatory factor analyses (CFA). Two versions of the performance anxiety measure were established in English (with two studies) and Chinese (the next three studies). Although these two measures were not exactly the same (e.g., scale length, item content), both measures were considered comparable as they were based on the same conceptual model and definitions developed by the same researchers, with sufficient understanding and knowledge concerning both cultures, specifically British and Taiwanese. More importantly, the replication of major factor structure was confirmed between two measures, suggested as a necessary indication for conceptual equivalence of measures across cultures (Leung & Wong, 2003; Butcher et al., 2003). Both scales were relatively short for practical purposes. The factor loadings of all items were significant, and internal consistencies of both measures were examined using Cronbach's reliability coefficient. Throughout the five CFA studies, the factorial validities of the measurement and structural models in the two cultures supported a first-order three-dimensional model, rather than a hierarchical five-dimensional structure, in which worry and self-focus

merged into a single dimension of cognitive anxiety and autonomous hyperactivity and somatic tension merged into one dimension of physiological anxiety.

Chapter 4 reports a predictive study (Study 6) that was conducted as a preliminary test of the model in the highly competitive context of Taiwanese tae-kwon-do sports, using the Chinese version of the performance anxiety measure. Three predictions with respect to the three-dimensional framework were generally supported in this study. In particular, perceived control was shown to be the best predictor, significantly accounting for an additional 20.4% of performance variance over and above cognitive and physiological anxiety, and the interaction of perceived control and physiological anxiety significantly made an additional contribution of 11.6% of the variance in performance over and above main effects of anxiety.

Theoretical Implications

The findings in the predictive study (Chapter 4) supported the hypothesis that perceived control is the most important anxiety variable in predicting performance. Both its single (main) effect and its interactive effect with other anxiety variables substantially contributed a major portion of the variance in performance anxiety accounted for by the model. These results suggest that the regulatory capacity involved in anxiety is potentially much more influential in predicting the effects of anxiety upon performance than other symptom-oriented components of anxiety. This may well provide some explanation for why previous research findings of anxiety and performance based on the two-component (worry and emotionality) model of anxiety (using mostly the CSAI-2) have generally showed relatively disappointing predictive power. Overall, the findings provide preliminary support for the predictive

potential of this three-dimensional model, and thus the complex relationship of anxiety and performance may be better unfolded by the interactive as well as single effects of the three anxiety dimensions.

However, it is worth pointing out that the inclusion of perceived control as an anxiety element may seem counterintuitive at first sight. One may argue that perceived control relates to the notion of coping, a separate concept on its own. In addition, the relationship between anxiety and efficacy expectancy has been debated inconclusively by anxiety theorists (e.g., Bandura, 1988; Eysenck, 1992; Schwarzer & Jerusalem, 1992). Nevertheless, in direct relevance to the present three-dimensional framework, Schwarzer and Jerusalem (1992) suggested integrating self-efficacy (a construct closely linked to perceived control concerning goal attainment) into anxiety. Furthermore, Mathews (1992) viewed it as a cognitive mechanism involved in maintaining or perhaps causing the anxiety itself rather than as a method of coping with anxiety. Above all, in the present framework of performance anxiety, perceived control is a reflection of coping capacity and part of appraisal processes involved in anxiety in reaction to perceived threat, rather than a coping response or strategy. A summary of rationale supporting perceived control as an eligible element of anxiety is followed.

First of all, one of the main functions of the emotion system concerns regulation. Anxiety, by definition, is a complex emotion in response to perceived threat. A regulatory process is thus proposed to underlie anxiety by many theorists (Izard & Ackerman, 2000; Frijda, 2000; Ohman, 2000; Johnson-Laird & Oatley, 2000). Consequently, it is not in conceptual conflict to explicitly include a "regulatory"

component of perceived control, representing a coping capacity involved in anxiety, in the present model of anxiety. Second, from the perspective of explanatory power, perceived control has been shown to help in understanding variations in the effects of anxiety (Jones, Swain & Hardy, 1993; Jones & Swain, 1995; Swain & Jones, 1996). In addition, perceived control appears to be one of the main characteristics of anxiety, as active engagement with the environment may well differentiate anxiety from depression, which is associated with passive disengagement (Eysenck, 1992; Schwarzer, Jerusalem & Stiksrud, 1984). Lastly, the construct of perceived control concerns the process of self-evaluation that is considered one of the key factors underlying anxiety (Gibbons, 1990; Izard, 1972b). It is therefore logical to speculate that (from a comprehensive perspective) anxious individuals may evaluate not only environmental and internal threats, but also their capacities of coping with them and of meeting the demand of the task in reaction to performance stress. Consequently, apart from cognitive and physiological anxiety, perceived control appears to be one of the necessary features of performance anxiety in the dynamics of a more sophisticated analysis of performance-stress phenomena.

The proposed three-dimensional model appears to be theoretically meaningful. On the one hand, rather than the narrower viewpoint of maladaptive-natured anxiety often adopted in the area of sport performance research, an alternative more "neutral" perspective (producing both negative and positive effects) of anxiety is offered, which is more consistent with the origin of anxiety, explicitly acknowledging its adaptive or regulatory capacity. On the other hand, the perplexed nature of anxiety and anxiety effects may better be revealed by considering more components of anxiety. Perhaps more importantly, as belief affects human behavior,

the belief that anxiety may not always be maladaptive can serve a motivational purpose. That is, stressed individuals would probably be psychologically stronger in the face of perceived threat and the unpleasant symptoms of anxiety because of their belief in the adaptive potential of anxiety, which may in turn bring forth more positive effects of anxiety upon performance.

Applied Implications

From the findings of the predictive study (Chapter 4), perceived control appears to be generally desirable in order to perform better. From the perspective of intervention, other than the intensity-oriented symptoms of anxiety (e.g., physiological anxiety, worry), the regulatory dimension of anxiety appears to be an alternative target for intervention on debilitative effects of anxiety. Nevertheless, some caution might be warranted because as physiological anxiety increases high perceived control might become less beneficial, possibly due to a cognitive coping style (e.g., repressive defense) or over-confidence effects. Consequently, it would probably be helpful to implement the intervention via raising the level of perceived control for highly anxious performers with some consideration for individual difference factors, e.g., the individual's sensitivity to not only negative but also positive emotional states, personal coping tendencies or preferences, etc. Undoubtedly, more research is desirable to further substantiate the results and the above reasoning.

Another relevant implication of these findings is that positive states (e.g., perceived control, or self-confidence, etc.) may not always lead to positive performance effects. Interestingly, this highlights one of the fundamental arguments

addressed earlier (Chapter 1 and 2) that it is doubtful to simply attribute facilitative effects to positive states. At an applied level, some caution may thus be useful concerning the intervention of "psyching up" performers with positive states.

Strengths of the Research

There are several strengths to the thesis. From the perspective of research training, the thesis has been written up as a series of research papers, which encouraged the candidate to write for and submit her work to the scientific community in the relevant area. Moreover, the thesis follows one single focus concerning the construct of performance anxiety with the aim of better understanding and predicting the anxiety-performance relationship, which covers both conceptual and empirical perspectives.

At a theoretical level, the strengths of this thesis include the construction of a conceptual model of performance anxiety from first principles, incorporating arguments, propositions and theories/models from various fields of psychology. The argument on "facilitative anxiety" may remain, but this model is the first in sport psychology to provide an alternative theoretical viewpoint that is more consistent with the origin of anxiety by explicitly including a regulatory dimension (i.e., perceived control) as an integral part of anxiety.

At an empirical level, the CSAI-2, the most widely used measure of anxiety in the domain of sports performance, has been questioned in many ways (e.g., its construct validity, the role of self-confidence, the operational definition of cognitive anxiety), and the directional scale of anxiety (CSAI-2d) has lacked psychometric

evidence. The development of a new measure of performance anxiety shows some potential. In addition, the present proposed measure reflecting three dimensions of anxiety is captured by a relatively small numbers of items (a total of 25 items in the English version and 21 items in the Chinese version) in order to examine pre-competitive anxiety more effectively for practical concern. As a result, this measure of performance anxiety with a scale length less than the CSAI-2 (27 items) but potentially measures anxiety more broadly (e.g., cognitive anxiety includes not only worry but also self-focus) than the CSAI-2. Furthermore, the notion of control that is indirectly measured by the directional scale (symptom interpretation) associated with the CSAI-2 is measured directly by the factor of perceived control in the present measure of performance anxiety. From the results of the predictive study (Chapter 4), the component of perceived control appears to be the best predictor, accounting for an additional 20.4% of performance variance over and above cognitive and physiological anxiety. This short subscale of perceived control has therefore shown considerable potential for predicting the effects of anxiety upon performance rather efficiently. Collectively, this measure of performance anxiety may well be an option worth using in future anxiety-performance research.

Moreover, the thesis involves cross-cultural studies (two English studies and four Chinese studies). Two versions of the performance anxiety measure were developed with the benefit that this conceptual framework at its relatively early stage can be further tested simultaneously via two of the most widely used languages in the world. As shown from the five CFA studies (Chapter 2 and 3), the replication of factor structure was confirmed between the two versions of the measure - suggested as one way to ascertain conceptual equivalence of measures across cultures (Leung & Wong,

2003; Butcher et al., 2003). More importantly, the validity of the structural model was considered to be strengthened particularly through cross-validation between cultures (Van de Vijver & Leung, 1997; Sue & Chang, 2003).

Above all, the predictive validity of this model was tested and supported in Study 6 (Chapter 4). This final study, although simply the beginning of model testing, was crucial to the thesis as, without it, the potential theoretical value and practical applications of both the conceptual model and measure of performance anxiety would remain in considerable doubt. In addition, it is worth noting that the process of data collection of this final study was very challenging as the contest involved was highly competitive. It is advantageous that the PhD candidate had worked with the community of tae-kwon-do sports in Taiwan for many years, and has built sufficient knowledge and understanding of this sport. More importantly, good rapport and trust with most coaches and athletes were thus established for this investigation to work. Nevertheless, ethical issue in terms of possible intrusion on pre-performance preparation is particularly warranted in such a context of very important competition. Consequently, all participants were contacted directly by the PhD candidate two weeks before their contest. Confidentiality of individual results was guaranteed and consent was obtained from each of them. Additionally, all participants were given the opportunity of access to their individual questionnaire results if they felt interested as a feedback for their participation.

Limitations of the Research

Limitations of the research include that although considerable endeavor was put into the conceptual model and six studies were conducted, five of the empirical

studies were strictly measurement-related and even the final one was a correlational field study. Despite the fact that the candidate had conducted and published two qualitative studies regarding psychological factors of elite sports performance in Taiwan before starting the thesis work, a broad experience in research skills is favored in terms of the training of a PhD candidate. Both true experimental designs and intervention studies are missing from the research reported here, but can and should be pursued in the ongoing process of development and validation of the conceptual model and measurement.

The most obvious setback in the findings is that the discriminant validity of worry and self-focus in the cognitive dimension, and autonomous hyperactivity and somatic tension in the physiological anxiety, were not established across the five CFA studies. There are a number of possible reasons for this. First, the subscale length of each construct is rather short (mostly with only four items), which inevitably increases the difficulty of separating two related constructs in cognitive or physiological anxiety. Second, the samples were heterogeneous (involving more than 30 sports) to increase the generalizability of the measure, which may well have reduced their discriminant power, which is probably better revealed in a more homogeneous context. A final relevant note concerns the nature of self-report measurement. The approach of measuring awareness of physiological anxiety with respect to performance contexts has received criticism (e.g., Woodman & Hardy, 2001). Given that it may not be most effective to measure physiological symptoms via self-report instrument, it is perhaps unsurprising that the sub-dimensions of physiological anxiety were not differentiated in the present research (cf., Ekehammar, Magnusson & Ricklander, 1974).

The findings of weak discriminant validity between worry and self-focus, and between autonomous hyperactivity and somatic tension across five CFA studies limit the applications of the proposed measures (both versions) in the sense that only three (rather than five) subscales of the cognitive, physiological and regulatory dimension can be assessed. Until further separation is revealed by future research, this conceptualization of performance anxiety is best presented as a first-order three-dimensional model, merging worry and self-focus as one single dimension of cognitive anxiety, and autonomous hyperactivity and somatic tension as one dimension of physiological anxiety. That is, the empirical value on the approach of further differentiation of anxiety elements in cognitive and physiological anxiety upon performance has yet to be demonstrated. Nevertheless, at this relatively early stage of model development; the distinction between worry and self-focus, and between autonomous hyperactivity and somatic tension is retained only at a descriptive level.

Other limitations can be identified regarding the measurement development in the five CFA studies. First, although two versions of the measure have been established with promising preliminary data, more psychometric evaluation is clearly needed. In particular, the English version was tested on relatively small samples, a replication on a large-scale sample is imperative before an official recommendation of its usage can be made. Other than factorial validity, further evidence regarding concurrent validity, etc. would be helpful. Additionally, although the item content of the perceived control subscale does not explicitly contain the wording of "control", it measures essentially expectancy for goal attainment, which is consistent with the definition of perceived control. However, further refinement of the measure may consider rephrasing some of the perceived control items (e.g., "I feel in control about

my upcoming performance" instead of "I feel confident about my upcoming performance.") in order to enhance the face validity of this subscale. Furthermore, it is worth noting that although the majority of the retrospective data was collected within what would normally be considered a reliable recall time frame (i.e., recalled within two days to one week), the appropriateness of collecting data within two months of an event (e.g., 18.4% to 30% of the participants in the three Chinese samples) may be questioned. These data are possibly less valid due to memory bias and this might have had a bearing on the failure to discriminate the further differentiated subcomponents for cognitive and physiological anxiety. Given that all the psychometric studies in the current program were conducted in a retrospective manner, future prospective data is desirable to confirm the current findings.

Future Research Directions

Despite the conceptual rationale (Chapter 1 and 2) that supported the incorporation of a regulatory dimension in the model, the precise nature of the link between perceived control and performance anxiety awaits further empirical support. One important question is whether this regulatory dimension is truly uni-dimensional? To be specific, is perceived control the only component, or are there other components that might represent the regulatory dimension of anxiety? Clearly, the proposed conceptual model represents a beginning rather than an end. However, the explicit inclusion of a regulatory dimension encourages more future investigations into its nature and mechanism, which may potentially be a key to unlocking the anxiety-performance dynamics. Further development of this model is therefore anticipated. In particular, it is hypothesized that the regulatory dimension in the proposed model may regulate in a quantitative and/or qualitative way (Chapter 3).

From a conceptual perspective, this is consistent with Hockey's (1986) speculation on a control or self-regulatory system and its relationship with the effects of anxiety on processing and performance. The present findings in Studies 1-5 showed a wide range of intercorrelation between cognitive anxiety and perceived control (from -.54 to -.02.). There have also been comparable findings from previous research that worry and self-confidence may correlate not only negatively (Martens et al., 1990; Cox et al, 2003), but also positively (Jones et al, 1993; Edwards & Hardy, 1996; Woodman & Hardy, 2003; Hardy et al., 2004). However, it is for future research to examine the mechanism of this regulatory dimension and to obtain empirical evidence on its qualitative regulation assumed in the present model of performance anxiety.

Undoubtedly, the proposed three-dimensional model needs more tests not only via field studies but also via true experimental designs which are lacking in this thesis. To be more specific, other than the three hypotheses tested in the predictive study here (Chapter 4), more specific predictions based on the model are yet to be established. For example, how do the proposed anxiety variables, and particularly their interactions, impact differently upon performance under different contexts? Related to this is the consideration of contextual variables with respect to the prediction of the anxiety-performance relationship. In essence, it may be that the more the research context is differentiated, the better the predictive power of the effects of anxiety upon performance. For example, the present data in Studies 1-6 has shown that skill level potentially impacts the interplay between perceived control and cognitive anxiety differently. More specifically, the findings showed that as the skill level became higher, the magnitude of intercorrelation between perceived control and cognitive anxiety became smaller; it shifted from a moderate size of negative relation (two

English Studies and Chinese Study 1) to a near zero correlation (Chinese Studies 2-3 and the final predictive study). It is possible that through various contextual variables, such as skill level, task difficulty, sports type, etc., differential effects of anxiety variables upon performance may better be revealed, as various groups of performers might manifest anxiety responses differently and various anxiety components might impact performance dissimilarly under different performance demands or sports contexts. In addition, it is speculated from the above mentioned findings of intercorrelation patterns that more skilled performers may have better regulatory potential than less skilled performers to qualitatively neutralize (e.g., tolerate or dissociate) high (cognitive) anxiety in order to maintain their performance. Nevertheless, more research data is required to substantiate this assumption.

Finally, regarding the regulatory dimension, it is worth mentioning that lack of confidence (rather than confidence) was specifically suggested as a component of test anxiety (Hodapp & Benson, 1997). This is not completely dissimilar to Martens et al.'s (1990) proposition that self-confidence is an opposite end of a bipolar factor of worry (i.e., cognitive anxiety). Indeed, it is not uncommon that anxiety may be characterized by a sense of doubt or lack of confidence. A theoretical framework of anxiety from an information processing perspective developed by Mathews (1992) may shed some light on this issue. Mathews proposed three stages of information processing that were characteristic of anxious individuals. The first stage was relevant to the detection of threat, involving the selection of significant information. The second stage concerned the evaluation of stimulus input and involved interpreting and deciding whether there was a personal threat. The final process was a voluntary or controlled stage involving coping capacity. In particular, the acquisition of threatening

information (implying lack of confidence, etc.) could be favored at an early stage of vigilance (a bias of selective attention to threatening stimuli), without necessarily implying a similar cognitive bias at the later stage, in which coping capacity may be involved. Consequently, it may be plausible to suggest that as the dynamics of anxiety progress, the level of perceived control may vary (e.g., from low to high) due to its regulatory potential as representing the underlying coping capacity involved in anxiety. Such a regulatory component of perceived control may thus result in variations in the effects of anxiety (e.g., from maladaptive to adaptive). However, Mathews' theoretical framework and the above reasoning are all speculative, and these hypotheses have yet to be tested.

The initial model testing (Study 6) on the predictive power of this conceptual framework was in the competitive context of elite level of Taiwanese tae-kwon-do sport. Future studies are desirable to assess the generalizability of the findings, e.g., with participants at other skill levels, from different sports and cultures. However, as stated earlier, it is possible that across contexts the interplay among anxiety variables may be different, e.g., different significant patterns of interaction may emerge. For example, in data that is not included in this thesis a significant three-way interaction (perceived control x physiological anxiety x cognitive anxiety) was revealed (instead of a two-way interaction of perceived control x physiological anxiety as shown in Study 6) in predicting the tae-kwon-do performance of less-skilled performers in Taiwan. What really matters thus may not be confirmation of the present findings for generalizability purposes, but the establishment of reliable differential patterns of prediction for different contexts.

A common concern of anxiety research conducted via self-report instruments in competitive performance settings regards the intrusion on pre-competitive preparation and the social desirability issue that may bias the validity of data collection. It is ironic that the advantage of field studies on anxiety (i.e., true anxiety would likely be induced) may result in the undesirable effects of possible intrusion and social desirability. True experimental designs used in anxiety research, similarly, have strengths and weakness only in a contrary direction to those of field studies. Future studies may benefit from designs that deal better with all the practical difficulties generally encountered in both field studies and true experimental designs. In particular, it is yet to be investigated whether or not, and to what degree, the control for social desirability factor, e.g., via social desirability scales (e.g., Crowne & Marlowe, 1960; Paulhus, 1998; Stober, 2001) could improve research results, such as the discriminant validity of the paired subcomponents in cognitive/physiological anxiety or the predictive power of the present anxiety model in performance.

It is beyond the scope of this thesis to examine and discuss detailed differences in the English speaking (British) and Chinese speaking (Taiwanese) cultures. The proposed model and two versions of anxiety measure provide an opportunity for pursuing future research to this end. Given that the conceptual model and the applied tools were developed by the same researchers and comparable for both cultures, possible false differences in cultural comparisons due to misinterpretation of the theoretical model or incompatibility of measurement may be minimized. Anxiety is certainly a universal stress-related state and individuals experience anxiety despite cultures. The question is how much difference and similarity is there between cultures concerning the impact of anxiety upon performance? For example, social

research showed that Westerners and Easterners were characterized more by individualism and collectivism respectively (Chao, 1994; Lam, 1997; Supple, Peterson & Bush, 2004). Do such differences in general characteristics in different cultures affect the predictions of the anxiety-performance relationship? Would the social desirability issue be more apparent in the East as collectivistic orientation may imply more conformity with social values or standards than individualism?

To conclude, this thesis presents the research conducted on the topic of performance anxiety from very first principles. That is, from the construction of a conceptual model, incorporating various conceptual arguments and rationales derived from anxiety literature in various fields of psychology. This integrated conceptualization of performance anxiety is a comprehensive one and offers an alternative perspective on anxiety that reflects more explicitly the (adaptive) origin of anxiety. Huge effort has been devoted to the conceptual work but more development is undoubtedly needed in the near future. To initiate empirical testing of the model, measurement was subsequently established with preliminary psychometric support. More validation work is necessary to further develop the two measures in both English and Chinese. Finally, findings from a predictive study reveal promising prospects for future empirical validations of the proposed three-dimensional conceptualization of performance anxiety.

References

References

Alpert, R., & Haber, N.N. (1960). Anxiety in academic achievement situations. *Journal of Abnormal and Social Psychology*, **61**, 207-215.

American Psychiatric Association. (1987). *Diagnostic and statistical manual of mental disorders* (3rd ed., revised). Washington, DC: Author.

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

Aron, A., & Aron, E.N. (2003). *Statistics for psychology* (3rd ed., pp. 81-83). New Jersey: Pearson Education.

Baddeley, A. (1986). *Working Memory*. London: Oxford University Press.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, **84**, 191-215.

Bandura, A. (1988). Self-efficacy conception of anxiety. *Anxiety Research*, **1**, 77-98.

Baumeister, R.F. (1984). Choking under press: Self-consciousness and paradoxical effects of incentives on skillful performance. *Journal of Personality and Social Psychology*, **46**, 610-620.

Beauducel, A., & Wittmann, W. (2005). Simulation study on fit indices in confirmatory factor analysis based on data with slightly distorted simple structure. *Structural Equation Modeling*, **12**, 41-75.

Bentler, P.M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, **107**, 238-246.

Bentler, P.M., & Chou, C.P. (1987). Practical issues in structural modeling. *Sociological Methods and Research*, **16**, 78-117.

Bong, M., & Skaalvik, E.M. (2003). Academic self-concept and self-efficacy: How different are they really? *Educational Psychology Review*, **15**, 1-40.

Boomsma A. (1983). *On the robustness of LISREL (maximum likelihood estimation) against small sample size and non-normality*. PhD Thesis, University of Groningen. The Netherlands.

Borkovec, T.D., & Inz, J. (1990). The nature of worry in generalized anxiety disorder: A predominance of thought activity. *Behavior Research and Therapy*, **28**, 153-158.

Borkovec, T.D., Robinson, E., Pruzinsky, T., & Depree, J.A. (1983). Preliminary exploration of worry: Some characteristics and processes. *Behavior Research and Therapy*, **21**, 9-16.

Browne, M.W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K.A, Bollen, & J.S. Long (Eds.), *Testing structural equation models*. Newbury Park, CA: Sage.

Burton, D. (1988). Do anxious swimmers swim slower? Reexamining the elusive anxiety-performance relationship. *Journal of Sport and Exercise Psychology*, **10**, 45-61.

Burton, D., & Nayor, S. (1997). Is anxiety really facilitative? Reactions to the myth that cognitive anxiety always impairs sport performance. *Journal of Applied Sport Psychology*, **9**, 295-302.

Butcher, J.N., Cheung, F.M., & Lim, J. (2003). Use of the MMPI-2 with Asian population. *Psychological Assessment*, **15**, 248-256.

Butt, J., Weinberg, R., & Horn, T. (2003). The intensity and directional interpretation of anxiety: Fluctuations throughout competition and relationship to performance. *The Sport Psychologist*, **17**, 35-54.

Calvo, M.G., Avero, P., Castillo, M.D., & Miguel-Tobal, J.J. (2003). Multidimensional anxiety and content-specificity effects in preferential processing of threat.

European Psychologist, **8**(4), 252-265.

Calvo, M.G., & Cano-Vindel A. (1997). The nature of trait anxiety: Cognitive and biological vulnerability. *European Psychologist*, **2**(4), 301-312.

Carrier, C., Higson, V., Klimoski, V., & Peterson, E. (1984). The effects of facilitative and debilitative achievement anxiety on note taking. *Journal of Education Research*, **77**, 133-138.

Carver, C.S., & Scheier, M.F. (1986). Functional and dysfunctional responses to anxiety: The interaction between expectancies and self-focused attention. In R. Schwarzer (Ed.), *Self-related cognitions in anxiety and motivation* (pp. 111-141). Hillsdale, NJ: Erlbaum.

Carver, C.S., & Scheier, M.F. (1988). A control-process perspective on anxiety. *Anxiety Research*, **1**, 17-22.

Carver, C.S., & Scheier, M.F. (1998). *On the self-regulation of behavior*. Cambridge: Cambridge University Press.

Chao, R. K. (1994). Beyond parental control and authoritarian parenting style: Understanding Chinese parenting through the cultural notion of training. *Child Development*, **65**, 1111-1119.

Cheng, W.N.K., Hardy, L., & Markland, D. (2007a). Toward a three-dimensional conceptualization of performance anxiety: Rationale and initial factorial validation in the context of sports performance. (in submission).

Cheng, W.N.K., Hardy, L., & Markland, D. (2007b). Toward a three-dimensional conceptualization of performance anxiety: Measurement development in Chinese and factorial validation in the context of Taiwanese sports performance. (in preparation).

Chou, C.P., & Bentler, P.M. (1995). Estimates and tests in structural equation

modeling. In R.H. Hoyle (Ed.), *Structural equation modeling: Concepts, issues and applications* (pp. 37-55), Thousand Oaks: Sage.

Clark, L.A., & Watson, D. (1991). Tripartite model of anxiety and depression: Psychological evidence and taxonomic implications. *Journal of Abnormal Psychology*, **100**(3), 316-336.

Clark, L.A., & Watson, D. (1995). Constructing validity: Basic issues in objective scale development. *Psychological Assessment*, **7**, 309-319.

Comrey, A.L., & Lee, H.B. (1992). *A first course in factor analysis* (2nd ed.). Hillsdale, NJ: Erlbaum.

Converse, J.M., & Presser, S. (1986). *Survey questions: Handcrafting the standardized questionnaire*. Beverly Hills, CA: Sage.

Covington, M.V. & Omelich, C.L. (1988). Achievement dynamics: The interaction of motives, cognitions, and emotions over time. *Anxiety Research*, **1**, 165-183.

Covington, M.V., Omelich, C.L. & Schwarzer, R. (1986). Anxiety, aspirations, and self-concept in the achievement process. A longitudinal model with latent variables. *Motivation and Emotion*, **10**, 71-88.

Cox, R.H., Martens, M.P., & Russell, W.D. (2003). Measuring anxiety in athletics: The revised competitive state anxiety inventory-2. *Journal of Sport & 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 & Exercise Psychology*, **25**, 44-65.

Cronbach, L.J. (1951). Coefficient alpha and the internal structure of tests. *Psychmetrika*, **16**, 297-334.

Cronbach, L.J. (1971). Test validation. In R.L. Thorndike (Ed.), *Education*

measurement (2nd ed.). Washington, DC: American Council on Education.

Cronbach, L.J. (1987). Statistical tests for moderator variables: Flaws in analysis recently proposed. *Psychological Bulletin*, **102**, 414-417.

Crowne, D.P., & Marlowe, D. (1960). A new scale of social desirability independent of psychopathology. *Journal of Consulting Psychology*, **24**, 349-354.

Derakshan, N., & Eysenck, M.W. (2001). Manipulation of focus of attention and its effects on anxiety in high-anxious individuals and repressors. *Anxiety, Stress, and Coping*, **14**, 173-191.

Diamantopoulos, A., & Siguaw, J.A. (2000). *Introducing LISREL* (pp. 129-142). CA: Sage.

Doctor, R.M., & Altman, F. (1969). Worry and emotionality as components of test anxiety: Replication and further data. *Psychological Reports*, **24**, 563-568.

Duda, J. (1986). Perceptions of success and failure among white, black and Hispanic adolescents. In J. Watkins, T. Reilly, & L. Burwitz (Eds.), *Sports science* (pp. 214-222). London: Spon.

Duda, J., & Allison, M.T. (1989). The attributional theory of achievement motivation: Cross-cultural considerations. *International Journal of Intercultural Relations*, **13**, 37-55.

Dunn, J.G.H. (1999). A theoretical framework for structuring the content of competitive worry in ice hockey. *Journal of Sport & Exercise Psychology*, **21**, 259-279.

Dunn, J.G.H., & Syrotuik, D.G. (2003). An investigation of multidimensional worry dispositions in a high contact sport. *Psychology of Sport and Exercise*, **4**, 265-282.

Duval , S., & Wicklund, R.A. (1972). *A theory of objective self-awareness*. New York:

Academic Press.

Edwards, T., & Hardy, L. (1996). The interactive effects of intensity and direction of cognitive and somatic anxiety and self-confidence upon performance. *Journal of Sport & Exercise Psychology*, **18**, 296-312.

Egloff, B., & Schmukle, S. C. (2002). Predictive validity of an implicit association test for assessing anxiety. *Journal of Personality and Social Psychology*, **83**(6), 1441-1455.

Ekehammar, B., Magnusson, D. & Ricklander, L. (1974). An interactionist approach to the study of anxiety: An analysis of an S-R inventory applied to an adolescent sample. *Scandinavian Journal of Psychology*, **15**, 4-14.

Everett, J.E. (1983). Factor comparability as a means of determining the number of factors and their rotation. *Multivariate Behavioral Research*, **18**, 197-218.

Eysenck, M.W. (1978). Expectations as causal elements in behavioral change. In S. Rachman (Ed.), *Advances in behavioral research and therapy*. Oxford: Pergamon.

Eysenck, M.W. (1992). *Anxiety: The cognitive perspective*. East Sussex, UK: Erlbaum.

Eysenck, M.W., & Calvo, M.G. (1992). Anxiety and performance: The processing efficiency theory. *Cognition and Emotion*, **6**(6), 409-434.

Fan, X., & Sivo, S.A. (2005). Sensitivity of fit indices to misspecified structural or measurement model components: Rationale of two-index strategy revisited. *Structural Equation Modeling*, **12**, 343-367.

Fazey, J.A., & Hardy, L. (1988). The inverted-U hypothesis: A catastrophe for sport psychology, *British Association of Sport Sciences Monograph* 1. Leeds: The National Coaching Foundation.

Fenigstein, A., Scheier, M.F., & Buss, A.H. (1975). Public and private self-consciousness: Assessment and theory. *Journal of Consulting and Clinical Psychology*, **43**, 522-527.

Fontaine, P., Mollard, E., Yao, S.N., & Cottraux, J. (2001). Current trends in cognitive behaviour therapy for anxiety disorders. In E.J.L. Griez, C. Faravelli, D. Nutt, & J. Zohar (Eds.), *Anxiety disorders: An introduction to clinical management and research*. Chichester: Wiley.

Frijda, N.H. (2000). The psychologists' point of view. In M. Lewis, & J.M. Harviland-Jones (Eds), *Handbook of emotions* (2nd ed.). New York: Guilford Press.

Gana, K., Martin, B., Canouet, M-D., Trouillet, R., & Meloni, F. (2002). Factorial structure of a French version of the Penn state worry questionnaire. *European Journal of Psychological Assessment*, **18**(2), 158-164.

Gibbons, F.X. (1990). Self-evaluation and self-perception: The role of attention in the experience of anxiety. *Anxiety, Stress, and Coping*, **2**, 153-163.

Gould, D., Petlichkoff, L., Simons, J., & Verera, M. (1987). Relationships between Competitive State Anxiety Inventory-2 subscales scores and pistol shooting performance. *Journal of Sport psychology*, **9**, 33-42.

Gould, D., Petlichkoff, L., & Weinberg, R.S. (1984). Antecedents of temporal changes in, and relationship between CSAI-2 subcomponents. *Journal of Sport psychology*, **6**, 289-304.

Gould, D., Tuffey, S., Hardy, L., & Lochbaum, M. (1993). Multidimensional state anxiety and middle distance running performance: An exploratory examination of Hanin's (1980) zones of optimal functioning hypothesis. *Journal of Applied Sport Psychology*, **5**, 89-95.

Gray, J.A. (1979). A neuropsychological theory of anxiety. In C.E. Izard (Ed.), *Emotions in personality and psychopathology* (pp. 303-335). New York: Plenum.

Greenwald, A. G., Banaji, M.R. Rudman, L.A., Farnham, S.D. Nosek, B.A., & Mellott, D.S. (2002). A unified theory of implicit attitudes, stereotypes, self-esteem, and self-concept. *Psychological Review*, **102**, 4-27.

Hagtvet, K.A., & Benson, J. (1997). The motive to avoid failure and test anxiety responses: Empirical support for integration of two research traditions. *Anxiety, Stress, and Coping*, **10**, 35-57.

Hagtvet, K.A., & Ren-Min, Y. (1992). Changing impact of ability, motivation, and anxiety in cognitive performance: A process analysis. In D.G. Forgays, T. Sosnowski, & K. Wrzesniewski, (Eds.), *Anxiety: Recent developments in self-appraisal, psycho-physiological, and health psychology* (pp. 63-74). New York: Hemisphere.

Hair, J.F., Anderson, R.E., Tatham R.L., & Black, W.C. (1998). *Multivariate data analysis* (5th ed.). UK: Prentice Hall.

Hambleton, R.K., & Kanjee, A. (1995). Increasing the validity of cross-cultural assessments: Use of improved methods for test adaptations. *European Journal of Psychological Assessment*, **11**(3), 147-157.

Hanin, Y.L. (1980). A study of anxiety in sports. In W.F. Straub (Ed.), *Sport psychology: An analysis of athlete behavior* (pp. 236-249). Ithaca, NY: Mouvement.

Hanin, Y.L. (1986). State trait anxiety research on sports in the USSR. In C.D. Speilberger, & R. Diaz Guerrero (Eds.). *Cross-cultural anxiety* (pp. 45-64). Washington, DC: Hemisphere.

Hanin, Y.L. (1997). Emotions and athletic performance: Individual zones of optimal functioning model. *European Yearbook of Sport Psychology*, **1**, 29-72.

Hanton, S., & Connaughton, D. (2002). Perceived control of anxiety its relationship to self-confidence and performance: A qualitative inquiry. *Research Quarterly for Exercise and Sport*, **73**, 87-97.

Hanton, S., & Jones, G. (1995). Antecedents of multidimensional state anxiety in elite competitive swimmers. *International Journal of Sport Psychology*, **26**, 512-523.

Hanton, S., & Jones, G. (1997). Antecedents of intensity and direction dimensions of competitive anxiety as a function of skill. *Psychological Reports*, **81**, 1139-1147.

Hanton, S., Jones, G., Mullen, R. (2000). Intensity and direction of competitive anxiety as interpreted by rugby players and rifle shooters. *Perceptual and Motor Skills*, **90**, 513-521.

Hanton, S., Mellalieu, S.D. & Hall, R. (2004). Self-confidence and anxiety interpretation: A qualitative investigation. *Psychology of Sport and Exercise*, **5**, 477-495.

Hanton, S., O'Brien, M., & Mellalieu, S.D. (2003). Individual differences, perceived control and competitive trait anxiety. *Journal of Sport Behavior,* **26**, 1, 39-55.

Hardy, L. (1990). A catastrophe model of performance in sport. In G. Jones & L. Hardy (Eds.), *Stress and performance in sport* (pp. 81-106). Chichester: Wiley.

Hardy, L. (1996). A test of catastrophe models of anxiety and sports performance against multidimensional anxiety theory models using the method of dynamic differences. *Anxiety, Stress, and Coping*, **9**, 69-86.

Hardy, L. (1998). Responses to the reactions on three myths in applied consultancy work. *Journal of Applied Sport Psychology*, **10**, 212-219.

Hardy, L., & Hagtvet, K.A. (1996). Anxiety and performance: Measurement and

modeling issues. *Anxiety, Stress, and Coping*, **9**, v-viii.

Hardy, L., & Hutchinson, A. (2007). Effects of performance anxiety on effort and performance in rock climbing: A test of processing efficiency theory. *Anxiety, Stress, and Coping*, **00**(0), 1-15.

Hardy, L., & Whitehead. R. (1984). Specific modes of anxiety and arousal. *Current Psychological Research and Reviews*, **3**, 14-24.

Hardy, L., Woodman, T., & Carrington, S. (2004). Is self-confidence a bias factor in higher-order catastrophe models? An exploratory analysis. *Journal of Sport & Exercise Psychology*, **26**, 359-368.

Harger, G.J., & Raglin, J.S. (1994). Correspondence between actual and recalled precompetition anxiety in collegiate track and field athletes. *Journal of Sport & Exercise Psychology*, **16**, 206-211.

Hippler, H.J., Schwarz, N., & Sudman, S. (1987). *Social information processing and survey methodology*. New York: Springer-Verlag.

Hippel, W., Hippel C., Conway, L., Preacher, K.J., Schooler, J.W., & Radvansky, G.A. (2005). Coping with stereotype threat: Denial as an impression management strategy. *Journal of Personality and Social Psychology*, **89**(1), 22-35.

Hockey, G.R.J. (1986). A state of control theory of adaptation to stress and individual differences in stress management. In G.R.J. Hockey, A.W.K. Gaillard, & M.G.H. Cole (Eds.), *Energetics and human information processing*. Dordrecht: Martinus Nijhoff.

Hockey, G.R.J., & Hamilton, P. (1983). The cognitive patterning of stress states. In G.J.R. Hockey (Ed.), *Stress and fatigue in human performance* (pp. 331-362). Chichester: Wiley.

Hodapp, V., & Benson, J. (1997). The multidimensionality of test anxiety: A test of

different models. *Anxiety, Stress, and Coping*, **10**, 219-244.

Hu, L., & Bentler, P.M. (1995). Evaluating model fit. In R.H. Hoyle (Ed.), *Structural equation modeling: Concepts, issues and applications* (pp. 76-99). London: Sage.

Hu, L., & Bentler, P.M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, **6**, 1-55.

Izard, C.E. (1972a). Anxiety: A variable combination of interacting fundamental emotions. In C.D. Spielberger (Ed.), *Anxiety: Current trends in theory and research* (pp. 55-106). New York: Academic Press.

Izard, C.E. (1972b). *Patterns of emotion: A new analysis of anxiety and depression*. New York: Academic Press.

Izard, C.E., & Ackerman, B.P. (2000). Motivational, organizational, and regulatory functions of discrete emotions. In M. Lewis, & J.M. Haviland-Jones (Eds), *Handbook of emotions* (2nd ed.). New York: Guilford Press.

Jaccard, J., Turrisi, R. & Wan, C. (1990). *Interaction effects in multiple regression* (pp 30-31). Newbury Park, CA: Sage.

Janis, I.L. (1969). Stress and frustration. In I.L. Janis, G.F. Mahl, J. Kagan, & R.R. Holt (Eds.), *Personality: Dynamics, development, and assessment*. New York: Harcourt, Brace & World.

Jerusalem, M. (1990). Temporal patterns of stress appraisals for high- and low-anxious individuals. *Anxiety Research*, **3**, 113-129.

Johnson-Laird, P.N., & Oatley, K. (2000). Cognitive and social construction in emotions. In M. Lewis, & J.M. Haviland-Jones (Eds), *Handbook of emotions* (2nd ed.). New York: Guilford Press.

Jones, G. (1991). Recent developments and current issues in competitive state anxiety research. *The Psychologist*, **4**, 152-155.

Jones, G. (1995). More than just a game: Research developments and issues in competitive anxiety in sport. *British Journal of Psychology*, **86**, 449-478.

Jones, G., & Cale, A. (1989). Relationship between multidimensional competitive state anxiety and cognitive and motor subcomponents of performance. *Journal of Sports Sciences*, **7**, 129-140.

Jones, G., & Hanton, S. (2001). Pre-competitive feeling states and directional anxiety interpretations. *Journal of Sports Sciences*, **19**, 385-395.

Jones, G., Hanton, S., & Swain, A. (1994). Intensity and interaction of anxiety symptoms in elite and non-elite sports performers. *Personality Individual Difference*, **17**(5), 657-663.

Jones, J.G., & Swain, A. (1992). Intensity and direction dimensions of competitive state anxiety and relationships with competitiveness. *Perceptual and Motor Skills*, **74**, 467-472.

Jones, G., & Swain, A. (1995). Predisposition to experience debilitative and facilitative anxiety in elite and nonelite performers. *The Sport Psychologist*, **9**, 201-211.

Jones, G., Swain, A., & Cale, A. (1991). Gender differences in precompetition temporal patterning and antecedents and self-confidence. *Journal of Sport & Exercise Psychology*, **13**, 1-15.

Jones, G., Swain, A., & Hardy, L. (1993). Intensity and direction dimensions of competitive state anxiety and relationships with performance. *Journal of Sports Sciences*, **11**, 525-532.

Jones, G., Swain, A., & Harwood, C. (1996). Positive and negative affect as predictors

of competitive anxiety. *Personality and Individual Differences*, **20**, 109-114.

Joreskog, K.G. (1993). Testing structural equation models. In K.A. Bollen, & J.S. Long (Eds.), *Testing structural equation models* (pp. 294-316). Newbury Park: Sage.

Joreskog, K.G., & Sorbom, D. (1989). *LISREL 7: User's reference guide*. Mooresville, IN: Scientific Software.

Joreskog, K.G., & Sorbom, D. (2005). *LISREL 8.72* (computer software). Lincolnwood: Scientific Software.

Krampen, G. (1991). Competence and control orientations as predictors of test anxiety in students: Longitudinal results. In R. Schwarzer, & R. Wicklund (Eds.), *Anxiety and self-focused attention*. London: Harwood.

Krane, V., & Williams, J.M. (1987). Performance and somatic anxiety, cognitive anxiety, and confidence changes prior to competition. *Journal of Sport Behavior*, **10**, 47-56.

Krane, V., Williams, J., & Feltz, D. (1992). Path analysis examining relationships among cognitive anxiety, somatic anxiety, state confidence, performance expectations, and golf performance. *Journal and Sport Behavior*, **15**, 279-295.

Lam, C. M. (1997). A cultural perspective on the study of Chinese adolescent development. *Child and Adolescent Social Work Journal*, **14**, 95-113.

Lane, A.M., Sewell, D.F., Terry, P.C. Bartram, D., & Nesti, M.S. (1999). Confirmatory factor analysis of the competitive state anxiety inventory-2. *Journal of Sports Sciences*, **17**, 505-512.

Leung, P.W.L., & Wong, M.M.T. (2003). Measures of child and adolescent psychology in Asia. *Psychological Assessment*, **15**, 268-279.

Lewis, B.P., & Linder, D.E. (1997). Thinking about choking? Attentional processes

and paradoxical performance. *Personality and Social Psychology Bulletin*, **23**(9), 937-944.

Liao, C.M., & Masters, R.S.W. (2002). Self-focused attention and performance failure under psychological stress. *Journal of Sport & Exercise Psychology*, **24**, 289-305.

Libert, R.M., & Morris, L.W. (1967). Cognitive and emotional components of test anxiety: A distinction and some initial data. *Psychological Reports*, **20**, 975-978.

Lowe, R., & McGrath, J.E. (1971). Stress, arousal and performance: Some findings calling for a new theory. *Project Report*, AF 1161, AFOSR.

Markland, D., & Ingledew, D.K. (1997). The measurement of exercise motives: Factorial validity and invariance across gender of a revised Exercise Motivations Inventory. *British Journal of Health Psychology*, **2**, 361-376.

Marsh, H.W., Antill, J.K., & Cunningham, J.D. (1989). Masculinity, femininity, and androgyny: Bipolar and independent constructs. *Journal of Personality*, **57**, 652-663.

Marsh, H.W., & Hocevar, D. (1985). Application of confirmatory factor analysis to the study of self-concept: First- and higher order factor models and their invariance across groups. *Psychological Bulletin*, **97**, 562-582.

Martens, R.S., Vealey, R., & Burton, D. (1990). *Competitive anxiety in sport*. Champaign, IL: Human Kinetics.

Martin, J.J., & Gill, D.L. (1991). The relationships among competitive orientation, sport-confidence, self-efficacy, anxiety, and performance. *Journal of Sport and Exercise Psychology*, **13**, 149-159.

Masters, R.S.W. (1992). Knowledge, knerves, and know-how: The role of explicit versus implicit knowledge in the breakdown of a complex motor skill under

pressure. *British Journal of Psychology*, **83**, 343-358.

Mathews, A. (1992). Attention and memory for threat in anxiety. In H.W. Krohne (Ed), *Attention and avoidance*. The Hogrefe & Huber Publishers.

Matthews, G., Campbell, S.E., Falconer, S., Joyner, L.A., Huggins, J., Gilliland, K., et al. (2002). Fundamental dimensions of subjective state in performance settings: Task engagement, distress, and worry. *Emotion*, **2**(4), 315-340.

McDonald, R.P., & Ho, M.R. (2002). Principles and practice in reporting structural equation analysis. *Psychological Methods*, **7**, 64-82.

Mendolia, M. (2002). An index of self-regulation of emotion and the study of repression in social contexts that threaten or do not threaten self-concept. *Emotion*, **2**(3), 215-232.

Morris, L.W., Davis, M.A., & Hutchings, C.H. (1981). Cognitive and emotional components of anxiety: Literature review and revised worry-emotionality scale. *Journal of Educational Psychology*, **73**, 541-555.

Neiss R. (1988). Re-conceptualizing arousal psychobiological states in motor performance. *Psychological Bulletin*, **103**(3), 345-366.

Oatley, K., & Johnson-Laird, P.N. (1987). Towards a cognitive theory of emotions. *Cognition and Emotion*, **1**, 29-50.

Ohman, A. (1996). Preferential pre-attentive processing of threat of anxiety: Preparedness and attentional biases. In R.M. Rapee (Ed.), *Current controversies in the anxiety disorders* (pp. 253-290). New York: Guilford Press.

Ohman, A. (2000). Fear and anxiety: Evolutionary, cognitive, and clinical perspectives. In M. Lewis, & J.M. Haviland-Jones (Eds.), *Handbook of emotions* (2nd ed.). New York: Guilford Press.

Oxford dictionary of English (4th ed.). (1994). Oxford: Oxford University Press.

Parfitt, G., & Hardy, L. (1993). The effects of competitive anxiety on memory span and rebound shooting tasks in basketball players. *Journal of Sports Sciences*, **11**, 517-524.

Parfitt, G., Hardy, L., & Pates, J. (1995). Somatic anxiety and physiological arousal: Their effects upon a high anaerobic, low memory demand task. *International Journal of Sport Psychology*, **26**, 196-213.

Parfitt, G., Jones, G., & Hardy, L. (1990). Multidimensional anxiety and performance. In G. Jones & L. Hardy (Eds.), *Stress and performance in sport* (pp. 81-106). Chichester: Wiley.

Parfitt, G., & Pates, J. (1999). The effects of cognitive and somatic anxiety and self-confidence on components of performance during competition. *Journal of Sports Sciences*, **17**, 351-356.

Paulhus, D.L. (1998). *The Balanced Inventory of Desirable Responding*. Buffalo, NY: Multi-Health Systems.

Prapavessis, H., Cox, H., & Brookes, L. (1996). A test of Martens, Vealey and Burton's theory of competitive anxiety. *Australian Journal of Science and Medicine in Sport*, **28**, 24-29.

Pribram, K.H., & McGuiness. D. (1975). Arousal, activation and effort in the control of attention. *Psychological Review*, **82**, 116-149.

Randle, S., & Weinberg, R.S. (1997). Multidimensional anxiety and performance: An exploratory examination of the zone of optimal functioning hypothesis. *The Sport Psychologist*, **11**, 160-174.

Rost, D.H. & Schermer, F.J. (1989). The various facets of test anxiety: A subcomponent model of test anxiety measurement. In R. Schwarzer, H.M. van der Ploeg, & C.D. Spielberger (Eds.), *Advances in test anxiety research*, Vol. 6.

Amsterdam: Swets & Zeitlinger.

Rost, D.H., & Schermer, F.J. (1992a). "Reactions to tests" (RTT) and "manifestation of test anxiety" (DAI-MAN): Same or different concepts? In K.A. Hagtvet, & T.B. Johnsen (Eds.), *Advances in test anxiety research* (Vol. 7, pp. 114-129). Lisse, the Netherlands: Swets & Zeitlinger.

Rost, D.H., & Schermer, F.J. (1992b). Stabilization of test anxiety. In K.A. Hagtvet, & T.B. Johnsen (Eds.), *Advances in test anxiety research* (Vol. 7, pp. 84-102). Lisse, the Netherlands: Swets & Zeitlinger.

Runkel, P.J., & McGrath, J.E. (1972). *Research on human behavior: A systematic guide to method.* New York: Holt, Rinehart & Winston.

Sanders, A.F. (1983). Towards a model of stress and human performance, *Acta Psychologica*, **53**, 64-97.

Sarason, I.G. (1984). Stress, anxiety, and cognitive interference: Reactions to tests. *Journal of Personality and Social Psychology*, **46**, 929-938.

Satorra, A., & Bentler, P.M. (1988). Scaling corrections for chi-square statistics in covariance structure analysis. *Proceedings of the American Statistical Association*, 308-313.

Satorra, A., & Bentler, P.M. (2001). A scaled difference chi-square test statistic for moment structure analysis. *Psychometrika*, **66**, 507-514.

Schwab, D.P. (1980). Construct validity in organizational behavior. In B.M. Staw, & L.L. Cummings (Eds.), *Research in organizational behavior* (Vol. 2, pp. 3-43). Greenwich, CN: JAI Press.

Schwarzer, R. (1986). Self-related cognitions in anxiety and motivation: An introduction. In R. Schwarzer (Ed.), *Self-related cognitions in anxiety and motivation.* Hillsdale, NJ: Lawrence Erlbaum Association Inc.

Schwarzer, R., & Jerusalem, M. (1992). Advances in anxiety theory: A cognitive process approach. In K.A. Hagtvet, & T.B. Johnsen (Eds.), *Advances in test anxiety research* (Vol. 7, pp. 2-17). Lisse, the Netherlands: Swets & Zeitlinger.

Schwarzer, R., Jerusalem, M., & Stiksrud, H.A. (1984). The developmental relationship between test anxiety and helplessness. In H.M. van der Ploeg, R. Schwarzer, & Spielberger (Eds), *Advances in test anxiety research* (Vol. 3). Hillsdale, NJ: Erlbaum.

Skinner, E.A. (1996). A guide to constructs of control. *Journal of Personality and Social Psychology*, **71**, 549-570.

Smith, G.T., & MaCarthy, D.M. (1995). Methodological considerations in the refinement of clinical assessment instruments. *Psychological Assessment*, **7**(3), 300-308.

Sonstroem, R.J., & Bernardo, P. (1982). Individual pregame state anxiety and basketball performance. A re-examination of the inverted-U curve. *Journal of Sport Psychology*, **4**, 235-245.

Spielberger, C.D. (1966). Theory and research on anxiety. In C.D. Spielberger (Ed.) *Anxiety and Behavior*. New York: Academic Press.

Spielberger, C.D. (1980). *Test anxiety inventory: Preliminary professional manual.* Palo Alto, CA: Consulting Psychologists Press.

Steiger, J. (1990). Structural model evaluation and modification: An interval estimation approach. *Multivariate Behavioral Research*, **25**, 173-180.

Stober, J. (2001). The Social Desirability Scale-17 (SDS-17): Convergent validity, discriminant validity, and relationship with age. *European Journal of Psychological Assessment*, **17**, 222-232.

Stober, J., Tepperwien, S., & Staak, M. (2000). Worrying leads to reduced

concreteness of problem elaborations: Evidence for the avoidance theory of worry. *Anxiety, Stress, and Coping*, **13**, 217-227.

Strongman, K.T. (1996). *The psychology of emotion: Theories of emotion in perspective* (4th ed.). New York: Wiley.

Sue, S., & Chang, J. (2003). The state of psychological assessment in Asia. *Psychological Assessment*, **15**(3), 306-310.

Supple, A.J., Peterson, G.W., & Bush, K.R. (2004). Assessing the validity of parenting measures in a sample of Chinese adolescents. *Journal of Family Psychology*, **18**(3), 539-544.

Swain A., & Jones, G. (1996). Explaining performance variance: The relative contribution of intensity and direction dimensions of competitive anxiety. *Anxiety, Stress and Coping*, **9**, 1-18.

Tabachnick, B.G., & Fidell, L.S. (2001). *Using Multivariate Statistics* (International student ed.). Needham Heights MA: Allyn and Bacon.

Thayer, R.E. (1989). *The biopsychology of mood and arousal*. New York: Oxford University Press.

Tucker, L.R., & Lewis, C. (1973). The reliability coefficient for maximum likelihood factor analysis. *Psychometrika*, **38**, 1-10.

Van de Vijver, F.J.R., & Leung, K. (1997). *Methods and data analysis for cross-cultural research*. Thousand Oaks, CA: Sage.

Wicklund, R.A. (1991). Introduction. In R. Schwarzer, & R.A. Wicklund (Eds.), *Anxiety and self-focused attention*. London: Harwood.

Wicklund, R.A., & Gollwitzer, P.M. (1987). The fallacy of the private-public self-focus distinction. *Journal of Personality*, **55**, 491-523.

Wine, J.D. (1980). Cognitive-attentional theory of test anxiety. In I.G. Sarason (Ed.),

Test-anxiety: Theory, research, and applications (pp. 349-385). Hillsdale, NJ: Erlbaum.

Wolfe, M.L. (1989). Correlates of adaptive and maladaptive musical performance anxiety. *Medical Problems of Performing Artists*, **4**, 49-56.

Woodman, T., & Hardy, L. (2001). Stress and anxiety. In R. Singer, H.A. Hausenblas, & C.M. Janelle (Eds.), *Handbook of sport psychology* (2nd ed., pp. 290-318). New York: Wiley.

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.

Appendix A

The Measure of Performance Anxiety:

The English Version

Psychological Performance States Inventory

Some very common statements that athletes have used to describe their psychological states when anticipating or performing sports under pressure are given below. Please try to recall a recent competition that you can remember clearly now. Then read each statement and circle the number on the scale that is closest to ***how you felt before that competition***. There is no right or wrong answer. Your answers will be kept completely confidential, and we will only be looking at group responses. Please do not skip any items.

Do not spend too much time on any one statement, but choose the most appropriate number which describes ***your feelings before the specific competition you are recalling.***

		Totally Disagree				**Totally Agree**
1)	I am confident that I can stay focused during my performance	1	2	3	4	5
2)	I am worried that I may not perform as well as I can	1	2	3	4	5
3)	My heart is racing	1	2	3	4	5
4)	I believe my performance goal is achievable	1	2	3	4	5
5)	I tend to dwell on shortcomings in my performances	1	2	3	4	5
6)	I feel ready for my performance	1	2	3	4	5
7)	I am conscious that others will judge my performance	1	2	3	4	5
8)	My hands are clammy	1	2	3	4	5
9)	I believe in my ability to perform	1	2	3	4	5
10)	I am worried about making mistakes	1	2	3	4	5
11)	My body feels tense	1	2	3	4	5
12)	I believe that I have the resources to meet this challenge	1	2	3	4	5
13)	I am very conscious of every movement I make	1	2	3	4	5
14)	My mouth feels dry	1	2	3	4	5
15)	I am worried about the consequences of failure	1	2	3	4	5

16)	I am very aware of the possibility of disappointing important others	1	2	3	4	5
17)	I feel restless	1	2	3	4	5
18)	I find myself evaluating myself more critically than usual	1	2	3	4	5
19)	I feel easily tired	1	2	3	4	5
20)	I dwell on how I might fail to impress important others	1	2	3	4	5
21)	I have a slight tension headache	1	2	3	4	5
22)	I am worried about the uncertainty of what may happen	1	2	3	4	5
23)	I feel the need to go to the toilet more often than usual	1	2	3	4	5
24)	I am conscious that people might disapprove of my performance	1	2	3	4	5
25)	I feel confident about my upcoming performance	1	2	3	4	5

Appendix B

The Measure of Performance Anxiety:

The Chinese Version

運動表現相關狀態量表

下列是比賽前常見的各種狀態，請根據你目前的感覺及想法作答，圈選一個最符合你目前狀況的數字。數字越大，代表愈符合。謝謝！

	非常不符合				非常符合
1) 我有信心在表現過程中保持專注……	1	2	3	4	5
2) 我擔心無法發揮應有的實力……	1	2	3	4	5
3) 我感到手心出汗……	1	2	3	4	5
4) 我相信可以達成所設定的表現目標……	1	2	3	4	5
5) 我意識到別人將會評價我的表現……	1	2	3	4	5
6) 我擔心表現會失誤……	1	2	3	4	5
7) 我覺得自己已經做好上場的準備……	1	2	3	4	5
8) 我意識到自己內在不利於表現的弱點……	1	2	3	4	5
9) 我擔心表現失敗的相關後果……	1	2	3	4	5
10) 我感到焦躁不安……	1	2	3	4	5
11) 我相信自己表現的實力……	1	2	3	4	5
12) 我意識到自己的表現可能不會讓人滿意……	1	2	3	4	5
13) 我感到較容易疲勞……	1	2	3	4	5
14) 我的背頸感到僵硬……	1	2	3	4	5
15) 我擔心表現不佳……	1	2	3	4	5
16) 我覺得比平時想上廁所……	1	2	3	4	5
17) 我意識到別人將會看到我在表現上的缺點……	1	2	3	4	5
18) 我感覺呼吸不順暢……	1	2	3	4	5
19) 我感到自己在評估各種對表現不利的因素……	1	2	3	4	5
20) 我的胸部有壓迫感……	1	2	3	4	5
21) 我意識到自己內在比較負面的情緒……	1	2	3	4	5

Appendix C

The Chinese Measure of Performance Anxiety:

An English Translation

The content and factor loadings of the Chinese scale items

— An English translation.

Worry

I am worried that I may not perform as well as I can. (Factor loading = 0.50)

I am worried about making mistakes. (0.70)

I am worried about the consequences of failure. (0.60)

I am worried about performing poorly. (0.74)

Self-focus

I tend to dwell on shortcomings in my performance. (0.65)

I find myself evaluating unfavorable factors concerning performance. (0.56)

I am aware of my own negative emotions. (0.59)

I am conscious that others will critically judge my performance. (0.46)

I dwell on how I might fail to impress important others. (0.63)

I am aware that important others will notice my shortcomings in performance. (0.60)

Autonomous hyperactivity

My hands are clammy. (0.43)

I feel the need to go to the toilet more often than usual. (0.54)

I am not breathing smoothly. (0.72)

My chest feels tight. (0.67)

Somatic tension

I feel restless. (0.75)

I feel easily tired. (0.57)

My back neck feels tense. (0.63)

Perceived control

I am confident that I can stay focused during my performance. (0.57)

I believe my performance goal is achievable. (0.68)

I feel ready for my performance. (0.75)

I believe in my ability to perform. (0.75)