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Cross-cultural validation of a three-dimensional measurement model of performance anxiety in the Context of Chinese Sports.

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This article presents cross-cultural validation of a three-dimensional measurement model of performance anxiety proposed recently (Cheng, Hardy, & Markland, 2009). This re-conceptualization of performance anxiety emphasizes the adaptive capacity involved in the dynamics of anxiety by including a regulatory dimension, in addition to the conventional intensity-oriented dimensions of cognitive and physiological anxiety. Specifically, this regulatory dimension of anxiety is represented by perceived control. The cognitive dimension is characterized by worry and self-focused attention, and the physiological dimension includes autonomic hyperactivity and somatic tension. The measure of performance anxiety was developed in Chinese based on the proposed conceptualization and its accordant anxiety measure previously established in English (Cheng et al., 2009). The factor structure of the measurement model was examined by confirmatory factor analysis through three samples (N = 203, 450, 236) of Taiwanese sports participants. Consistent with the previous English study, model fit indices indicated support for the three-dimensional first-order model. The factorial validity of the three-dimensional model has been strengthened via this cross-cultural confirmation, and the Chinese three-factor anxiety inventory will facilitate anxiety research and the further development of the model in the Chinese-speaking societies.

KEY WORDS: …………………

A three-dimensional conceptualization of performance anxiety was recently proposed, based on both conceptual and empirical considerations (for details, see Cheng, Hardy, & Markland, 2009). Performance anxiety refers to an unpleasant psychological state in reaction to perceived threat

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concerning the performance of a task under pressure. The main feature of this conceptual model is that in addition to the conventional intensity-oriented dimensions of 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. In more detail, based on the worry-emotionality model of anxiety (Liebert & Morris, 1967; Morris, Davis, & Hutchings, 1981), conceptualizations of anxiety seem to have emphasized its maladaptive role in performance. However, much research has supported the notion that anxiety could be facilitative on performance in the contexts of test, music and sports performance (Alpert & Haber, 1960; Hardy, 1996; Hardy, Woodman, & Carrington, 2004; Parfitt & Hardy, 1993; Parfitt & Pates, 1999; Wolfe, 1989). Consequently, 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, 2000). More specifically, anxiety is 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 motivation via a control system involved in anxiety to monitor and evaluate performance, and to plan and regulate the use of processing resources. Additional resources may be applied (e.g., effort) due to increased motivation under pressure. Furthermore, the utilization of a control system appears to be an important characteristic that differentiates anxiety from depression (Eysenck, 1992; Mathews, 1992). According to Diagnostic and Statistical Manual of Mental Disorder, fourth edition (*DSM-IV*; APA, 1994), the diagnostic criteria for generalized anxiety disorder include not only excessive levels of anxiety but also uncontrollability (over worry).

Along similar lines, Carver and Scheier (1988) proposed a control-process model of anxiety in which favorable versus unfavorable expectancy regarding coping and completion of actions was a critical variable, causing a fundamental variation in responses to and the effects of anxiety. Collectively, as self-evaluation is one of the key factors underlying anxiety (Gibbons, 1990; Izard, 1972), it is logical to posit that anxious individuals may evaluate not only environmental and internal threats (inducing cognitive and/or physiological anxiety), but also their capabilities for coping with them and for meeting task demands in reaction to performance threat (resulting in various levels of perceived control). That is, characteristics of anxiety appear to include not only the conventional intensity symptoms of cognitive and physiological anxiety, but also perceptions of control (or lack of control). With this regulatory dimension included as a reflection of coping capacity involved in the anxiety dynamics, the potential adaptive or positive effects of anxiety can better be realized.

In addition, Cheng et al.'s (2009) model of performance anxiety adopts the approach to multidimensionality that has been proposed in the test anxiety literature, namely, that further anxiety components should be considered in order to better understand the construct (Hagvet & Benson, 1997; Hodapp & Benson, 1997; Sarason, 1984; Schwarzer & Jerusalem, 1992). In line with a broad cognitive perspective (Johnson-Laird & Oatley, 2000), many integrated models of anxiety that go beyond the two components of worry and emotionality have been proposed across various fields of psychology (Hodapp & Benson, 1997; Mathews, 1990; Rost & Schermer, 1992; Schwarzer & Jerusalem, 1992; Wolfe, 1989). Taken together, apart from the additional regulatory element of anxiety that is represented by the component of perceived control, the range of cognitive anxiety considered by Cheng et al. (2009) was broadened to include self-focused attention (hereafter labeled self-focus) as well as worry. The main rationale to include self-focus was through the notion of self-evaluation involved in the anxiety dynamics (Gibbons, 1990; Izard, 1972). Anxious individuals have been characterized as being pre-occupied especially with regard to salient personal weakness (Schwarzer & Jerusalem, 1992). Such a self-evaluative state cannot occur unless attention is focused upon the self. Moreover, physiological anxiety has been differentiated into autonomic hyperactivity and somatic tension, according to anatomical structure (involuntary vs. voluntary structure). This differentiation is based mainly on the criteria utilized in the Diagnostic and Statistical Manual of Mental Disorder, third edition-revised (*DSM-III-R*; APA, 1987), and has been adopted in the research on clinical anxiety (Ohman, 2000) and test anxiety (Sarason, 1984). Such an integrated framework offers a more comprehensive perspective, which may better reflect the nature of anxiety and the complex anxiety-performance dynamics.

In our previous research (Cheng et al., 2009), a preliminary measure assessing the proposed conceptualization of performance anxiety was developed in English, and the factorial validity of the model was examined via confirmatory factor analysis (CFA) in two British samples. Of particular note was the finding that each pair of subcomponents of cognitive and physiological anxiety appeared to share some common features. More specifically, worry and self-focus were both defined as negatively toned and both related to a self-evaluative state. Similarly, both autonomic hyperactivity and somatic tension referred to physiological responses in reaction to perceived threat, which implied that their underlying mechanism may likely overlap to some degree. Consequently, the model testing in our previous research was to confirm whether the factor structure was best presented as a hierarchical five-dimensional model or a three-dimensional first-order model (with worry and self-focus merged into a single dimension of cognitive anxiety, and autonomic hyperactivity and somatic tension merged into one dimension of physiological anxiety). The study findings revealed support for a three-dimensional first order model, rather than a hierarchical five-dimensional model, due to the high inter-correlation between worry and self-focus, and between autonomic hyperactivity and somatic tension. Although the empirical distinction between these paired subcomponents for cognitive/physiological anxiety was weak using CFA, the Satorra-Bentler scaled chi-square tests (Satorra & Bentler, 2001) did show potential to separate them at a more detailed level on separately testing the two-factor models of each set of paired subcomponents. Consequently, the subcomponents of cognitive and physiological anxiety were retained at a descriptive (conceptual) level until further examination of their discriminant validity could be obtained in future empirical research.

The present paper presents a cross-cultural validation of the proposed measurement model of performance anxiety because cross-validation of a model across cultures has been suggested to offer a strong test of the validity of models (Sue & Chang, 2003; Van de Vijver & Leung, 1997). In summary, the objectives of this study were: 1) to develop a Chinese measure based on the conceptual framework presented by Cheng et al. (2009) together with its concordant measure of performance anxiety established earlier in English, and 2) to confirm the three-dimensional factor structure of the measure through CFA in three Chinese (Taiwanese) samples of sports performers.

Initial Development of the Measure

An initial item pool with approximately 120 English items was generated in our previous research (Cheng et al., 2009) as the basis for measurement development to assess worry, self-focus, autonomic hyperactivity, somatic tension, and perceived control. These items were consistent with the definitions of their corresponding subcomponents within the proposed model. The five anxiety elements were defined by the authors based on an extensive review of the anxiety-related literature (Baumeister, 1984; Carver & Scheier, 1988; Cox, Martens, & Russell, 2003; DSM-III-R, APA, 1987; Dunn, 1999; Duval & Wicklund, 1972; Eysenck, 1992; Fenigstein, Scheier & Buss, 1975; Gibbons, 1992; Hardy, 1996; Liao & Masters, 2002; Martens, Burton, Vealey, Bump, & Smith, 1990; Mathews, 1992; Ohman, 2000; Rost & Schermer, 1992; Sarason, 1984; Schwarzer & Jerusalem, 1992; Wicklund & Gollwitzer, 1987). The content of each subcomponent was operationalized fairly broadly. For example, the themes for "worry" (defined as a cognitive form of apprehension associated with possible unfavorable outcomes) included fear of failure, worry about making mistakes, and worry about uncertainty. Likewise, a range of content for "self-focus" (defined as an attentional shift to the self, leading to a self-evaluative state with an increased awareness of self-shortcomings concerning performance of the task under pressure) included increased awareness of negative self-evaluation, scrutiny of motor movement, being watched and judged, etc. Typical manifestations of "autonomic hyperactivity" (defined as physiological reactions involved with the involuntary muscle groups that are associated with the body's inner organs) included perceived breathlessness, cold sweat, increased heart rate, and dry mouth, etc. Manifestations of "somatic tension" (defined as physiological reactions involved with the voluntary muscle groups that are motor-oriented) included perceived trembling, muscle tension, fatigue, etc.. Lastly, the content areas of "perceived control" (defined as perception of one's capabilities to cope and attain goals under stress) 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 established guidelines for questionnaire design (Hippler, Schwarz, & Sudman, 1987). Based on the above process and the consensus of the authors, a preliminary measure (with 29 items) was developed, and examined through CFA using two British samples. Finally, a 25-item English measure of performance anxiety, showing appropriate reliability and factorial validity, was established (Cheng et al., 2009).

Based on the English version of the three-factor anxiety inventory, several steps were taken to construct a Chinese version. First, the 25-items of the English measure were inspected for culture-specific content, and none was found. That is, all the wordings were straightforward and could be translated into Chinese without difficulty. 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 added to the Chinese version to increase scale representativeness. In the English version of the measure, the three lowest factor loadings (all below .40) were revealed in the self-focus subscale and the two physiological subscales. Consequently, one item was added to self-focus (i.e., “I am aware of my negative emotions”), and two items to each subscale of physiological anxiety (“I am not breathing smoothly” and “My chest feels tight” for autonomic hyperactivity, and “My neck feels tense”, and “My body feels shaky” for somatic tension). 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 twelve items for cognitive anxiety (four for worry and eight for self-focus), twelve items for physiological anxiety (six items for each physiological subcomponent), and six items for the regulatory dimension of anxiety (perceived control). Despite these additions, the measures of both versions were considered compatible as all the inventory items of both versions were well-operationalized in accordance with the definition of their corresponding anxiety components. Both measures were also directly developed by the authors who proposed the conceptual model of performance anxiety and defined each anxiety component, and who possessed an understanding of both cultures. This should have effectively maximized the measurement equivalence of both versions at a conceptual level across cultures. In addition, this initial Chinese measure of anxiety was pilot tested on fifteen sports participants from the targeted population to ensure the clarity of wording and comprehensibility of the inventory.

Method of data analysis

Throughout the present studies, confirmatory factor analysis was employed using maximum-likelihood minimization estimation to assess factorial validity via LISREL 8.72 and PRELIS 2.72 (Joreskog & Sorbom, 2005). 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 procedure progressively tests the model from one to multiple factors primarily for diagnostic purposes to prospectively reduce potential problems by deleting inadequate items (e.g., low factor loadings, or troubling residual patterns). On testing the whole model, parceling (Marsh, Antill, & Cunningham, 1989) was employed where necessary to reduce the number of parameters that had to be estimated when the sample size was too small to obtain a stable estimation. Parceled models were produced by constructing composite scores from random combinations of items from the same first-order subcomponent. Such composite variables are typically more normally distributed and more reliable than the original variables (Marsh et al, 1989).

Goodness of fit was assessed at each stage. The global model fit indices were examined, along with detailed assessment of fit via 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 was the principal means of assessing model fit, with large χ^2 values relative to the degrees of freedom indicating a poor fit and small values a good fit. Nevertheless, arguments about how the χ^2 test should be best interpreted 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). Consequently, multiple criteria were also used in the present research to assess global fit as well as the χ^2 statistic. These criteria were the Root Mean Square Error of Approximation (RMSEA; Steiger, 1990), the Comparative Fit Index (CFI; Bentler, 1990), and the Standardized Root Mean Square Residual (SRMR). The cut-off levels required for good fit is the subject of much debate in the literature. Although RMSEA values of .08 or less have been suggested to be acceptable (McDonald & Ho, 2002), more stringent criteria have recommended that RMSEA values $\leq .06$, SRMR values $\leq .08$, and CFI values $\geq .95$ are required for an acceptable 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 30-item Chinese measure, including the characteristics and strength of the individual items, and the factorial validity of the model.

Method

Participants. A Chinese sample of 203 university-based participants was drawn from sports teams and athletics clubs in the colleges of physical education in Taiwan. The sample included a wide range of sports (30 types), and various skill levels, ranging from international or national (39.9%), through club, school, and regional (34.5%), to recreational level (25.6%). 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. Consent for participation was obtained from all participants. The inventory was administered individually or in small groups at practice sites in a secluded location near training facilities, but not before competition or any major life events to prevent possible cognitive bias due to internal or external distractions. Participants were briefed on the objective of the study and the instructions for the inventory. They were asked to focus on the most recent important sports event that was performed under pressure and could be remembered clearly. They were then asked to recall how they felt before that specific sports performance. Retrospective data were collected in order to: (a) enhance compatibility with the previous retrospective English studies (Cheng et al., 2009), and (b) prevent intrusions on pre-game preparation and potential response bias due to pressure. The recalled timeframe was from within two days (30%), one week (40.4%), to two months (29.6%).

Results

Although structural equation modeling (SEM) requires relatively large samples in order to achieve 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, 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 exhibited a ratio of 13.5:1 which 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 parameter estimates are not usually seriously affected by such violations, χ^2 tends to be inflated and standard errors deflated. Hence, the Satorra-Bentler scaled χ^2 (Robust χ^2; Satorra & Bentler, 1988) was utilized, which corrects the χ^2 statistic for non-normality and takes into account multivariate kurtosis (Hu & Bentler, 1995).

Under sequential CFA, three items were removed from the self-focus subscale, and four items were dropped from the physiological subscales (two items from each physiological subcomponent). These seven items were deleted due to low factor loadings, problematic residual patterns, or high modification indices. Following this item deletion, the fit indices of the one- and two-factor models were good (see Table 1). As in the Cheng et al. (2009) studies, the inter-factor correlations between worry and self-focus (r = .96), and between autonomic hyperactivity and somatic tension (r = .88), were both high.

At the final stage, the observed variables of the full model were parceled to reduce the number of parameters that needed to be estimated and thereby obtain a stable estimation. Given the relatively small sample, six composite variables were constructed by randomly combining items that indicated the

TABLE I

Fit indices for the one- and two-factor models in three analyses.

Robust χ^2	*df*	*p*	**RMSEA**	**CFI**	**SRMR**	**Study 1**
ONE-FACTOR MODELS						
Worry	4.40	2	.08	.08	.99	.03
Self-focus	2.70	5	.55	.00	1.00	.02
Autonomic hyperactivity	1.39	2	.04	.00	1.00	.02
Somatic tension	.04	2	.97	.00	1.00	.00
Perceived control	13.52	9	.04	.05	.99	.03
TWO-FACTOR MODELS						
Cognitive anxiety	24.45	26	.22	.00	1.00	.04
Physiological anxiety	25.01	19	.02	.04	.99	.04
Study 2-Stage 1						
ONE-FACTOR MODELS						
Worry	.99	2	.57	.00	1.00	.01
Self-focus	11.39	9	.07	.02	1.00	.03
Autonomic hyperactivity	8.15	2	.01	.08	.98	.03
Somatic tension	.41	2	.80	.00	1.00	.01
Perceived control	5.14	2	.06	.06	1.00	.02
Two-factor Models						
Cognitive anxiety	49.46	34	.00	.03	.99	.03
Physiological anxiety	36.20	13	.00	.06	.98	.04
Study 2-Stage 2						
ONE-FACTOR MODELS						
Worry	.64	2	.70	.00	1.00	.01
Self-focus	5.95	9	.51	.00	1.00	.03
Autonomic hyperactivity	2.73	2	.19	.04	1.00	.02
Somatic tension	.51	2	.76	.00	1.00	.02
Perceived control	4.24	2	.12	.07	.99	.02
TWO-FACTOR MODELS						
Cognitive anxiety	30.00	34	.31	.00	1.00	.03
Physiological anxiety	12.92	13	.12	.00	1.00	.03

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

same first-order subcomponent of anxiety. In light of the high correlations between the pairs of subcomponents reported above, worry and self-focus were collapsed into a single factor for the cognitive dimension, and autonomic hyperactivity and somatic tension were collapsed into a single factor for the physiological dimension, in the final test of the full model. This three-dimensional first-order model fitted well with Robust $\chi^2(6) = 4.1$, $p = .57$; RMSEA = .00, CFI = 1.0, and SRMR = .02. This 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, CFI = .97, and SRMR = .07.

The factor loadings of the final 23 retained items were all significant, ranging from .76 to .41, with 19 (83%) items achieving a loading higher than .50. The cognitive dimension had nine items (four for worry and five for self-focus), the physiological dimension had eight items (with four for each physiological subcomponent), and the regulatory dimension (perceived control) had six items. Cronbach's alphas for these three subscales ranged from .81 to .85.

Study 2: Refinement and Factorial Validation of the Measure

Stage 1: Refinement of the Measure

There were two stages involved in Study 2**.** The objective of Stage 1 here was to conduct a refinement to the instrument developed in Study 1, and to further validate the factor structure of the model in an independent sample. To improve the validity of the 23-item measure, two more items were added to the subscale of self-focus as the correlation between worry and self-focus was very high ($r = .96$), and three items of self-focus had been deleted in the previous CFA procedure in Study 1. The refined measure thus contained 25 items.

Method

Participants. A diverse university-based sample of 686 participants ($n_{\text{Men}} = 397$; $n_{\text{Women}} = 289$) was drawn from sports teams and athletics clubs in the colleges of physical education in Taiwan, with 35 sports and various levels of skill ability represented. To enhance the validity of the testing, a cross-validation procedure was applied, adapted from the widely used split-half cross-validation (Everett, 1983). Thus, the 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 stage, and the second sub-sample of 236 cases was used as a validation sample for the next stage. Providing that the two sub-samples had similar characteristics, the CFA results should be replicable to confirm the factorial validity of the model. The current calibration sample involved 34 different sports, 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. Using the same procedure as was used in Study 1, retrospective data were collected from within two days (29.1%), one week (43.6%), to two months (27.3%) of the event recalled. Data were analyzed in the same way as in Study 1.

RESULTS

The present sample (N = 450) was adequate to test the full model without any need for parceling as the cases to estimated parameters ratio was 10:1. 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. Consequently, Robust χ^2 was again employed to adjust for the non-normality of multivariate distributions.

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, or high modification indices. Following item deletion, all one- and two-factor models exhibited a fair fit (see Table 1), with the exception of the single-factor model of autonomic hyperactivity, which had a large Robust $\chi^2(2) = 8.15$, $p = .01$; and marginal RMSEA = .08 (but CFI = .98, and SRMR = .03). The inter-factor correlations between worry and self-focus (r = .87), and between autonomic hyperactivity and somatic tension (r = .94) were again both high.

A (non-parceled) three-dimensional first-order model was tested in which worry and self-focus, and autonomic hyperactivity and somatic tension, were merged into single factors. The fit indices were: Robust $\chi^2(186) = 459.4$, $p < .001$; RMSEA = .057; CFI = .97; and SRMR = .06 (see Figure 1). The χ^2 statistic was relatively large (relative to the degrees of freedom); however, the other fit indices suggested a good fit. Collectively, these results were taken to indicate an acceptable fit of the data to the three-dimensional model.

The factor loadings of the final 21 retained 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 1). The cognitive dimension had ten items (four for worry and six for self-focus), the physiological dimension had seven items (four for autonomic hyperactivity and three for somatic tension), and the regulatory dimension (perceived control) had four items (see Appendix for the Chinese three-factor anxiety inventory together with its English translation and the factor loadings). Cronbach's alphas for the three subscales ranged from .78 to .85.

STAGE 2: REPLICATION OF THE FACTORIAL VALIDITY

The objective of this stage was to cross-validate the 21-item measure of performance anxiety using a validation sample. The psychometric properties

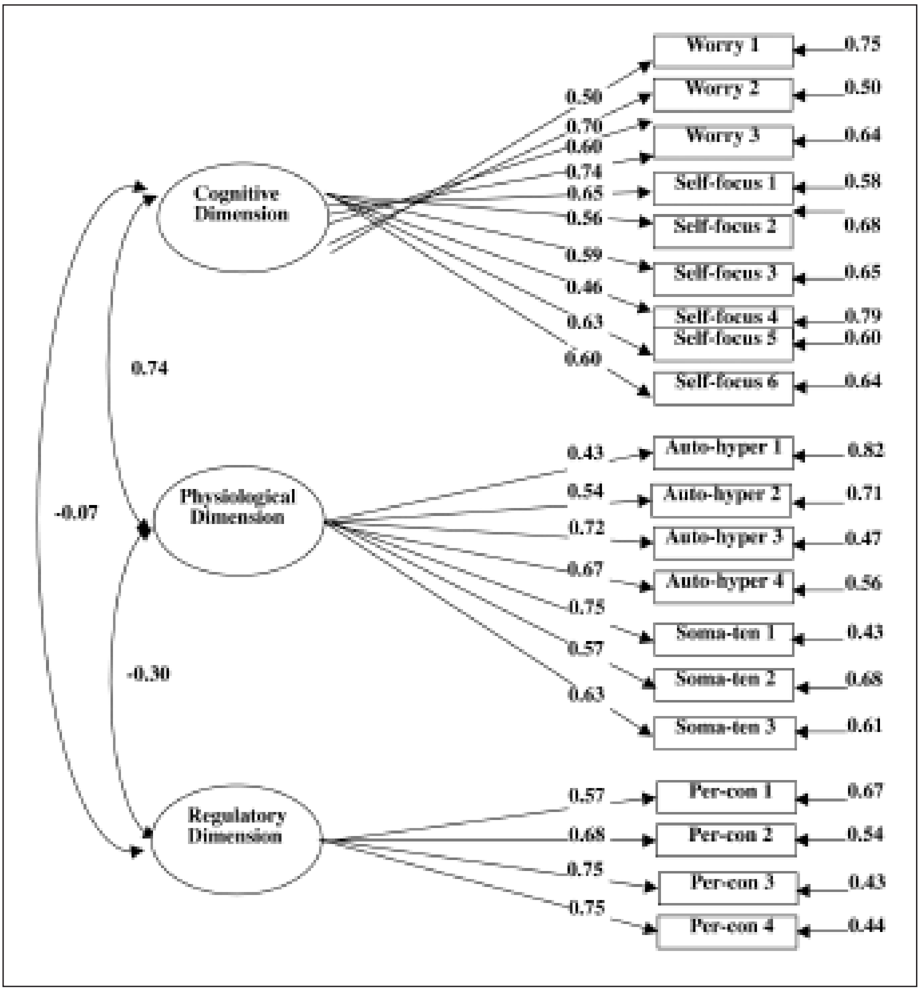

Fig. 1 - Results of confirmatory factor analysis for the final (non-parceled) model in Study 2 (Stage 1). Model fit indices were Robust $\chi^2(186) = 459.4$, $p = .00$; RMSEA = .057, CFI = .97, and SRMR = .06. All data shown were completely standardized solution.

as well as the factorial validity were examined under a loose replication strategy (Diamantopoulos & Siguaw, 2000), in which the validation sample here was analyzed using the same model specification as in the previous calibration sample.

Method

Participants. The cross-validation sample ($N = 236$) was obtained from a random split of the whole sample ($N = 686$) described earlier in Stage 1. The characteristics of the present sample corresponded well to that of the previous calibration sample, consisting of a variety of sports (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 were retrospective, with the timeframe within two days (31.8%), one week (44.0%), to two months (24.2%) of the recalled event. Data were analyzed in the same way as previously.

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 in the previous studies to adjust for 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 autonomic hyperactivity and somatic tension ($r = .96$). 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. As predicted, a parceled three-dimensional first-order model revealed a good fit, with Robust $\chi^2(24) = 41.4$, $p < .001$; RMSEA =.056, CFI = .99, and SRMR = .047. 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, CFI = .98, and SRMR = .076.

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. Cronbach's alphas for the three subscales ranged from .80 to .87.

Discussion

Based on a three-dimensional conceptualization of performance anxiety, the present paper reports the development of a Chinese measure of performance anxiety (titled "Three-Factor Anxiety Inventory-Chinese version", TFAI-C) and its factorial validation in the context of Chinese sports. Consistent with the previous CFA findings in the English studies (Cheng et al., 2009), the factor structure of the three-dimensional first-order model of performance anxiety was supported through three CFA tests in Taiwan. The factorial validity of the model was considered to be strengthened particularly through cross-validation across cultures (Sue & Chang, 2003; Van de Vijver & Leung, 1997).

When the two-factor models were tested, the correlations between worry and self-focus (with *r*s ranging from .87 to .96), and between autonomic hyperactivity and somatic tension (with *r*s ranging from .88 to .96), were both high. These findings are consistent with the English data (Cheng et al., 2009) as these paired subcomponents for cognitive/physiological anxiety appear to have some shared characteristics (see the introduction of the present paper for further details). However, confirmatory factor analysis is not the only study option for assessing empirical differentiation of psychological constructs. These paired subcomponents of anxiety may impact performance differently in germane contexts (for example, under specific sport types, task demands, and skill levels). Consequently, a homogeneous sample (with one or more similar sports within a more limited range of skill level) using a prospective design would be a sensible future research alternative to examine the differentiation between these subcomponents. More importantly, although the present anxiety framework is best presented as a three-dimensional first-order model (rather than a hierarchical five-dimensional model), the integrity of the general conceptualization is still considered intact as the factor structure supported distinctly the three major processes (i.e., cognitive, physiological and regulatory) that are proposed to be activated in the dynamics of anxiety from a broad cognitive perspective.

Whilst the three factors (cognitive, somatic anxiety and self-confidence) represented in the Competitive Sport Anxiety Inventory (CSAI-2; Martens et al., 1990) might appear to correspond to the present three dimensions, they are fundamentally different in several aspects, as addressed in previous research (Cheng et al., 2009). Most obviously, the present framework has been developed from a variety of theoretical viewpoints. It explicitly emphasizes the adaptive potential of anxiety and includes a regulatory dimension; whereas the data-driven model of the CSAI-2 clearly shows no concern for such a coping capacity involved in anxiety. In more detail, self-confidence was not originally included as an anxiety element in the CSAI-2, but emerged unexpectedly as an additional factor via exploratory factor analysis in the process of measurement validation. Martens et al. (1990) later proposed that self-confidence was dependent on worry as the bipolar opposite end of cognitive anxiety, a notion that has been consistently challenged empirically (Hardy, 1996; Hardy, Woodman, & Carrington, 2004; Woodman & Hardy, 2003). Apparently, the role of self-confidence in the CSAI-2 is in contrast to that of perceived control as a regulatory element of anxiety in the present model, even though both constructs are involved in goal-attainment.

The 21-item Chinese measure of performance anxiety exhibited significant factor loadings and good internal consistency. The measure appeared comparable to the English version of the measure (Cheng et al., 2009) in representing the proposed model of performance anxiety. Both 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 the factor structure was confirmed between the English and Chinese measures, which has been proposed as a necessary indication for conceptual equivalence of measures across cultures (Butcher, Cheung, & Lim, 2003; Leung & Wong, 2003). Nevertheless, further research is necessary to provide additional psychometric properties of the measure, for example, concurrent and predictive validities.

Finally, the pre-competitive anxiety data in the present studies were collected retrospectively. Whilst some researchers criticize the collection of retrospective data, this approach to the collection of anxiety data has been validated by previous researchers (Butt, Weinberg, & Horn, 2003; Hanin, 1986). Furthermore, although there are possible limitations to such an approach, there are also advantages when it is compared to the collection of prospective data. For example, the undesirable effects of response bias due to social desirability, or self-defense as a coping style (Hippel et al., 2005), may be reduced. Furthermore, a retrospective design may create least ethical concerns regarding possible intrusion on pre-game mental preparation. Despite the promise offered by the present findings, future prospective research would be desirable to confirm the current results, and the anxiety measure could be refined further along the development of the measurement. Above all, it is undoubtedly required 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 (Smith & McCarthy, 1995).

Appendix

The Chinese Three-Factor Anxiety Inventory with corresponding factor loading and English translation for each scale item.

Subscale of cognitive anxiety

Worry

我 擔 心 無 法 發 揮 應 有 的 實 力 (Factor loading = 0.50)
I am worried that I may not perform as well as I can.
我 擔 心 表 現 會 失 誤 (0.70)
I am worried about making mistakes.
我 擔 心 表 現 失 敗 的 相 關 後 果 (0.60)
I am worried about the consequences of failure.
我 擔 心 表 現 不 佳 (0.74)
I am worried about performing poorly.

Self-focus

我 意 識 到 自 己 內 在 不 利 於 表 現 的 弱 點 (0.65)
I tend to dwell on shortcomings in my performance.
我 感 到 自 己 在 評 估 各 種 對 表 現 不 利 的 因 素 (0.56)
I find myself evaluating unfavorable factors concerning performance.
我 意 識 到 自 己 內 在 負 面 的 情 緒 (0.59)
I am aware of my own negative emotions.
我 意 識 到 別 人 將 會 嚴 厲 評 價 我 的 表 現 (0.46)
I am conscious that others will judge my performance.
我 意 識 到 自 己 的 表 現 可 能 不 會 讓 人 滿 意 (0.63)
I dwell on how I might fail to impress important others.
我 意 識 到 別 人 將 會 看 到 我 在 表 現 上 的 缺 點 (0.60)
I am aware that important others will notice my shortcomings in performance.

Subscale of physiological anxiety

Autonomic hyperactivity

我 感 到 手 心 出 汗 (0.43)
My hands are clammy.
我 覺 得 比 平 時 想 上 廁 所 (0.54)
I feel the need to go to the toilet more often than usual.
我 感 覺 呼 吸 不 順 暢 (0.72)
I am not breathing smoothly.
我 的 胸 部 有 壓 迫 感 (0.67)
My chest feels tight.

Somatic tension

我 感 到 焦 躁 不 安 (0.75)
I feel restless.
我 感 到 較 容 易 疲 勞 (0.57)
I feel easily tired.
我 的 頸 部 感 到 僵 硬 (0.63)
My neck feels tense.

Subscale of regulatory dimension of anxiety

Perceived control

我 在 表 現 過 程 中 能 保 持 專 注 (0.57)
I can stay focused during my performance.
我 可 以 達 成 所 設 定 的 表 現 目 標 (0.68)
My performance goal is achievable.
我 覺 得 自 己 已 經 做 好 上 場 表 現 的 準 備 (0.75)
I feel ready for my performance.
我 相 信 自 己 運 動 表 現 的 實 力 (0.75)
I believe in my ability to perform.

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