The Psychobiosocial States (PBS-S) Scale: Factor Structure and Reliability

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Abstract

This study examined the factor structure and reliability of the Psychobiosocial States (PBS-S) scale in the assessment of situational performance-related experiences. We administered the scale to 483 Finnish athletes before a practice session to assess the intensity and perceived impact of their performance-related feeling states. The hypothesised two-factor structure indicating functional effects (10 items) and dysfunctional effects (10 items) towards performance was examined via exploratory structural equation modelling (ESEM), and confirmatory factor analysis (CFA). Regarding the intensity and perceived impact dimensions of reported states, ESEM and CFA showed a good fit for a two-factor solution of a 14-item PBS-S scale (7 functional and 7 dysfunctional items). For both intensity and impact ratings, core state functional modalities were bodily, cognitive, and volitional, while core state dysfunctional modalities were volitional, operational, and anxiety. Findings support the use of a 14-item PBS-S scale to measure a range of pre-performance states.

Keywords: IZOF model, emotion, feelings, measure

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Emotion research in sport during the past 40 years has focussed on the impact of discrete emotions on athletic performance, mostly precompetitive anxiety (for reviews, see Hanton, Neil, & Mellalieu, 2008; Mellalieu, Hanton, & Fletcher, 2006). However, athletes typically experience several pleasant and unpleasant feeling states, some of which can aid sport performance while others can disrupt it. The study of athletes' performance related experiences has been guided by the individual zones of optimal functioning (IZOF) model (Hanin, 2000, 2007). The model uses a systems approach (Ganzen, 1984) in the description of athletes' experiences related to performance. A systems description comprises five basic defining characteristics (i.e., form, content, intensity, time, and context), which are referred to as penta-basis. The model holds that the form characteristic of a psychobiosocial state is a situational condition manifested in eight interrelated modalities including emotional, which is a central modality, cognitive, motivational, and volitional (psychological modalities); bodily and motor-behavioural (biological); operational and communicative (social modalities; Hanin, 2000, 2007; Ruiz, Hanin, & Robazza, 2016). Form modalities together with content (quality), and intensity (quantity) describe the structure of the athlete's experiences, while time (e.g., before, during, or after) and context (e.g., practice or competition) provide information about the dynamics of such experiences (for a detailed description, see Hanin, 2000). Other researchers also share the multiple-form notion. For example, Blascovich and Tomaka (1996) assume that emotional states result in a motivated response including emotional, cognitive, and behavioural factors.

Previous IZOF-based research indicated that athletes' descriptions of their performance related feeling states include emotion and non-emotion content. For instance, karate athletes' freely generated descriptions of their optimal performance states had emotion and non-emotion content connotations (Ruiz & Hanin, 2004a). Athletes' symbolic

descriptions of their states in most successful and unsuccessful performances also had direct emotion and non-emotion connotations (Hanin & Stambulova, 2002; Ruiz & Hanin, 2004b). Research using stimulus lists showed that athletes experienced a wide range of emotion and non-emotion descriptors for their optimal and dysfunctional feeling states accompanying successful and poor performances (Bortoli, Bertollo, & Robazza, 2009; Di Corrado, Vitali, Robazza, & Bortoli, 2015; Hanin & Stambulova, 2002; Ruiz & Hanin, 2004a, 2004b). Existing empirical evidence provides support for the validity and utility of the multimodal description of psychobiosocial states as conceptualized within the IZOF model (for an overview, see Ruiz, Raglin, & Hanin, 2017). A multidisciplinary approach integrating motor behaviour, sport psychology, and psychophysiology domains has been advocated for the assessment of performance-related experiences (Bertollo et al., 2013).

From a methodological perspective, researchers have paid most attention to the emotional modality. Existing measures of athletes' emotions are framed in group-oriented or individualized approaches. Traditionally, standardized emotion instruments in sport used two perspectives: global affect or discrete emotions. A global affect approach (Watson & Tellegen, 1985) is based on hedonic tone (pleasant–unpleasant) distinctions, while a discrete emotion approach (e.g., Lazarus, 2000), advocates the study of basic emotion syndromes, such as happiness, anxiety, joy, fear, or anger. In the sport context, for example, the latter approach was used in the development of the Sport Emotion Questionnaire (SEQ; Jones, Lane, Bray, Uphill, & Catlin, 2005). In the IZOF model, both global affect and discrete emotions approaches are combined using idiosyncratic items conceptualized in terms of hedonic tone and functionality distinctions (Hanin, 2000, 2007; Hanin & Syrjä, 1995; Ruiz & Hanin, 2004a). In line with Jones et al.'s (2005) call to assess a broader range of emotional states, Ruiz et al. (2016) developed an individualized procedure to measure each of the eight form modalities of a psychobiosocial state. A nomothetic version of the scale was then

developed and validated in a trait-like format in which the items were rated in terms of intensity, frequency, and perceived impact (Robazza, Bertollo, Ruiz, & Bortoli, 2016). However, the reliability and item characteristics of a state-like version of the scale remained unexplored. Therefore, the Psychobiosocial States (PBS-S) scale was proposed to measure the intensity and functional impact of athletes' current feeling states.

Functionality or perceived impact, oftentimes termed "direction", has been examined on separate scales in particular as applied to anxiety (e.g., Jones & Swain, 1992). In the PBS-S scale, athletes identify qualitatively different items that are functional or dysfunctional. In addition, athletes provide information about the perceived impact of their feeling states on their performance. Empirical qualitative evidence supports the practical utility of the individualized profiling before most successful and unsuccessful performances. For instance, the PBS-S scale has been successfully applied, using an individualized approach, to measure athletes' states before their most successful and poor performances (Ruiz et al., 2016). Findings indicate that descriptors selected by the participants reflected several modalities of a state including a wide range of emotional and non-emotional experiences associated with their performances. Participants chose different words to describe their states before their most successful performances compared to poor performances, as well as in describing multiple successful or poor achievements. High variability in the intensity of these experiences was found in competitions, with high intensity of functional states and low intensity of dysfunctional states reported for successful performances, while the opposite was true for unsuccessful performances.

Drawing on the IZOF model perspective, the purpose of the current study was to examine the structural properties of the PBS-S scale as administered to a large sample of participants. Assessment included the intensity and perceived impact (functionality) of athletes' current states. In particular, we explored the item characteristics, factor structure, and

reliability of the scale for the assessment of the eight form modalities of a state (i.e., emotional, cognitive, motivational, volitional, bodily-somatic, motor-behavioural, operational, and communicative).

Materials and Methods

Participants

We purposefully involved in the study athletes having a wide experiential knowledge. Participants were 483 Finnish athletes (277 men and 206 women; mean age = 20.27 ± 4.23 years) involved in team sports (n = 357; e.g., floorball, basketball, volleyball, futsal) and individual sports (n = 126; e.g., figure skating, gymnastics, orienteering). One hundred and ninety-eight participants were competing at the first national divisions or at international level (e.g., European or World Championships), while 285 took part in regional level competitions.

Instrument

The PBS-S scale was derived from the Individualized Emotion Profiling developed by Ruiz et al. (2016). As described in the Ruiz et al.'s study, the following steps were taken to capture idiosyncratic relevant content and to generate synonym adjectives forming each specific item of the scale: selection of descriptors contained in existing individualized scales, item revision by a panel of experts, and scale validation with two groups of athletes. The scale consists of 20 rows of 74 descriptors (3-4 per row) assessing eight modalities of a performance state (i.e., emotional, cognitive, motivational, volitional, bodily-somatic, motor-behavioural, operational, and communicative). A row of synonym descriptors formed an item. Each modality is assessed by two rows of items, one categorized as functional and the other as dysfunctional for performance. As an exception, the emotional modality is assessed on six rows of functional (+) and dysfunctional (–) items assessing pleasant, anxiety-related, and anger-related emotions. First, athletes select one word answering the question "how do you feel right now in relation to your forthcoming performance?" Second, they rate the intensity

on a scale ranging from 0 (*nothing at all*) to 4 (*very much*). Third, in line with previous research assessing functional impact of anxiety (Jones & Swain, 1992; see Hanton et al., 2008 for review) athletes assess the anticipated impact on performance on a scale ranging from +3 (*very helpful*) to -3 (*very harmful*), with 0 indicating no effect. Participants are first asked to consider whether the impact of their states is helpful (+) or harmful (-) and then to rate the magnitude of the impact.

Back translation procedures and expert review were conducted to develop the Finnish version of the PBS-S scale. First, a bilingual person translated the items from English into Finnish. Second, a panel of three academics whose first language was Finnish, competent in written and spoken English and familiar with the instrument, examined the translated version. Third, the panel evaluated the items and discussed possible discrepancies making efforts to ensure that the underlying item meaning remained unchanged. Fourth, the modified Finnish version was back translated into English. Fifth, the translated English version was compared to the original to ensure that meaning and intent of the original items were maintained (the PBS-S items are included in the Electronic Supplementary Material 1).

Procedure

Participants were contacted through training centres, sport schools and clubs in five cities in Northern, Central, and Southern parts of Finland. Following approval from the local institution review board, written consent was obtained from all participants. Athletes under 18 years of age gave their assent and a guardian provided written consent. The questionnaire was administered 30 min before a practice session, either individually or in small groups, in a quiet place, close to the participants' training facilities. Questionnaire administration took approximately 15-20 minutes.

Data analysis

Prior to conducting the main analyses, data were screened for missing values, distribution, and multivariate outliers as recommended by Tabachnick and Fidell (2013). Eight cases were identified as outliers and were removed from further analyses. Missing data were below the recommended 5% (i.e., 1.9%), thus, not problematic. The internal structure of the PBS-S scale was examined with M*plus* 7.31 (Muthén & Muthén, 2012) for reported intensity and functional impact separately, using the missing-data function and adjusting for non-normality with the robust full information maximum likelihood estimator. In line with previous research (Marsh et al., 2009; Morin & Maïano, 2011), the analytic strategy involved exploratory structural equation modelling (ESEM), where factor loadings for each item were estimated (see Asparouhov & Muthén, 2009), and confirmatory factor analysis (CFA), where all cross-loadings were constrained to zero. Specifically, the whole sample was divided into two subsamples (sample 1, n = 238; sample 2, n = 237), which were homogeneous in terms of age, gender, sport type practiced, and competitive level. ESEM using bi-geomin orthogonal rotation for uncorrelated factors was conducted on a first subsample. Based on these findings, CFA was performed on the second subsample restricting loadings to influence resulting latent factors. The comparative fit index (CFI), the Tucker-Lewis Index (TLI), the standardized root mean square residual (SRMR) and the root mean square error of approximation (RMSEA) were examined. A good model fit is inferred when values of CFI, and TLI are close to .95; the SRMR is smaller than .08; and the RMSEA is smaller than .06 (Hu & Bentler, 1999).

Results

Preliminary Analysis

A multivariate analysis of variance (MANOVA) was preliminary conducted to examine possible differences across athletes' competitive level (international/national vs. regional) on psychobiosocial modality scores. Results indicated that the two subsamples were

172 homogeneous in regards to both intensity and perceived impact ($p > .05$). All adjectives
173 included in each item were selected by the participants to describe their feeling states prior to
174 performance. Top 10 most selected descriptors were: relaxed-movement [Motor-
175 behavioural(+), 68.9%], fighting spirit [Anger(+), 68.2%], ineffective-task execution
176 [Operational(-), 59.0%], worried [Anxiety(-), 49.6%], sociable [Communicative(+), 48.4%],
177 calm [Pleasant(-), 47.0%], sluggish movement [Motor-behavioural(-), 46.3%], motivated
178 [Motivational(+), 46.2%], uninterested [Motivational(-), 46.2%], and energetic [Bodily(+),
179 43.1%]. Top-10 least selected descriptors were: nervous [Anxiety(+), 13.0%], troubled
180 [Anxiety(-), 11.3%], aggressive [Anger(+), 11.2%], exhausted [Bodily(-), 11.0%],
181 uncommitted [Motivational(-), 11.0%], coordinated-movement [Motor-behavioural(+), 9.9%],
182 furious [Anger(-), 9.3%], uncoordinated [Motor-behavioural(-), 9.3%], sharp [Cognitive(+),
183 7.6%], and effortless-movement [Motor-behavioural(+), 5.0%]. Descriptive statistics for
184 reported intensity and functional impact for the whole sample are presented in Table 1. Item
185 intercorrelations can be found in the Electronic Supplementary Material 2. Participants
186 reported moderate intensity values for functional modalities (e.g., motivational, pleasant, and
187 communicative). Perceived impact ratings were reversed for the Anxiety(+) item, which was
188 perceived as dysfunctional (instead of functional), and the Pleasant(–) item, which was
189 perceived as functional (instead of dysfunctional). These incongruous effects have also been
190 found in previous research (Ruiz & Hanin, 2004b).

191 **Factor Analysis**

192 To examine dimensionality of the PBS-S scale, ESEM of 2-factor models was
193 conducted in the first subsample independently for intensity and functional impact.
194 Problematic items, based on high cross-loadings (> .30) on hypothesized factors, or high
195 values of the modification indices (> 20), were progressively removed. A 14-item solution

[excluding Anxiety(+), Pleasant(-), Communicative(+), Communicative(-), Motivational(+), Motivational(-) items] showed acceptable fit to the data (see Table 2).

A CFA of the 14-item model, conducted on the second subsample independently for intensity and functional impact, fitted data well, allowing the correlation of residuals [Motor-behavioural(-) with Bodily(-), Motor-behavioural(-) with Operational(-), and Volitional(+) with Anger(+)] in the case of states intensity. Figure 1 presents CFA results for the whole sample. Mplus input and output data are contained in the Electronic Supplementary Material 3.

Using the whole sample, the ratio of the factor loading to the standard error was examined to identify best markers, or core modalities of a state. In the case of states intensity, core functional state modalities were: bodily (factor loading to standard error ratio of 21.27), cognitive (17.59), pleasant (12.10), and volitional (11.87). The following were core dysfunctional modalities: volitional (19.06), anger (19.29), anxiety (16.38), and operational (14.66). Regarding perceived impact ratings, core functional state modalities were: bodily (ratio of 15.14), motor-behavioural (13.09), volitional (13.04), and cognitive (12.75). Dysfunctional state modalities were: volitional (21.45), operational (17.27), anxiety (14.91), and motor-behavioural (12.50).

Composite reliability (CR) scores for 14-item PBS-S scale, two-factor models were above .70 for states intensity (functional, CR = .738; dysfunctional, CR= .810) and perceived impact ratings (functional, CR = .782; dysfunctional, CR= .770) indicating good construct reliability. Cronbach's alpha coefficients were above .70 for states intensity (functional α = .742, dysfunctional α = .810) and perceived impact (functional α = .780, dysfunctional α = .767) showing adequate internal consistency. As expected, significant inter-factor correlations were found for intensity (functional and dysfunctional, value of -.299, $p < .001$) and perceived impact (functional and dysfunctional, value of -.529, $p < .001$).

Discussion

This study examined the factor structure and reliability of the Finnish version of the PBS-S scale assessing situational intensity and perceived functional impact of performance-related experiences. The PBS-S scale has been previously administered to high-level athletes using an individualized approach (Ruiz et al., 2016) and in a trait-like format (Robazza et al., 2016). However, no evidence about factor structure or reliability of a state-like version of the scale exists. This study extends literature on the assessment of athletes' performance states by examining *form*, *intensity*, and *content* of psychobiosocial states before (*time*) practice performance (*context*), as well as their perceived impact on performance.

As expected, athletes selected all adjectives included in the items representing eight form manifestations of a psychobiosocial state: emotional, cognitive, motivational, volitional, bodily, motor-behavioural, operational, and communicative. This finding concurs well with the Ruiz et al.'s study (2016) and with IZOF-based research (Hanin & Stambulova, 2002; Ruiz & Hanin, 2004b) indicating that athletes' descriptions of their states reflect emotion and non-emotion content. Athletes reported high intensities of functional states and low intensities of dysfunctional states before their practices. Overall, functional items were perceived as helpful for performance, while dysfunctional modalities were perceived as detrimental except for two items that showed reverse effects.

Poor fit to the data (CFIs and TLIs < .90) was found for a 20-item scale regarding reported intensity (see Table 2). However, after exclusion of communicative and motivational items an adequate fit (CFIs and TLIs > .90 and RMSEAs < .06, on both ESEM and CFA) was obtained for a 14-item solution for situational intensity and impact ratings. There are several possible explanations for the poor fit of a 20-item scale. First, athletes might have different perceptions of the impact (i.e., functional or dysfunctional) of anxiety, pleasant states, and motivation on performance (see Ruiz et al., 2017, for a review). For example, an athlete may

experience a certain level of anxiety (pleasant state or motivation) as helpful while another athlete may perceive the same state as harmful. The perceived impact of the communicative modality was also found to be idiosyncratic. Some athletes tend to isolate themselves to avoid distractions, while some others prefer to communicate with their coach or peers to deal with situational demands (Rees & Freeman, 2012).

A second explanation for the poor fit of a 20-item solution could be related to the inclusion of several items per row. Although it is expected that when the participants read all items in a row they consider them as synonyms, there may be different interpretations of the meaning for each word. The inclusion of several descriptors per row aims at providing athletes choices to best describe their individual experiences, and it is in line with previous individualized assessments (for a review, see Ruiz et al., 2017). This is considered an advantage over existing instruments, and the present results indicate that the PBS-S scale, which includes person and task-relevant items, can be used for intra-individual as well as for inter-individual analysis of athletes' functional and dysfunctional states. A third explanation may be related to athletes' degree of (or lack of) awareness of the functional impact of their experiences (meta-experiences). For instance, some athletes may develop a negative meta-experience (preference or attitude) of anxiety based on common beliefs that unpleasant states are always harmful for performance and that pleasant states are always helpful. In this view, the hedonic experience would determine the individual's perception of performance effects [i.e., anxiety(+) and pleasant(-) states can be perceived as exerting dysfunctional and functional effects, respectively, because of the unpleasant and pleasant hedonic experience]. Further research with participants possessing high experiential knowledge is warranted to better understand individual differences in experiences and meta-experiences.

Regarding the motivational modality, the volitional modality items, to a certain extent, yield information about aspects associated with decision-making processes also related to

motivation (Kuhl, 1987). In line with previous qualitative reports of participants (Ruiz et al., 2006), the perceptions of the impact of the communicative modality are related to being focused or distracted. Thus, an athlete reporting feeling alone or withdrawn may perceive this state as helpful for performance in terms of being focused and avoiding distractions. However, a detrimental interpretation of the same state may be due to a perceived lack of support from significant others (e.g., the coach). Similarly, an athlete may perceive being outgoing, or sociable as either helpful or distracting from the task at hand. Thus, from an applied perspective it is important to assess the intensity of athletes' feeling states and the perceived impact.

An examination of factor loading to standard error ratios revealed that bodily, cognitive, volitional, and pleasant functional items, and volitional, anger, anxiety, and operational dysfunctional items were core markers for feeling states intensity. Similarly, athletes' impact ratings indicated bodily, motor-behavioural, volitional, and cognitive to be core functional items, while volitional operational, anxiety, and motor-behavioural were core dysfunctional items. These results are in line with previous qualitative research showing cognitive, emotional, and operational as most relevant modalities in athletes-generated descriptors of their optimal states (Ruiz & Hanin, 2004a). This finding accords well with the IZOF model conceptualization of a psychobiosocial state as a constellation of individually optimal and dysfunctional emotion and non-emotion content, described by athlete-generated idiosyncratic markers (Hanin, 2000, 2007). The identification of the core elements is important for an understanding of athletes' psychobiosocial states. Using the analogy of degrees of freedom, we contend that the identification of core modalities is similar to the notion of dimensional compression, drawn from motor learning literature and applied to the description of inter-personal coordination (Riley, Richardson, Shockley, & Ramenzoni, 2011). Dimensional compression refers to the reduction of degrees of freedom or elements

and serves to describe collective effects of state modalities. This notion can also be used to "compress" or identify core descriptors within the same modality. A second key feature in the understanding of psychobiosocial states involves information on how state modalities are interrelated. Information about the interrelationships among the key elements is akin to reciprocal compensation, which refers to the ability of one form modality to react to changes in others. For instance, functional psychological modalities (e.g., emotional, volitional, cognitive) are interrelated amongst them, and negatively related to dysfunctional modalities (see Electronic Supplementary Material 2). Thus, both dimensional compression and reciprocal compensation provide important information on psychobiosocial states.

Limitations and Future Research

The inclusion of multiple adjectives in each item may be seen as a limitation. With this procedure, indeed, each psychobiosocial modality is measured by a single adjective rather than by multiple descriptors, thereby resulting in functional and dysfunctional global categories. Asking athletes to rate separately the adjectives forming an item would enable the identification of discrete categories of psychobiosocial states. Future research is warranted to address this limitation. A second limitation is that we assessed athletes' experiences before a practice session rather than before competition. However, and especially with top level athletes, the assessment of performance states before competition may have a detrimental effect of their performance, and it is not always recommended. Retrospective evaluation of pre-competitive states can be a feasible option in future studies. Another limitation is that we did not assess performance in our study, and thus we do not know whether the reported states were associated to successful, average, or poor performances. This issue could be addressed in future research including performance and outcome measures in practice and competition. In addition, qualitative research is needed to shed more light on the individual perceptions of descriptors tapping anxiety, pleasant, motivational, and communicative modalities. Future

research, including psychophysiological indices, is needed to establish the criterion validity of the scale in comparison with other emotion measures.

Electronic Supplementary Material

ESM 1. Psychobiosocial States (PBS-S) scale items.

ESM 2. Item intercorrelations.

ESM 3. Factor analysis input and output data.

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