Czech Adaptation of the Brunel Mood States for Adolescent Athletes

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Abstract

The Brunel Mood States is a 24-items long questionnaire (formerly referred to as the Profile of Mood States for Adolescents POMS-A) used to capture emotional profile of an individual. It has been used in various settings including sport psychology, where it is considered a valid indicator for overtraining syndrome. The aim of this study was to develop the Czech adaptation of BRUMS and verify its psychometric properties in adolescent athletes. The data were collected from a sample of 246 participant (50.8% females; age range 14–19 years). Confirmatory factor analysis was used to evaluate original six-dimensional structure (with factors of Depression, Tension, Confusion, Anger, Fatigue, and Vigor). Even though this model showed acceptable fit to the data, Depression and Tension factors were empirically indistinguishable. Therefore, we proposed and verified alternative five-factor model with these two factors collapsed. Measurement invariance across gender was assessed using the Multiple Indicators Multiple Causes (MIMIC) model. Although three items showed signs of differential item functioning, the Czech adaptation of the instrument can in general be considered a measurement invariant.

Keywords: *emotions assessment, overtraining, gender, BRUMS*

INTRODUCTION

Emotions are an ever-present part of human activities. Researchers in various disciplines put considerable efforts into understanding the role emotions play in our performance, health, and wellbeing. Sport psychologists consider emotions to be a critical factor in either enhancing or impairing individual or team performance (Hanin, 2000). Changes in mood states have also been studied in connection to overtraining syndrome (OTS) and were repeatedly found to be its valid indicator (Goss, 1994; Hollander et al., 1995). OTS can be defined as an abnormal extension of the training process resulting in chronic fatigue, underperformance, and/or an increased vulnerability to infection leading to recurrent infections (Budgett, 1998). OTS is usually accompanied by six emotions: anger-hostility, anxiety, confusion, depression, sadness, and lack of vigor (Henschen, 2000)[1]. It is thus not surprising that in the field of sport psychology the Profile of Mood States (POMS) was established as the most prominent instrument, as it captures all above mentioned emotions. There are various versions of POMS but all of them share the same internal structure with six distinct but interrelated factors: (1) depression-dejection reflects experiences of mood states characterized by feelings of sadness and feelings associated with negative self-schema; (2) tension-anxiety reflects somatic tension (either observable or non-observable) and anxious states; (3) confusion-bewilderment is characterized by mental confusion and cognitive ineffectiveness connected to inability to control attention; (4) anger-hostility captures states of anger and antipathy toward others; (5) fatigue-inertia combines symptoms of tiredness and weariness; (6) vigor-activity reflects states of high energy and vitality.

[1] Henschen in his text prefers medical term *maladaptive fatigue syndrome* but notes that it describes the same phenomenon as OTS.

The first version of POMS (McNair et al., 1971) was developed via factor analytic procedures. It is used mainly for monitoring effect of psychotherapy, medication, sleep deprivation and other experimental interventions in research settings. In the revised version of the instrument's manual McNair, Lorr, and Droppleman (1992) declared that it is valid to use the POMS in sport and exercise environments. The POMS is an adjective checklist which consists of 65 items unevenly distributed into 6 dimensions, which are described in the previous paragraph and one additional dimension called friendliness. The latter dimension is conceptually different from others and thus is not typically used in research practice. The instrument's manual admits two variants of instructions which focus either on actual emotion states ("How you feel RIGHT NOW?") or on temporary mood states ("How have you been feeling over the PAST WEEK, INCLUDING TODAY?"). Individual dimensions can be scored separately or added together (with vigor scored negatively) to determine the total mood disturbance score.

Even though the completion of the POMS questionnaire is in normal and healthy population relatively fast (usually between 3 and 7 minutes), Shacham (1983) argued that the administration can be overly demanding in specific populations like patients with severe pain. Therefore she developed a shortened form of the POMS with 37 items (POMS-SF). Scores for shortened and original versions of POMS shared substantial portion of variance (more than 90% for individual dimensions and 98% for total mood disturbance). Given the fact that shortening of POMS did not resulted in significant loss of information on the level of individual dimensions, the POMS-SF can be considered a good alternative for situations where there are time limits (e.g. research purposes) or respondent limitations (clinical practice). The psychometric qualities of the shortened form were confirmed in various settings and national contexts (Aroian et al., 2007; Baker et al., 2002; Curran et al., 1995).

POMS-SF has been previously translated into Czech language and its psychometric properties have been evaluated (Stuchlíková et al., 2005). On a sample of 162 university students Stuchlíková et al. confirmed that the Czech version of POMS-SF respects original six-factor structure, however, to achieve good fit to the data, secondary factor loadings in case of five items needed to be added. Moreover, the authors estimated multiple indicators, multiple causes model (MIMIC) to examine effect of gender and age on measurement parameters. In either case no signs of severe measurement invariance were detected.

In 1999, Terry, Lane, Lane, and Keohane published a new version of POMS designed specifically for use in adolescent population. The authors suspected that adjectives in original POMS might be in some cases inappropriate for adolescents and therefore they added additional 18 items to an initial item pool. In the pilot stage, face validity of the items was evaluated on small samples of teachers and children. Based on their ratings, preliminary 42-item inventory was assembled with seven items per each dimension. Confirmatory factor analysis on a larger sample revealed poor fit of the six-factor model and thus the authors decided to remove the weakest three items from each dimension. The revised 24-item version was then administered to extensive samples of young athletes and school children for final evaluation of its psychometric properties. In general, Terry et al. concluded that their instrument showed strong evidence of factorial validity and can be used with school children and young athletes. In a follow-up study, Terry, Lane, and Fogarty (2003) further examined construct validity of POMS-A for use with adult athletes. They presented evidence supporting the psychometric integrity of the POMS-A when extended from adolescent to adult populations. The POMS-A scale was subsequently renamed to the Brunel Mood Scale (BRUMS; Terry & Lane, 2003).

The present study

The general aim of the study was to create and verify Czech adaptation of the Brunel Mood States questionnaire in adolescent athletes' population. More specifically, our goal was to confirm factor structure postulated by Terry et al. (1999), and, due to the differences in emotionality between males and females, also to test measurement invariance across gender subgroups.

METHODS

Participants

A total of 251 adolescent athletes recruited from a sport-focused high school in Brno, Czech Republic participated in our study. Five cases were removed due to a substantial number of missing answers (more than five missed items from 24 items long instrument). The final research sample consisted of 246 participants aged from 14 to 19 years (M = 16.40, SD = 1.31). Participating athletes were engaged in various sports (mostly volleyball, swimming, football, athletics, basketball, or tennis). Most of the athletes competed at national (49.6%) or international (31.3%) level, 14.2% at regional level and only 4.9% participants on recreational level.

Tab. 1: Sample characteristics

Gender	males	49.2%
	females	50.8%
Age	14 y.	5.3%
	15 y.	24.4%
	16 y.	22.0%
	17 y.	28.0%
	18 y.	14.2%
	19 y.	6.1%
Type of sport	individual	58.5%
	team	41.5%
Achievement level	recreational	4.9%
	regional	14.2%
	national	49.6%
	international	31.3%

Procedure

Students were contacted through class teachers and coaches. Prior to the actual data collection, informed consent for students to participate in the research was obtained from parents or legal representatives. Participation in the study was voluntary and no incentives were given in exchange for participation. The data were obtained using a paper/pencil questionnaire battery. It contained

numerous instruments focused on demographic, social, psychological, and sport-related characteristics. The whole questionnaire battery including Brunel Mood States and other research instruments was administered in school settings in autumn 2018 and the administration took two one and a half hour. Data collection was provided by trained administrators, acquainted with the purpose of the project and research methods.

Instruments

Brunel Mood States (BRUMS, earlier also referred to as POMS-A; Terry, Lane, Lane, & Keohane, 1999). This instrument is used to assess transient, distinct mood states. It contains 24 items evenly distributed into 6 dimensions – confusion, depression, fatigue, tension, vigor, anger. The instruction we used was:"Please describe how have you been feeling over the past week, including today?". Individual items are in the form of single adjectives (e.g. "angry"). The response format is a 5-point rating scale (0 = not at all, 1 = a little, 2 = moderately, 3 = quite a bit, 4 = extremely). The Czech translation of the instrument is available in the Appendix and original item wording in Terry et at. (1999). Because BRUMS shares 14 items with POMS-37 (Shacham, 1983), in our translation procedure we utilized existing and verified Czech translation of POMS-37 items (Stuchlíková et al., 2005). Unique BRUMS items were translated using a sequential process generally considered a standard for cross-cultural questionnaire adaptations in the field of social sciences (e.g. Guillemin et al., 1993): a) forward translation by a professional familiar with psychological terminology, b) back translation by an independent translator, c) resolving inconsistencies in a team of study authors and the two translators, and d) pre-testing on a sample of 10 adolescent athletes focused on clarity and unambiguity of items.

Data analysis

Prior to main analyses, we used the expectation-maximization method to impute missing values (there were no more than 1.0% of missing values in any of the items). The instrument structure was evaluated using confirmatory factor analysis (lavaan package in R; Rosseel, 2012). Measurement invariance regarding gender was assessed using the MIMIC procedure (Brown, 2006). The MIMIC model was used to examine effects of gender on measurement parameters, because it is more suitable to detect differential item functioning in relatively small sample sizes than Multiple Group Confirmatory Factor Analysis (Brown, 2006). In the first step of this procedure, the latent factors of BRUMS were regressed on the exogenous predictor gender (0 = males, 1 = females). Next, direct path between predictor and item indicator with highest potential to improve the model fit was identified using modification indices. Then, the model was re-specified with free estimation of the identified path. A significant (1% level) direct effect of gender on the item was considered as an indication of differential item functioning (DIF). This process was repeated until all DIF items were identified. In all the analyses, we assumed multivariate nonnormality of the data (Henze-Zirkler's coefficient = 1.01, $p < 0.01$) and therefore we used maximum likelihood estimation with robust standard errors and Satorra-Bentler scaled test statistic, and robust CFI, NNFI, and RMSEA fit indices. According to Little (2013), we used the following ranges for interpreting model fit: mediocre fit (RMSEA: 0.10–0.08, CFI and NNFI: 0.85–0.90) and acceptable fit (RMSEA: 0.08–0.05, CFI and NNFI: 0.90–0.99). Internal consistencies of the scales were assessed using McDonald's omega coefficient.

RESULTS

Confirmatory factor analysis of BRUMS

In concordance with originally proposed structure of the instrument the six-factor model with correlated factors was initially evaluated. This model showed acceptable fit to the data (S-B $\chi^2 = 471.27$, df = 237, $p < 0.01$; CFI = 0.92; NNFI = 0.90; RMSEA = 0.07, 90%CI[0.06, 0.08]). As can be seen in Table 2, all factor loadings are sufficiently high (higher than 0.05). Correlations between latent factors with their 95% confidence intervals are presented in Table 3. In general, all factors are closely related, which is especially evident for the depression and tension factors. In this case, corresponding confidence interval includes the value of 1, indicating that these factors are almost indistinguishable in our sample. Therefore, we proposed modified model in which depression and tension factor were collapsed into a single dimension. This new model showed a similar fit to the data as the original one (S-B $\chi^2 = 495.00$, df = 242, $p < 0.01$; CFI = 0.91; NNFI = 0.90; RMSEA = 0.07, 90%CI[0.06, 0.08]). All factor loadings were higher than 0.05 (see Table 2). Factor correlations in the five-factor model do not suggest the existence of indistinguishable factors (see Table 3). Internal consistencies of individual dimensions in both models were acceptable (McDonald's omega higher than 0.70).

Tab. 2: BRUMS item factor loadings with 95% confidence intervals

	Six-factor model	Five-factor model
Depression		
depressed	0.82[0.76;0.87]	0.80[0.74;0.86]
downhearted	0.86[0.82;0.90]	0.84[0.80;0.88]
unhappy	0.82[0.77;0.87]	0.83[0.78;0.87]
miserable	0.81[0.76;0.87]	0.81[0.75;0.86]
Tension		
Panicky	0.60[0.49;0.71]	0.56[0.45;0.67]
anxious	0.81[0.76;0.86]	0.81[0.75;0.87]
worried	0.65[0.58;0.73]	0.65[0.57;0.73]
nervous	0.60[0.52;0.68]	0.58[0.49;0.66]
Confusion		
confused	0.75[0.68;0.82]	0.75[0.68;0.82]
mixed-up	0.70[0.61;0.78]	0.70[0.61;0.78]
muddled	0.82[0.76;0.89]	0.84[0.77;0.90]
uncertain	0.72[0.63;0.80]	0.70[0.61;0.79]
Anger		
annoyed	0.76[0.68;0.83]	0.76[0.68;0.83]
bitter	0.79[0.72;0.87]	0.79[0.72;0.87]
Angry	0.70[0.62;0.78]	0.70[0.62;0.78]
bad-tempered	0.81[0.76;0.87]	0.81[0.76;0.87]

	Six-factor model	Five-factor model
Fatigue		
worn-out	0.67[0.59;0.76]	0.67[0.59;0.76]
exhausted	0.84[0.78;0.89]	0.84[0.78;0.89]
Sleepy	0.77[0.70;0.83]	0.77[0.70;0.83]
Tired	0.85[0.80;0.90]	0.85[0.81;0.90]
Vigor		
Lively	0.76[0.69;0.84]	0.76[0.69;0.84]
energetic	0.51[0.40;0.61]	0.50[0.40;0.61]
Active	0.76[0.67;0.84]	0.76[0.67;0.84]
alert	0.71[0.62;0.81]	0.71[0.61;0.81]

Note. Standardized parameter estimates are stated.

Tab. 3: Internal consistencies and correlations between BRUMS latent factors

Six-factor model	ω	(2)	(3)	(4)	(5)	(6)
Depression (1)	0.90 [0.87; 0.92]	0.95 [0.89; 1.01]	0.78 [0.70; 0.86]	0.70 [0.60; 0.79]	0.61 [0.51; 0.70]	–0.64 [–0.73; –0.55]
Tension (2)	0.76 [0.72; 0.81]		0.90 [0.83; 0.97]	0.72 [0.62; 0.82]	0.54 [0.42; 0.66]	–0.52 [–0.64; –0.40]
Confusion (3)	0.83 [0.80; 0.87]			0.61 [0.48; 0.73]	0.53 [0.42; 0.64]	–0.35 [–0.49; –0.22]
Anger (4)	0.85 [0.82; 0.88]				0.50 [0.38; 0.63]	–0.37 [–0.49; –0.24]
Fatigue (5)	0.86 [0.83; 0.89]					–0.64 [–0.74; –0.54]
Vigor (6)	0.79 [0.75; 0.83]					
Five-factor model			(3)	(4)	(5)	(6)
Depression/ Tension (1)	0.91 [0.89; 0.93]		0.82 [0.75; 0.89]	0.71 [0.63; 0.79]	0.59 [0.49; 0.69]	–0.62 [–0.71; –0.52]
Confusion (3)				0.60 [0.47; 0.73]	0.53 [0.42; 0.64]	–0.35 [–0.49; –0.22]
Anger (4)					0.50 [0.38; 0.63]	–0.37 [–0.49; –0.24]
Fatigue (5)						–0.64 [–0.74; –0.54]

Note: ω = McDonald's Omega. 95% CI intervals for correlations between factors are stated in square brackets.

MIMIC analysis of differential item functioning

The MIMIC analysis started with model based on the five-factor solution (with depression and tension factors collapsed) with gender added as exogenous predictor of all latent variables and direct paths from gender to all items set to zero. Even though this model showed acceptable fit to the data (S-B $\chi^2 = 546.45$, df = 261, $p < 0.01$; CFI = 0.90; NNFI = 0.89; RMSEA = 0.07, 90%CI[0.06, 0.08]), we attempted to identify items showing signs of DIF. Using the iterative step-wise procedure (see the Data analysis section for more details) suggested by Brown (2006), we found three items that were significantly influenced by gender. These were items *angry* (from the Anger factor), *worn-out* (from the Fatigue factor), and *active* (from the Vigor factor). When controlling for the appropriate latent factor, males scored higher than females in *angry* and *worn-out* items, and conversely females scored higher than males in *active* item. Gender significantly predicted all but one (Anger) latent factors. Values of semi-standardized regression coefficients in Table 4 (which can be interpreted akin to Cohen's d) show that males scored higher than females in Vigor, whereas females scored higher than males in Depression/Tension, Confusion, and Fatigue. However, we can conclude, that freeing the three gender-item parameters did not lead to substantial increase in model fit (S-B $\chi 2 = 508.20$, df = 258, $p < 0.01$; CFI = 0.92; NNFI = 0.90; RMSEA = 0.07, 90%CI[0.06, 0.08]).

Tab. 4: MIMIC model results – regression coefficients for the effects of gender on items and latent factors

Items/factors	unstandardized / semi-standardized coefficients	95%CI
DIF items		
Angry	0.56	[0.36; 0.76]
Worn-out	0.38	[0.15; 0.62]
Active	–0.36	[–0.60; –0.11]
Latent factors		
Depression/Tension	–0.45	[–0.69; –0.20]
Confusion	–0.42	[–0.69; –0.15]
Anger	–0.06	[–0.34; 0.21]
Fatigue	–0.48	[–0.74; –0.23]
Vigor	0.75	[0.49; 1.02]

Note: In case of the items, unstandardized coefficients are stated. In case of factors, semi-standardized coefficients are stated.

DISCUSSION

The BRUMS represents the shortest standardized questionnaire from the family of POMS instruments. Authors of the method convincingly proved that it is suitable to capture emotional states of an individual during the whole (adolescent and adult) athletic career (Terry et al., 1999; Terry, Lane, et al., 2003). Reliable qualities of the BRUMS were verified in many cultural contexts (Hashim et al., 2010; Quartiroli et al., 2017; Terry, Potgieter, et al., 2003; Zhang et al., 2014). The aim of this study was to develop Czech adaptation of BRUMS, verify its factorial structure on a sample of adolescent athletes, and concurrently evaluate measurement equivalence across gender.

Results indicated good empirical support for originally postulated six-factor model of BRUMS. All item factor loadings were sufficiently high and individual dimensions showed reasonable levels of internal consistency. Latent factors in our sample were highly correlated in general, but especially high intercorrelations were found in case of depression-tension and tension-confusion. These findings contradicted original Terry et al.'s (1999) study and several other studies (Terry, Lane, et al., 2003; Terry, Potgieter, et al., 2003; Zhang et al., 2014). Nevertheless, low discriminant validity of negative emotions subscales were found by others. Hashim et al. (2010) mentioned correlations above 0.9 in case of depression-confusion and depression-anger. Aroian et al. (2007) reported even more extreme results with intercorrelations between depression, tension, anger, and confusion ranging from 0.89 to 0.98. Based on our results we decided to propose a modified model, where depression and tension were collapsed, because in this case the factors seemed to be empirically indistinguishable. Despite the high correlation of tension-confusion, we decided to preserve both dimensions, because confidence interval did not suggest lack of differentiation. Modified model with five dimensions did not show signs of substantial misspecification.

Besides examining factorial structure, we also focused on measurement invariance. Previous studies examined this psychometric quality across various grouping variables, such as developmental stages or sport-nonsport involvement (Zhang et al., 2014), languages (Terry, Potgieter, et al., 2003), and gender (Quartiroli et al., 2017; Stuchlíková et al., 2005). We contributed to this discussion by testing measurement invariance across gender. Due to the relatively small sample size we decided to use the MIMIC procedure instead of multigroup CFA approach. We detected sings of differential item functioning in case of three items. Despite this finding we suggest that assumption of measurement invariance across gender was not substantially violated because (a) overall model fit was not substantially deteriorated by omitting appropriate parameters and (b) each item originated from different dimension. Moreover, our conclusion about gender-related measurement invariance is partially supported by study of Quartiroli et al. (2017), who used multigroup analysis and confirmed factorial invariance across adult male and female athletes. Also, in Czech cultural context, Stuchlíková et al. (2005) did not find measurement invariance across gender in a related POMS-SF questionnaire.

CONCLUSION

Our study demonstrated factorial validity of the Czech adaptation of the 24-item BRUMS questionnaire in adolescent athletes. Confirmatory factor procedures revealed that questionnaire items represent high-quality indicators of mood states dimensions, but also suggested problems with differentiation of negative mood factors, especially depression and tension. Measurement invariance analysis did not reveal serious manifestations of differential item functioning regarding gender.

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APPENDIX

The Czech version of BRUMS

Níže je seznam slov, která popisují lidské pocity. Každé slovo si pozorně přečti, a potom zakroužkuj odpověď, která nejlépe vystihuje, jak ses cítil/a v průběhu minulého týdne včetně dneška. *V průběhu minulého týdne jsem se cítil/a:*	vůbec ne	trochu	středně	docela	extrémně
1. vyděšeně	0	1	2	3	4
2. plný/á života	0	1	2	3	4
3. zmateně	0	1	2	3	4
4. opotřebovaně	0	1	2	3	4
5. depresivně	0	1	2	3	4
6. sklesle	0	1	2	3	4
7. rozzlobeně	0	1	2	3	4
8. vyčerpaně	0	1	2	3	4
9. chaoticky	0	1	2	3	4
10. ospale	0	1	2	3	4
11. rozhořčeně	0	1	2	3	4
12. nešťastně	0	1	2	3	4
13. úzkostně	0	1	2	3	4
14. ustaraně	0	1	2	3	4
15. energicky	0	1	2	3	4
16. mizerně	0	1	2	3	4
17. popleteně	0	1	2	3	4
18. nervózně	0	1	2	3	4
19. vztekle	0	1	2	3	4
20. aktivně	0	1	2	3	4
21. unaveně	0	1	2	3	4
22. podrážděně	0	1	2	3	4
23. nabuzeně	0	1	2	3	4
24. nejistě	0	1	2	3	4

Note. Original English instruction: "Below is a list of words that describe feelings that people have. Please read each one carefully. Then circle the answer which best describes, how have you been feeling over the past week, including today?" English wording of the items (in the same item ordering) can be found in Terry et al. (1999, p. 872). BRUMS subscales: Depression – 5, 6, 12, 16; Tension – 1, 13, 14, 18; Confusion – 3, 9, 17, 24; Anger – 7, 11, 19, 22; Vigor – 2, 15, 20, 23; Fatigue – 4, 8, 10, 21.