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SPORT MOTIVATION SCALE-II IN ADOLESCENT ATHLETES: SYSTEMATIC REVIEW OF EXISTING PSYCHOMETRIC STUDIES AND CZECH ADAPTATION OF THE INSTRUMENT

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The study aimed to provide a comprehensive review of the psychometric properties of the Sport Motivation Scale-II in different cultural contexts and to further enrich the knowledge base by adapting and examining the properties of the newly-created Czech version of the SMS-II. This study uses the confirmatory factor analysis approach to examine the factor structure of the instrument. The data were collected from 243 adolescent athletes (50.6% females, age 14–19 years). The instrument's originally proposed six-factor structure showed acceptable fit to the data, but due to insufficient discrimination between intrinsic, integrated, and identified regulation, a four-factor model was proposed. An investigation of the composite reliability, average variance extracted indices, interrelations between SMS-II subscales, and relationships of the SMS-II subscales with external variables confirmed a sufficient level of reliability and construct validity of the Czech adaptation of the SMS-II in the adolescent population.

Keywords: SMS-II; Self-determination theory; Validity; Reliability; Adolescent athletes.

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Desire and determination are keys to enabling talented athletes to become champions. To maximize their full potential, they must be motivated to maintain their efforts until they have achieved their goals. Today's highly competitive world of sports requires countless hours of hard training, which is sometimes crowned with success, but, on the other hand, athletes may suffer from fatigue, pain, boredom, and frustration. Over the years, many scientific studies based on different theoretical backgrounds have been conducted on motivation in sports. The most prominent comprehensive theoretical framework for understanding both extrinsic and intrinsic motives of human behavior is the self-determination theory (SDT; Deci & Ryan, 2000). Deci and Ryan (2012) distinguished six types of behavioral regulations that can be placed along the self-determination continuum: intrinsic, integrated, identified, introjected, external, and amotivated. These six types of regulation can be hierarchically organized. Depending on the source of motivation, the SDT differentiates amotivation lacking a source of motivation, extrinsic motivation with an external source (external, introjected, identified, and integrated regulation), and intrinsic motivation with an internal source. From a different point of view, the SDT subsumes external and introjected regulation into controlled motivation, and identified, integrated, and intrinsic regulation into autonomous motivation. Auton-

omously motivated individuals experience feelings of self-directedness, while individuals with controlled motivation feel pressure to behave in a particular way.

Systematic Review of SMS-II Psychometric Studies in Different Cultural Contexts

Several measures of sports motivation based on the SDT were developed, including the Behavioral Regulation in Sport Questionnaire (Lonsdale et al., 2008), the Pictorial Motivation Scale (Reid et al., 2009), and the Situational Motivation Scale (Guay et al., 2000). A considerable number of research studies focusing on understanding the role of motivation in sport have utilized the Sport Motivation Scale (SMS). Originally, this scale was created in French (Brière et al., 1995) then translated into English and validated (Pelletier et al., 1995). The original scale consists of 28 items evenly distributed into seven factors. Three of these factors measure different aspects of intrinsic motivation (to know, to experience stimulation, and to accomplish) and the remaining four factors cover identified, introjected, external, and amotivated regulation. Integrated regulation was not included in the SMS, because pilot testing of the measure did not reveal it to be a perceived reason for participating in sport. Later, Mallett and Hanrahan (2004) provided empirical evidence that integrated regulation can be an important source of motivation for a specific group of elite athletes. Based on this evidence and also due to repeatedly reported problems with the lack of factorial validity and the low reliability of the SMS, Mallett et al. (2007) developed a revised six-factor version called SMS-6, which differs from the original SMS by including an integrated regulation factor and a general intrinsic motivation factor. The SMS-6 consists of 24 items (four items per factor), 16 of which are adopted from the SMS and eight items were newly created (four items for the integrated regulation factor and four items replaced in other dimensions). The work of Mallet and his colleagues was noticed by the original authors of the SMS and in 2007, Pelletier et al. (2007) questioned the psychometric superiority of the SMS-6 over the original SMS and subsequently published their revision of the scale, called the SMS-II (Pelletier et al., 2013). The SMS-II consists of 18 items (three items per factor), only five of which were adopted from the original SMS. The factorial structure of the scale is the same as in the SMS-6, that is, it includes factors of amotivated, external, introjected, identified, integrated, and intrinsic regulation. The authors provided two validation studies on distinct samples (adult and adolescent athletes). Compared to the original SMS, this version showed a better factorial structure, higher levels of reliability, and increased evidence of a simplex-like pattern, that is, different subscales placed along the self-determination continuum form a pattern in which types of regulation that are situated closely along the continuum demonstrate stronger correlations than the ones further apart. The construct validity was also verified by comparing SMS-II subscales to external measures. More autonomous types of regulation were related positively to satisfaction with life and vitality, while amotivated regulation was related in the opposite direction.

Due to its qualities in terms of administration efficiency and solid theoretical grounding, the SMS-II became the most widely used instrument for capturing motivational structure in sports. Since its creation, it has been adapted into several languages and cultural contexts, including Portuguese, Swedish, Spanish, Chinese, and French. We used three electronic databases including Web of Science, SCOPUS, and Google Scholar to find relevant psychometric studies using the keywords “Sport Motivation Scale-II” combined with “psychometric,” “factor,” and “dimensionality” with Boolean operators OR and AND. We identified seven studies (C. Li et al., 2018; Nascimento Jr. et al., 2014; Pelletier et al., 2013; Pelletier et al., 2019; Pineda-Espejel et al., 2016; Stenling et al., 2015; Viciana et al., 2017) focused primarily on the psychometric characteristics of the SMS-II.

Nascimento Jr. et al. (2014) adapted the scale to the Brazilian cultural context using a sample of young adult athletes. In addition to showing that the Portuguese version of the SMS-II possessed an adequate factorial structure, they demonstrated measurement invariance between men and women and an acceptable level of temporal stability. Stenling et al. (2015) confirmed that the Swedish version of the SMS-II fits the expected six-factor structure using a common and a Bayesian approach to structural equation modeling. The Spanish version of the scale was adapted in two different cultural contexts. Pineda-Espejel et al. (2016) used a sample of adolescent and young adult Mexican athletes and concluded that the Mexican Spanish version offers an adequate factorial structure and construct validity; however, it was necessary to exclude one of the items ("Because I feel better about myself when I do") from the introjected regulation subscale. Viciana et al. (2017) adapted the Spanish version of the SMS-II for adolescent athletes. Even though they showed adequate support for the six-factor model, they revealed that the introjected regulation factor lacks sufficient discriminant validity and proposed a five-factor model as the best fitting solution. The authors also verified that the instrument can be considered invariant across gender and between sport-federated and non-federated athletes. In 2018, C. Li and colleagues introduced a Chinese version of the scale, which was validated on a population of university athletes. Factorial and external validity and test-retest reliability were evidenced in three separate studies. Finally, Pelletier et al. (2019) created a French adaptation of the scale; in addition to providing evidence about its sufficient discriminant validity, convergent validity, and adequate internal consistency, they showed that French and English athletes were invariant with regard to the structure of the six-factor scale.

To conclude, the SMS-II proved itself a viable instrument in various language and cultural contexts. However, there have been reports of recurring problems with specific items, issues related to internal consistencies of the subscales, and discrepancies in the pattern of mutual correlations between individual subscales. In Table 1 we summarize item factor loadings from confirmatory factor analyses as well as internal consistencies of subscales from all the above-mentioned studies. It is noticeable that some items had lower levels of factor loadings across several independent studies. Due to the low number of items per factor and also following Viciana et al.'s (2017) SMS-II psychometric study, we adopted a relatively strict factor loading criterion (.60) for considering items as problematic. Four items did not reach the threshold in three or more studies (two items from the introjected regulation subscale, one from the external regulation subscale, and one from the amotivated regulation subscale). The lower functionality of two introjected regulation items consequently resulted in more frequent reports of insufficient internal consistency of the subscale. Table 2 presents a comprehensive summary of mutual relationships among individual dimensions found in previous psychometric studies of the SMS-II. To provide clearer insight into the relationships, we computed averaged latent factor correlations using a random-effects meta-analytic procedure (Hedges & Vevea, 1998), utilizing Fisher's *r*-to-*Z* transformation and taking into account both within-study variance and between-study variance in effect sizes.

From the perspective of the SDT, the most important information is placed along the diagonal, where relations between adjacent dimensions can be found. While relations between intrinsic motivation (IM) and integrated regulation (IG), integrated regulation and identified regulation (ID), and external regulation (EXT) and amotivation (AM) are clearly consistent and positive across all studies, relations between introjected regulation (IJ) and both neighboring dimensions identified and external regulations are far more heterogeneous (from .17 to .92 in case of ID and IJ relationship, and .06 to .91 in case of IJ and EXT). Another noticeable finding concerns the three facets of autonomous motivation. The averaged correlation coefficients are higher than .80; in some of the individual studies these facets seem to be empirically indistinguishable ($r > .90$).

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TABLE 1
SMS-II item factor loadings and reliabilities of individual subscales in psychometric studies

Item	Pelletier et al. (2013) Study 1 / 2	Nascimento et al. (2014)	Stenling et al. (2015)	Pineda-Espejel et al. (2016)	Viciana et al. (2017)	C. Li et al. (2018) Study 1 / 2*	Pelletier et al. (2019)
IM1	.86 / .77	**.59**	.87	.73	.65	.68 / **.55**	.73
IM2	.86 / .85	.60	.75	.79	.68	.69 / .67	.86
IM3	.80 / .85	.78	.71	.85	.77	.75 / .72	.62
IG1	.78 / .68	.69	.66	.72	.68	.75 / .64	.62
IG2	.73 / .77	.69	**.59**	.86	.73	.61 / .62	.65
IG3	.75 / .79	.67	.73	.71	.70	.66 / .72	.62
ID1	.70 / .75	.62	.79	.74	**.58**	.67 / .63	.78
ID2	.78 / .90	.71	.77	.85	.70	.75 / .81	.74
ID3	.91 / .63	.82	.76	.74	.69	**.59** / .63	.78
IJ1	.59 / .71	**.47**	.70	**.44**	**.40**	**.55** / **.58**	.63
IJ2	.68 / **.47**	**.38**	.68	.79	**.54**	.68 / .69	.76
IJ3	.62 / .67	.72	**.59**	NA	.67	.82 / .69	.63
EXT1	.94 / **.59**	.75	.67	.78	.65	.84 / .76	.85
EXT2	.79 / .76	.71	.71	.95	.70	.80 / .82	.80
EXT3	.57 / .74	**.52**	**.44**	**.58**	**.53**	**.55** / **.59**	.76
AM1	.74 / .95	.67	.87	.70	**.56**	**.47** / **.59**	.83
AM2	.76 / .77	**.56**	.73	.96	**.59**	.76 / .74	.77
AM3	.74 / .77	.70	**.18**	.98	.69	.79 / .73	.60
Subscale	α / α	α		α	ω	α / α	α
IM	.88 / ≥ .73	.71	NA	.76	.74	.75 / **.69**	.77
IG	.80 / ≥ .73	.70	NA	.73	.75	.70 / .70	**.67**
ID	.82 / ≥ .73	.75	NA	.74	.70	.70 / .74	.81
IJ	.70 / ≥ .73	**.61**	NA	**.51**	**.66**	.73 / **.69**	.71
EXT	.74 / ≥ .73	**.69**	NA	.75	**.55**	.76 / .76	.83
AM	.81 / ≥ .73	.78	NA	**.68**	**.65**	.70 / .73	.77

Note. IM = intrinsic motivation; IG = integrated regulation; ID = identified regulation; IJ = introjected regulation; EXT = external regulation; AM = amotivation; NA = not available. *Information about item factor loadings was obtained from the authors based on e-mail communication. Item IJ3 in the study by Pineda-Espejel et al. (2016) was not included in the factor analysis due to its low correlations to other items in the scale. Factor loadings lower than .60 and reliabilities lower than .70 are shown in bold.

TABLE 2
Correlations between SMS-II factors in psychometric studies

	IG	ID	IJ	EXT	AM
IM	.63/.78, .83, .69, .94, .74, .91/.87, .73 **.83**	.56/.68, .87, .56, .87, .75, .85/.92, .65 **.80**	.26/.33, .88, .11, .03, .84, .28/.32, .56 **.49**	.16/.06, .07, –.14, –.13, .14, –.03/–.17, –.02 **–.02**	–.08/–.14, –.37, –.47, –.50, –.24, –.40/–.59, –.12 **–.36**
IG		.59/.70, .81, .79, .98, .86, .94/.91, .87 **.89**	.42/.62, .91, .47, .02, .87, .33/.31, .68 **.61**	.19/.17, .15, .03, –.31, .17, –.05/–.11, .16 **.03**	–.04/–.12, –.18, –.41, –.63, –.22, –.49/–.57, –.14 **–.36**
ID			.46/.45, .92, .50, .17, .87, .21/.29, .74 **.60**	.24/.20, .09, .15, –.24, .18, –.04/–.16, .22 **.05**	–.03/–.08, –.34, –.16, –.52, –.15, –.49/–.55, –.05 **–.30**
IJ				.36/.50, .06, .83, .91, .22, .53/.37, .41 **.55**	.16/.16, –.28, .20, .44, –.23, .20/.17, –.03 **.08**
EXT					.38/.38, .32, .39, .74, .67, .41/.39, .32 **.47**

Note. IM = intrinsic motivation; IG = integrated regulation; ID = identified regulation; IJ = introjected regulation; EXT = external regulation; AM = amotivation. The first two lines in each cell provide correlations reported in individual studies: Pelletier et al. (2013) - Study 1/2, Nascimento et al. (2014), Stenling et al. (2015), Pineda-Espejel et al. (2016), Viciana et al. (2017), C. Li et al. (2018) - Study 1/2, Pelletier et al. (2019). Pelletier et al. (2013) in Study 1 reported only correlations between composite scores, all other studies reported latent factor correlations. The third line in each cell (in bold) provides averaged latent factor correlations.

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The general aim of the present study was to create a Czech adaptation of the revised Sport Motivation Scale and to compare its psychometric characteristic with other cross-cultural adaptations of the instrument. First, we assessed the factorial structure of the instrument, and second, we examined reliability and construct validity using various indices (composite reliability, average variance extracted, maximum shared variance). To support the evidence for construct validity, we investigated subscales interrelationships with regard to theoretical expectations about the self-determination continuum as proposed in a simplex-like model. According to the SDT theory, all SMS-II subscales are arranged along the self-determination continuum and therefore we expected that the more closely positioned to each other factors are, the stronger their mutual correlation would be (Howard et al., 2017; F. Li & Harmer, 1996). In line with the SDT background, we also expected that self-determined forms of motivation should be negatively related to dimensions of burnout and positively related to satisfaction with life. For external motivation and amotivation, we posited a reverse pattern of relationship.

METHOD

Participants

A sample of 251 adolescent athletes representing a variety of sports participated in the study. All athletes were recruited from a sport-focused high school in Brno, Czech Republic. Eight cases were removed from the dataset due to a substantial number of missing answers (more than 20% in any of the included instruments). The final sample consisted of 243 participants (123 females) in the age range from 14 to 19 years (M = 16.42, SD = 1.31). Each participant was actively training for their sports (the most frequent being athletics, swimming, tennis, volleyball, basketball, and football). The majority (235 participants) trained a minimum of 3 times per week. Participants competed at the recreational (11 participants), regional (35 participants), national (120 participants), and international (77 participants) levels.

Procedure

Because localized versions of the Sport Motivation Scale revised and the Athlete Burnout Questionnaire were not available, it was necessary to translate these instruments into Czech before collecting the data. Following the guidelines suggested by Ljungberg et al. (2015), the translation process involved four steps: a) forward translation by a professional familiar with psychological terminology; b) back translation by an independent translator; c) resolution of inconsistencies in a team of study authors and the two translators; and d) pre-test on a sample of 10 adolescent athletes to achieve clarity and unambiguity of the items.

The data were obtained using a paper-and-pencil questionnaire that contained a broad spectrum of instruments focused on demographic, social, psychological, and sport-related characteristics. The questionnaire was administered in school settings in autumn 2018 during two classes. Participation in the study was voluntary, all participants (and their legal representatives) provided informed consent, and no incentives were offered in exchange for participation.

Instruments

Sport Motivation Scale revised (SMS-II; Pelletier et al., 2013)

The SMS-II is theoretically grounded in the self-determination theory and assesses individuals' levels of motivation toward sport. It consists of 18 items equally distributed into six factors (intrinsic regulation, integrated regulation, identified regulation, introjected regulation, external regulation, and amotivated regulation). The response format is a 7-point Likert scale ranging from 1 (*does not correspond at all*) to 7 (*corresponds completely*). The original item wording was published in Pelletier et al. (2013), the Czech translation of the instrument is available by the authors upon request.

Athlete Burnout Questionnaire (ABQ; Raedeke & Smith, 2001)

Athlete burnout is defined as a three-dimensional construct: physical/emotional exhaustion (ABQ_PEE), reduced sense of accomplishment (ABQ_RA), and devaluation (ABQ_D). The questionnaire consists of 15 items (five items per dimension) with a 5-point Likert scale (1 = *almost never*, 2 = *rarely*, 3 = *sometimes*, 4 = *frequently*, 5 = *almost always*). The internal structure of the instrument in our data was evaluated using a confirmatory factor analysis (CFA) that suggested an acceptable fit of the model, S-B χ^2 = 218.39, *df* = 87, $p < .01$; CFI = .91; NNFI = .89; RMSEA = .08, 90% confidence interval (CI) [.07, .10]. The composite reliability (CR) of all dimensions was satisfactory (all CRs > .80).

Satisfaction with Life Scale (SWLS; Pavot et al., 1991)

The scale was developed as a measure of the judgmental component of subjective well-being. It consists of five items with a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The unidimensional structure of the instrument in our data showed great fit, S-B χ^2 = 3.83, *df* = 5, $p = .57$; CFI = 1.00; NNFI = 1.00; RMSEA = .00, 90%CI [.00, .09]. Composite reliability of the scale was satisfactory (CR = .85).

Data Analysis

In this study, we evaluated the psychometric aspects of the SMS-II: its factorial structure, reliability, and construct validity. As the first step prior to the main analyses, we used the expectation-maximization algorithm to impute missing values (there were no more than 1.6% missing values in any of the items and no more than 20% missing values per instrument in individual vectors) with all discrete variable imputations rounded to the nearest integer.

The factorial structure of the SMS-II was verified using a CFA approach. In all the analyses, we assumed multivariate non-normality of the data (Henze-Zirkler's coefficient = 1.11, $p < .01$) and therefore we used a maximum likelihood estimation with robust standard errors and a Satorra-Bentler scaled test statistic (MLR). MLR estimation technique is suitable for performing CFA with ordinal variables when the number of response categories for each item is equal to or higher than five (Raykov, 2012; Rhemtulla et al.,

2012). To assess model fit, we examined both absolute and incremental fit indices including the root mean square error of approximation (RMSEA) and its 90% CI, the non-normed fit index (NNFI), and the comparative fit index (CFI) in their robust variants (Jackson et al., 2009). According to Little (2013), we set the following ranges for interpreting model fit: mediocre fit (RMSEA = .10-.08, CFI and NNFI = .85-.90) and acceptable fit (RMSEA = .08-.05, CFI and NNFI = .90-.99). We also took into consideration the 90% CI of RMSEA to reject the poor fit hypothesis; in line with Kline's (2011) recommendation, we applied the .10 threshold for the upper bound of the interval. To compare competing models, we also used Akaike and Bayesian information criteria (AIC and BIC indices).

The reliability of the instrument was captured by composite reliability (CR), convergent validity and discriminant validity by average variance extracted (AVE) and maximum shared variance (MSV). Composite reliability and AVE indices were interpreted against .70 and .50 cut-offs, respectively (Hair et al., 2010). Discriminant validity was established where MSV was lower than AVE, as Hair et al. (2010) suggested. Construct validity was further assessed by examination of the simplex-like pattern of latent factor relationships. We also performed a more rigorous test of the self-determination continuum assumption using the bifactor confirmatory factor analysis (B-CFA) approach (Howard et al., 2016). In bifactor-CFA models, each item is used to define the general factor together with theoretically expected specific factors. This way, as Howard et al. pointed out, the variance shared among all items is captured by the general factor, whereas variances specific to subsets of items are preserved in particular factors. In our case, we modeled specific factors corresponding to different types of motivation and a general factor that should represent a continuum underlying all the items across the subscales.

Results

Factorial Structure

We tested the six-factor structure of the SMS-II, in which each factor was constituted by three items, and no cross-loadings were allowed. Covariances between individual factors were freely estimated. Most fit indices showed acceptable fit to the data with the exception of NNFI, which was slightly below the defined threshold — S-B χ^2 = 255.35, *df* = 120, $p < .01$; CFI = .91; NNFI = .89; RMSEA = .08, 90% CI [.06, .09]; AIC = 14597.28; BIC = 14775.43. Factor loadings were in the range of .38 to .88, and all of them were significant and substantial in size (see the left hand side of Table 3).

Table 4 summarizes the correlations between individual factors. All factors are evidently interrelated. Especially strong mutual correlations (> .85) were found for intrinsic, integrated, and identified regulation. Given that these factors are situated next to each other along the self-determination continuum and all are forms of autonomous motivation, it was both empirically and theoretically justified to consider a modified model in which these factors were collapsed into a single one. Because the newly postulated model showed comparable fit to the data as the original one, and comparison of AIC and BIC indices for both models yielded inconclusive results — S-B χ^2 = 282.14, *df* = 129, $p < .01$; CFI = .90; NNFI = .88; RMSEA = .08, 90% CI [.07, .09]; AIC = 14614.82; BIC = 14761.53), we decided to favor the more parsimonious four-factor model. Factor loadings in this model varied from .38 to .87 (see the left hand side of Table 3) and the factors represented interrelated but discrete dimensions of motivation (see Table 4).

TABLE 3
Results of confirmatory factor analyses — CFA (left hand side) and B-CFA (right hand side)

Item		CFA		B-CFA (based on four-factor model)	
		Six-factor model	Four-factor model	Subscale factor loadings	General factor loadings
	Intrinsic motivation				
IM1	interesting to improve	.88**	.83**	.46**	.71**
IM2	enjoyable to discover strategies	.75**	.72**	.49**	.57**
IM3	pleasure to learn	.71**	.70**	.30**	.65**
	Integrated regulation				
IG1	essence of whom I am	.50**	.49**	.20*	.44**
IG2	integral part of life	.75**	.70**	–.14	.87
IG3	in line with deepest principles	.67**	.68**	.33**	.59**
	Identified regulation				
ID1	develop valued aspects	.80**	.79**	.38**	.69**
ID2	develop myself	.73**	.72**	.37**	.69**
ID3	develop other aspects of myself	.80**	.79**	.39**	.61**
	Introjected regulation				
IJ1	feel bad if not	.73**	.74**	.62**	.44**
IJ2	not feel worthwhile if not	.48**	.46**	.53**	.16*
IJ3	feel better when I do	.78**	.78**	.48**	.60**
	External regulation				
EXT1	people I care about upset if not	.80**	.83**	.80**	–.33**
EXT2	others disapprove if not	.82**	.79**	.67**	–.35**
EXT3	people reward me when I do	.38**	.38**	.41**	–.05
	Amotivated regulation				
AM1	used to have good reasons	.86**	.87**	.66**	–.59**
AM2	I don't know	.71**	.73**	.65**	–.39**
AM3	it is not clear to me	.71**	.69**	.31**	–.66**

Note. IM = intrinsic motivation; IG = integrated regulation; ID = identified regulation; IJ = introjected regulation; EXT = external regulation; AM = amotivation. Standardized parameter estimates are stated.
*p < .05. **p < .01.

Reliability and Construct Validity

Composite reliabilities of subscales in the six-factor model were acceptable (except for IG, see Table 4). Three subscales (IM, ID, AM) yielded AVE estimates higher than the .50 thresholds, EXT had an AVE estimate close to the threshold, and AVE estimates for IG and IJ were below the threshold. Comparison of AVE and MSV implied that subscales IM, IG, and ID clearly did not meet the requirement for discriminant validity (AVE > MSV), which can be considered as further support for our decision to favor the four-factor model. In the case of the four-factor model, all composite reliabilities were sufficiently high. AVE values were above the .50 threshold in AUT and AM, and below the threshold in IJ and EXT. In all subscales, AVE estimates were higher than their corresponding MSV estimates.

TABLE 4
Correlations between SMS-II latent factors, descriptive statistics, and internal consistencies

6F model	(2)	(3)	(4)	(5)	(6)	*M* (*SD*)	CR	AVE	MSV
IM (1)	**.87**	**.94**	**.56**	**–.29**	**–.62**	4.95 (1.36)	.82	.61	.88
IG (2)		**.95**	**.72**	**–.37**	**–.74**	5.07 (1.22)	.68	.42	.90
ID (3)			**.63**	**–.25**	**–.64**	5.18 (1.30)	.82	.60	.90
IJ (4)				.02	**–.25**	4.88 (1.26)	.71	.46	.52
EXT (5)					**.54**	2.56 (1.22)	.72	.48	.29
AM (6)						2.47 (1.46)	.81	.58	.55
4F model			(4)	(5)	(6)	*M* (*SD*)	CR	AVE	MSV
AUT (1)			**.64**	**–.30**	**–.67**	5.07 (1.16)	.90	.51	.45
IJ (4)				.01	**–.25**		.71	.46	.41
EXT (5)					**.53**		.72	.48	.28
AM (6)							.81	.59	.45

Note. IM = intrinsic motivation; IG = integrated regulation; ID = identified regulation; IJ = introjected regulation; EXT = external regulation; AM = amotivation; AUT = autonomous motivation (consisting of intrinsic, integrated, and identified regulation); CR = composite reliability; AVE = average variance extracted; MSV = maximum shared variance. Statistically significant correlations are shown in bold. Each scale was rated on a 7-point Likert scale.

According to the SDT, relationships between SMS-II dimensions should follow a simplex-like pattern. The pattern is empirically manifested in such a way that correlation coefficients indicating the relationship between adjacent factors on the self-determination continuum are higher than correlations between factors that are more distant. In general, both the six-factor and four-factor correlation matrix (see Table 4) showed the expected pattern. Additional evidence supporting the continuum assumption in the four-factor model was demonstrated using B-CFA, which adds a general factor to the specific factors. Results from the B-CFA solution, S-B χ^2 = 254.00, df = 117, p < .01; CFI = .91; NNFI = .89; RMSEA = .08, 90% CI [.07, .09], revealed that the general factor could be considered as a representation of general self-determination, because the pattern of factor loadings follows the idea of an underlying continuum (see the right hand side of Table 3). The general factor loadings were high and positive for the items representing autonomous motivation (from .44 to .87), moderate for introjected regulation (from .16 to .60), and negative for external regulation and amotivation (from –.66 to –.05). Because the general factor was taken into account, the subscale factors lost part of their specificity, most notably in autonomous motivation.

Construct validity of the SMS-II was also assessed by examining relationships to external variables. While autonomous motivation located in the upper part of the SDT continuum showed significant negative relationships with factors of burnout (r_{ABQ_RA} = –.30, r_{ABQ_PEE} = –.17, r_{ABQ_D} = –.59) and significant positive relationship with satisfaction with life (r = .28), the opposite was true for external and amotivated regulation, which were connected positively to burnout (external regulation: r_{ABQ_RA} = .13, r_{ABQ_PEE} = .17, r_{ABQ_D} = .33; amotivated regulation: r_{ABQ_RA} = .38, r_{ABQ_PEE} = .32, r_{ABQ_D} = .69) and negatively to satisfaction with life (external regulation: r = –.13, amotivated regulation: r = –.34). Introjected regulation had no or only weak (in case of devaluation) relations to criterion variables (r_{ABQ_RA} = –.01, r_{ABQ_PEE} = .04, r_{ABQ_D} = –.18, r_{SWLS} = –.02).

Discussion and Conclusion

Self-determination theory has become one of the most popular motivational theories. Within the SDT framework several instruments were created to capture motivation structure in various domains, for example, academic (Connell & Ryan, 1989), health care (Levesque et al., 2007), videogame playing (Lafreniere et al., 2012), and religion (Ryan et al., 1993). In the field of sport psychology, the most established instrument based on the SDT is the revised Sport Motivation Scale SMS-II. The general aim of the present study was to adapt the scale into the Czech cultural context and to contribute to the recent discussion of problematic aspects of this instrument. More specifically, we focused on the scale's factorial structure, reliability, and construct validity.

Regarding factorial validity, similarly to other versions of SMS-II, the original six-factor model showed acceptable data fit. However, we identified a lack of discriminant validity in the case of three factors, because in our sample of adolescent athletes, intrinsic, identified, and integrated regulations were empirically almost indistinguishable. Given the fact that these three factors had the strongest mutual interrelationships also in previous studies of the SMS-II (C. Li et al., 2018; Nascimento Jr. et al., 2014; Pelletier et al., 2013, 2019; Pineda-Espejel et al., 2016; Stenling et al., 2015; Viciana et al., 2017), this finding is not surprising. Similarly, Howard et al. (2017) in their meta-analysis, which included studies with a variety of SDT-based measures used in various fields and cultural contexts, concluded that intrinsic, identified, and integrated regulations are situated extremely close on the self-determination continuum. Therefore, we proposed a modified four-factor model where these adjacent factors, constituting an autonomous form of motivation according to the SDT (Deci & Ryan, 2012), were collapsed into one. All factors in this model (autonomous motivation, introjected regulation, external regulation, and amotivation) showed a sufficient level of reliability and discriminant validity. Congruent validity of the four-factor solution was adequate except for introjected regulation which showed the AVE value notably below the .50 threshold. Nevertheless, problems with lower AVE in case of introjected regulation subscale were reported in the previous literature (Pelletier et al., 2013; Viciana et al., 2017).

To further support the construct validity of our adaptation of the SMS-II, we tested whether it demonstrated a simplex structure reflecting the underlying self-determination continuum. We utilized two recommended approaches for evaluating the continuum assumption (Howard et al., 2017). First, we performed a visual inspection of the correlation matrix for the factors of motivation. As in all other psychometric studies of the SMS-II (C. Li et al., 2018; Nascimento Jr. et al., 2014; Pelletier et al., 2013, 2019; Pineda-Espejel et al., 2016; Stenling et al., 2015; Viciana et al., 2017), we observed the expected trend of positive to negative correlations between regulations in the matrix. Second, we employed a more formal test based on bifactor CFA, which also confirmed that the regulatory styles are meaningfully organized along the self-determination continuum.

As the final step of the validation process, we assessed the SMS-II relations to athlete burnout and satisfaction with life. The SDT implies that the magnitudes and signs of correlation coefficients between SMS-II subscales and these criterion variables should be determined by the position of the regulation style on the SDT continuum, that is, when an athlete's motivation is more self-determined, that athlete is less likely to experience burnout symptoms and more likely to feel satisfied with life. Our pattern of results perfectly reflects this assumption, because the correlations of autonomous regulations (intrinsic, integrated, and identified) were positive in satisfaction with life and negative in burnout factors, while correlations of external regulation and amotivation were the opposite. Correlations of introjected regulation to the external variables were close to zero. Our findings are supported by previous studies, which reported similar results

in case of satisfaction with life (C. Li et al., 2018; Pelletier et al., 2013, 2019) and athlete burnout (Gustafsson et al., 2018; C. Li et al., 2018).

A closer look at individual items of the SMS-II revealed that three items had lower factor loadings. The lowest factor loading in both models (.38) was found in the case of Item EXT3, followed by Items IJ2 (.48 and .46) and IG1 (.50 and .49). While item IG1 showed good characteristics in the previous SMS-II studies, Items IJ2 and EXT3 were identified as problematic in several other studies — IJ2 in Nascimento Jr. et al., 2014; Pelletier et al., 2013; Viciana et al., 2017; EXT3 in C. Li et al., 2018; Nascimento Jr. et al., 2014; Pineda-Espejel et al., 2016; Stenling et al., 2015; Viciana et al., 2017. Therefore, we support the proposition of Viciana et al. (2017) who suggested revising the IJ2 and EXT3 items (together with the IJ1 item, which, however, was functioning properly in our data) to maintain the intended structure of the instrument.

To conclude, the Czech version of the SMS-II can be considered reliable and valid in general for use with Czech adolescent athletes in various sports disciplines. The scale successfully reflects the continuum of self-determination as defined by the SDT. Similar to other psychometric studies, we noticed problems with the discriminant validity of SMS-II subscales located on the more self-determined part of the continuum and we suggest that further research efforts are needed to ensure the stable factorial structure of the instrument.

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