Journal of Sports Sciences, 2013
Vol. 31, No. 2, 173–180, http://dx.doi.org/10.1080/02640414.2012.723132

Examining discriminant validity issues of the Sport Motivation Scale-6

MASATO KAWABATA[1,2] & CLIFFORD J. MALLETT[2]

[1]*Nanyang Technological University, National Institute of Education, Singapore, Singapore, and* [2]*The University of Queensland, School of Human Movement Studies, Australia*

(Accepted 15 August 2012)

Abstract
The current study was conducted to re-assess the factor structure of the 24-item Sport Motivation Scale-6 (SMS-6; Mallett, Kawabata, Newcombe, Otero-Forero, & Jackson, 2007) with an independent sample. A total of 437 participants completed the SMS-6, and their responses were examined with confirmatory factor analysis and recent exploratory structural equation modelling (Asparouhov & Muthén, 2009). A six-factor confirmatory-factor-analysis model did not fit to the sample data adequately. Through examination of the corresponding exploratory-structural-equation-modelling solution, it was found that two items loaded on non-target factors poorly. This result was replicated by a published data set (Mallett, Kawabata, Newcombe, et al., 2007). The modified confirmatory-factor-analysis model with these two items removed fit to the present study's data satisfactorily and all six factors were adequately diferentiated. These results generally validate the SMS-6 responses. Furthermore, this study demonstrated the usefulness of a comparison of confirmatory-factor-analysis and exploratory-structural-equation-modelling solutions for an accurate interpretation of individual parameters.

Keywords: *measurement progress, multidimensional motivation, integrated regulation, factorial validity, cross-examination*

Introduction

Measurement is a critical issue in empirical research and attempts to progress measurement should be valued and encouraged (Mallett, Kawabata, & Newcombe, 2007). In an attempt to progress measurement in contextual sport motivation using self-determination theory (SDT; Deci & Ryan, 1985), the Sport Motivation Scale (SMS; Pelletier et al., 1995) was revised and a 6-factor 24-item scale (SMS-6; Mallett, Kawabata, Newcombe, Otero-Forero, & Jackson, 2007) was developed by including integrated regulation. Consistent with SDT, the SMS-6 measures six forms of motivation: amotivation, external regulation, introjected regulation, identified regulation, integrated regulation, and intrinsic motivation. In the initial study based on the responses from Australian samples, the revised SMS-6 was preferable to the original SMS. When Mallett, Kawabata, Newcombe, et al. (2007) examined the SMS-6 factor structure using confirmatory factor analysis, however, Identified Regulation was not empirically distinguishable from Intrinsic Motivation and Integrated Regulation factors. They urged future researchers to examine the factor structure of the SMS-6 with different independent samples in order to know whether the problem was sample specific. Construct validation is an ongoing process (Marsh & Jackson, 1999), and further examination of the SMS-6 is necessary to evaluate the efficacy of the SMS-6 in measuring contextual sport motivation (Mallett, Kawabata, & Newcombe, 2007).

Exploratory structural equation modelling

The discriminant validity issue of the Identified Regulation found in the SMS-6 might be sample specific. If the issue is observed with different samples, however, it may be attributed to other reasons. One of the reasons could be related to an unrealistic methodological assumption required in confirmatory factor analysis (Asparouhov & Muthén, 2009; Marsh et al., 2009, 2010; Morin & Maïano, 2011; Myers, Chase, Pierce, & Martin, 2011). The confirmatory-factor-analysis measurement model has been used for the latent variable measurement specification in the framework of structural equation modelling (Asparouhov & Muthén, 2009; Bollen,

Correspondence: Masato Kawabata, The University of Queensland, School of Human Movement Studies, St Lucia, Brisbane, 4072 Australia.
E-mail: masato-k@hotmail.com

1989). In typical confirmatory factor analysis, each indicator is required to load onto only one factor and no cross-loadings are allowed. This strict requirement, however, often produces poor fit of a priori model to the data (Asparouhov & Muthén, 2009). Furthermore, even when a confirmatory-factor-analysis model fits to the data well, mis-specification of zero cross-loadings usually inflates factor correlations to some extent unless all non-target loadings are close to zero (Asparouhov & Muthén, 2009; Marsh et al., 2009, 2010). Consequently, inflated factor correlations lead to two key issues: the lack of discriminant validity and multicollinearity (Asparouhov & Muthén, 2009; Marsh et al., 2010). Despite these methodological disadvantages of confirmatory factor analysis, the confirmatory-factor-analysis approach to factor analysis has been dominant for a decade over exploratory factor analysis in applied research (Marsh et al., 2009). Marsh and colleagues (2009, 2010) assumed that it is due to applied researchers' erroneous beliefs that exploratory factor analysis is outdated and no longer acceptable and methodological advantages related to confirmatory factor analysis (e.g., goodness-of-fit indices, latent mean structures) are not applicable to exploratory factor analysis.

To overcome these methodological issues related to the traditional confirmatory-factor-analysis approach and provide a richer set of a priori model alternatives, Asparouhov and Muthén (2009) developed exploratory structural equation modelling that integrates the relative advantages of confirmatory factor analysis and exploratory factor analysis within the structural-equation-modelling framework. Exploratory structural equation modelling is a less restrictive measurement model in which factor loading matrix rotations can be used and all the common structural-equation-modelling parameters (e.g., residual correlations) and latent mean structures are available. The primary advantage of the exploratory-structural-equation-modelling model over existing modelling practices is that it seamlessly includes exploratory-factor-analysis and structural-equation-modelling models, making model testing sequences better (Asparouhov & Muthén, 2009). In most applications with multiple factors, the exploratory-factor-analysis approach is employed to identify factors and usually followed by a confirmatory-factor-analysis model that is based on the identified factors in order to specify a simple structure. However, the conversion of an exploratory-factor-analysis model into a confirmatory-factor-analysis model results in potential issues (e.g., poor model fit). On the other hand, the exploratory-structural-equation-modelling approach carries out these tasks in a one-step approach by simultaneously estimating measurement and structural parts. Therefore, the exploratory-structural-equation-modelling approach is more precise because it evades the conversion problem. For these flexibilities and merits of exploratory structural equation modelling, Marsh and colleagues (2010) recommended that, "subsequent CFA [confirmatory-factor-analysis] studies routinely consider ESEM [exploratory-structural-equation-modelling] solutions as a viable alternative, even when the fit of CFA solutions is apparently acceptable" (p. 485).

The present study

Ryan (2011), a founding father of SDT on which the SMS-6 is based, reported concerns about scale development through exclusive focus on independence of inter-related constructs, which could lead to distortion of the constructs themselves. Given that motivation is conceptualised along the self-determination continuum within SDT (Ryan & Deci, 2007) and positive correlations between adjacent factors on the continuum are expected; it seems theoretically questionable to suppose all non-target cross-loadings are zero for the SMS-6. The discriminant validity issues of the SMS-6 responses could be due to their specific sample and/or the unrealistic methodological assumption of the typical confirmatory-factor-analysis structure for the SMS-6. To examine these issues, therefore, the factor structure of the SMS-6 was reassessed with an independent Australian sample using both confirmatory-factor-analysis and exploratory-structural-equation-modelling approaches and their solutions were compared.

Method

Participants and procedures

A total of 437 undergraduate students at a large public university in Australia (188 men and 245 women; four did not report their gender) agreed to participate in the present study. Participants' ages ranged from 17 to 58 years ($M = 19.7$, $s = 4.3$). They were recruited from classes in psychology or human movement studies. The study was approved by an institutional review committee and adhered to the guidelines for ethical practice. Participation was voluntary and informed consent was received from each participant. To be eligible for participation in this study, they were required to be involved in sport at least once a week. This sample involved 58 different sport activities that involved more than one participant. The five most common activities reported were soccer (9.6%), running (7.3%), netball (5.5%), tennis (5.5%), and basketball (4.6%). Highest participation levels reported were international (5.7%), national (19.2%), state (32.0%), club or school (22.9%), and recreational (18.5%).

Measures

Sport Motivation Scale-6 (SMS-6). The SMS-6 (Mallett, Kawabata, Newcombe, et al., 2007) is a 24-item revised Sport Motivation Scale (Pelletier et al., 1995) and consists of six subscales (four items each) corresponding to the six forms of motivation proposed by SDT. It is a measure of contextual motivation that is designed to identify the perceived reasons for participating in sport. Respondents are asked to reply to the question, "Why do you practice your sport?" with such items as, "For the excitement I feel when I am really involved in the activity" on a seven-point Likert-type scale ranging from 1 (*does not correspond at all*) to 7 (*correspond exactly*).

Dispositional Flow Scale-2 (DFS-2). Responses to the DFS-2 (Jackson & Eklund, 2002) were used to evaluate concurrent validity of the SMS-6. *Flow* is a metaphorical term to illustrate the feeling of an optimal state of mind that people often report when they are engaging in intrinsically motivated activities (Csikszentmihalyi, 1985). Flow and motivation are, therefore, considered conceptually closely related to each other. The DFS-2 is a 36-item dispositional assessment of flow experience in a physical activity setting and consists of nine subscales (four items each) corresponding to nine flow dimensions (e.g., challenge-skill balance, concentration on the task at hand, and autotelic experience). Respondents are requested to think about how often they generally experience the characteristics of flow within a particular activity (e.g., "I feel I am competent enough to meet the high demands of the situation") and to rate their responses on a 5-point Likert scale, ranging from 1 (*never*) to 5 (*always*).

Data analyses

Confirmatory factor analysis and exploratory structural equation modelling were conducted with M*plus* (Version 6.12; Muthén & Muthén, 2011) based on M*plus* robust maximum likelihood estimation (MLR). An oblique geomin rotation was used because the SMS-6 factors are expected to covary and the geomin rotation criterion is the most effective criterion when the true factor loading structure is unknown (Asparouhov & Muthén, 2009). In the typical confirmatory-factor-analysis model, each item is allowed to load on only one target factor and all non-target cross-loadings are constrained to be zero. In contrast, all items are allowed to load on every factor and all factor loadings are estimated in the exploratory-structural-equation-modelling model by imposing appropriate restrictions on the factor loading matrix and the factor covariance matrix (Marsh et al., 2009, 2010; see also Asparouhov & Muthén, 2009 for further details of the exploratory-structural-equation-modelling approach and identification issues). For this reason, the confirmatory-factor-analysis model is more parsimonious than the exploratory-structural-equation-modelling model. In the present study, the degrees of freedom for the 24-item SMS-6 are 237 and 147 for the confirmatory-factor-analysis and exploratory-structural-equation-modelling models, respectively. When the more parsimonious confirmatory-factor-analysis model adequately fits the data similar to the exploratory-structural-equation-modelling model, then the confirmatory-factor-analysis model should be used (Marsh et al., 2010).

To assess overall model fit, several criteria were used: the MLR chi-square statistic (Muthén & Muthén, 1998–2011), the comparative fit index (CFI; Bentler, 1990), the Tucker-Lewis index (TLI; Tucker & Lewis, 1973), the root mean square error of approximation (RMSEA; Steiger, 1990), and the standard root mean square residual (SRMR; Hu & Bentler, 1998). Values on the CFI and TLI that are greater than 0.90 and 0.95 are generally taken to reflect acceptable and excellent fits to the data (e.g., Marsh et al., 2009, 2010). For the RMSEA, values of 0.05 or less indicate a close fit, and 0.08 or less indicate an adequate fit (Brown & Cudeck, 1993). Finally, values on the SRMR that are less than 0.08 indicate an adequate fit (Hu & Bentler, 1999). In a well-fitting model, this value should be small – 0.05 or less. Hu and Bentler (1999) reported that mis-specified models are unlikely to be accepted if models are rejected when a) the CFI or TLI is less than 0.95 and b) the SRMR is greater than 0.09 (or 0.10). Although Hu and Bentler (1998, 1999) proposed the more stringent cut-off criteria and the two-index strategy, they and others have cautioned about potential overgeneralisation of their findings (e.g., Fan & Sivo, 2005; Marsh, Hau, & Wen, 2004). Consistent with current research (e.g., Marsh et al., 2009, 2010; McLachlan, Spray, & Hagger, 2011), therefore, conventional multiple cut-off values (i.e., the CFI and TLI ≥ 0.90, the RMSEA ≤ 0.08, the SRMR ≤ 0.08) were considered minimum thresholds for accepting model fit and achievement of Hu and Bentler's (1999) more stringent criteria for the CFI and TLI as evidence of an excellent fit.

Results

Descriptive statistics

The means and standard deviations of the 24 item scores ranged as follows: from 1.62 to 5.24 for means and from 1.11 to 1.90 for standard deviations. The items with the lowest and highest mean scores were Item 17 (Amotivation: "It is not clear to me anymore; I don't really think my place is in sport") and Item 1 (Intrinsic Motivation: "For the excitement I feel when I am really involved in the activity"), respectively (item numbers are consistent with those listed in Mallett, Kawabata, Newcombe, et al., 2007). Cronbach's αs for the subscales of the SMS-6 ranged from 0.71 (Identified Regulation) to 0.84 (Integrated Regulation), with a mean of 0.80. For the DFS-2, internal consistency coefficients ranged from 0.79 to 0.87.

Confirmatory factor analysis and exploratory structural equation modelling

Factor structure. The six-factor confirmatory-factor-analysis model did not fit to the data adequately (MLRχ^2 [237, $N = 437$] = 712.68, $P < 0.001$; CFI = 0.889, TLI = 0.871, RMSEA = 0.068, SRMR = 0.059). Although values on the RMSEA and SRMR were acceptable, values on the CFI and TLI were below minimum acceptable levels. Apparent problems were also observed with individual parameters. All factor loadings were substantial and statistically significant (range = 0.52–0.84); however, inter-factor correlations ranged from −0.25 to 0.95 and caused concerns about the discriminant validity of highly correlated factors. Identified Regulation was highly correlated with Intrinsic Motivation (0.92) and Integrated Regulation (0.95), which was consistent with the findings reported in Mallett, Kawabata, Newcombe, et al. (2007). Bagozzi and Kimmel (1995) proposed adding 1.96 times the standard error of the correlation to the correlation in order to construct the upper bound of a 95% confidence interval for the correlation. If the upper bound is less than 1, this is considered as evidence of discriminant validity. Based on Bagozzi and Kimmel's (1995) approach, the upper bounds of the two correlations were less than 1 (viz., 0.973 between Identified Regulation and Intrinsic Motivation and 0.998 between Identified Regulation and Integrated Regulation). Although these factors were highly correlated, they were found empirically distinct for the current sample.

The six-factor exploratory-structural-equation-modelling provided an excellent fit to the data (MLRχ^2 [147, $N = 437$] = 336.82, $P < 0.001$; CFI = 0.961, TLI = 0.927, RMSEA = 0.054, SRMR = 0.023). Compared to the corresponding confirmatory-factor-analysis model, it fit to the data much better. The size of correlations among the six factors was also considerably smaller for the exploratory-structural-equation-modelling solution, ranging from −0.18 to 0.46. Identified Regulation correlated with Intrinsic Motivation (0.37) and Integrated Regulation (0.42) and there was no concern about the discriminant validity issue between them. Examination of factor loadings, however, revealed that three items poorly loaded on their target factors. They were Items 4 (External Regulation: "Because it allows me to be well regarded by people that I know"), 15 (Identified Regulation: "Because it is one of the best ways to maintain good relationships with my friends"), and 20 (Identified Regulation: "Because training hard will improve my performance"). Items 4 and 15 were from the original SMS and Item 20 was from the revised SMS-6. None of these cross-loadings were surprisingly detected with modification indexes in the confirmatory-factor-analysis procedure. Given that Item 20 loaded on Intrinsic Motivation (0.41) and Integrated Regulation (0.34), it was apparent that these cross-loadings contributed to the unsatisfactory overall fit and the high correlation of Identified Regulation with Intrinsic Motivation and Integrated Regulation. These three items were highly problematic because they loaded on non-target factors more strongly than hypothesised target factors. Nevertheless, these poor loadings might be specific to the present sample. These findings were, therefore, cross-examined by conducting exploratory structural equation modelling on a data set used in Mallett, Kawabata, Newcombe, et al. (2007). The data were collected from 557 undergraduates (44.2% men) studying at the same university as the present study. Their ages ranged from 16 to 43 years ($M = 20.0$, $s = 3.5$). This sample involved 49 different sport activities. Comparing the demographic characteristics of this sample with the sample of the present study, these two samples were considered independent samples representing the same population.

The six-factor exploratory-structural-equation-modelling model also fit to the cross-examination data well (MLRχ^2 [147, $N = 557$] = 343.74, $P < 0.001$; CFI = 0.967, TLI = 0.938, RMSEA = 0.049, SRMR = 0.021). The correlations among the six factors ranged from −0.08 to 0.43. An examination of the factor loadings revealed that Items 15 and 20 inadequately loaded on their target factor again (their loadings on Identified Regulation factor were 0.23 and 0.04 for Items 15 and 20, respectively), whereas Item 4 loaded well on External Regulation (0.62). Because the poor loadings of Items15 and 20 were consistently observed across two samples, confirmatory factor analysis and exploratory structural equation modelling were conducted again on the present study's data, excluding these two items.

The confirmatory-factor-analysis model with 22 items provided a satisfactory fit to the data (MLRχ^2 [194, $N = 437$] = 511.71, $P < 0.001$; CFI = 0.918, TLI = 0.902, RMSEA = 0.061, SRMR = 0.055). Furthermore, no problems were observed with individual parameters. All factor loadings were statistically significant (range = 0.59–0.83) and inter-factor correlations ranged from -0.25 to 0.77. The corresponding exploratory-structural-equation-modelling model also provided an excellent fit to the data (MLRχ^2 [114, $N = 437$] = 243.31, $P < 0.001$; CFI = 0.970, TLI = 0.940, RMSEA = 0.051, SRMR = 0.020). All items, except for Item 4, loaded on their target factors more than non-target factors (the range of factor loadings on target factors = 0.37–0.88), and inter-factor correlations ranged from -0.19 to 0.44. The sizes of factor loadings on target factors were comparable between the confirmatory-factor-analysis and exploratory-structural-equation-modelling solutions, but the sizes of inter-factor correlations were different. By comparison with the exploratory-structural-equation-modelling solutions, the size of relations among the factors was found somewhat distorted in the confirmatory-factor-analysis solution by fixing all cross-loadings to be zero.

Correlations among the SMS-6 factors. The correlation matrix of the SMS-6 factors was analysed to determine whether the self-determination continuum postulated by Deci and Ryan (1985) emerged for the present sample. This continuum would be supported when a simplex pattern is displayed in which adjacent factors have positive correlations and the factors at the opposite end of continuum (i.e., Intrinsic Motivation and Amotivation) have a negative correlation. In both confirmatory-factor-analysis and exploratory-structural-equation-modelling solutions, correlations among the six latent factors demonstrated the simplex pattern in general (see Table I). External Regulation, however, did not follow the expected simplex pattern, as reported in the study by Standage, Duda, and Ntoumanis (2003).

Concurrent validity. Latent factor correlations between the SMS-6 and the DFS-2 were assessed to examine the concurrent validity of the SMS-6 responses (22 items). For the comparison between confirmatory-factor-analysis and exploratory-structural-equation-modelling solutions, two models were analysed for the data of the present study. In the first model, both SMS-6 and DFS-2 factors were specified as confirmatory-factor-analysis factors. In the second model, the SMS-6 and DFS-2 factors were specified as exploratory-structural-equation-modelling and confirmatory-factor-analysis factors, respectively. Considering individuals who are intrinsically motivated are likely to experience flow (Deci & Ryan, 1985), it was assumed that the DFS-2 factors correlated more with Intrinsic Motivation in a positive direction, but correlated negatively with Amotivation. Both models provided an acceptable fit to the data (the first model: MLRχ^2 [1490, $N = 437$] = 2520.01, $P < 0.001$; CFI = 0.911, TLI = 0.901, RMSEA = 0.040, SRMR = 0.049; the second model: MLRχ^2 [1410, $N = 437$] = 2416.53, $P < 0.001$; CFI = 0.921, TLI = 0.908, RMSEA = 0.040, SRMR = 0.041). Inter-factor correlations between the SMS-6 and DFS-2 factors ranged from -0.45 to 0.69 for the first model and from -0.41 to 0.65 for the second model. The size of correlations among the factors was found comparable between both the models. In the both models, Intrinsic Motivation positively correlated with DFS-2 factors, whereas Amotivation provided negative correlations with the dispositional flow factors (see Table II). Due to the space limitation, the results of three flow factors (Challenge-Skill Balance, Concentration on the Task at Hand, and Autotelic Experience) are only presented in Table II. These results supported the concurrent validity of the SMS-6 responses.

Summary and implications

The factor structure of the SMS-6 was examined in the present study for an independent Australian sample by using confirmatory-factor-analysis and exploratory-structural-equation-modelling approaches to investigate its discriminant validity issues. The confirmatory-factor-analysis model with all 24 items did not fit to the sample's data adequately, and Identified Regulation was highly correlated with Intrinsic Motivation and Integrated Regulation. Through examination of the corresponding exploratory-structural-equation-modelling solution, it was found that Items 4, 15, and 20, which

Table I. Latent factor correlations in the CFA (lower diagonal) and ESEM (upper diagonal) solutions for the SMS-6 ($N = 437$).

Subscale	AM	EXT	ITJ	IDT	ING	IM
Amotivation (AM)	(0.83)	0.16	0.04	0.03	−0.19	−0.16
External Regulation (EXT)	0.17	(0.80)	0.24	0.25	0.31	0.28
Introjected Regulation (ITJ)	0.02	0.60	(0.78)	0.16	0.35	0.07
Identified Regulation (IDT)	−0.08	0.54	0.43	(0.73)	0.43	0.37
Integrated Regulation (ING)	−0.25	0.62	0.63	0.77	(0.84)	0.44
Intrinsic Motivation (IM)	−0.23	0.58	0.33	0.63	0.74	(0.83)

Note: CFA = confirmatory factor analysis; ESEM = exploratory structural equation modelling. Absolute correlation values above 0.02 and 0.07 are significant at $P < 0.05$ in the CFA and ESEM solutions, respectively. Coefficient alphas of the SMS-6 subscale scores are presented in parentheses along the diagonal. Each subscale consists of four items except for Identified Regulation (2 items).

Table II. Latent factor correlations between the SMS-6 and DFS-2 ($N = 437$).

	Model 1			Model 2		
Subscale	CS (0.80)	CT (0.83)	AE (0.79)	CS (0.80)	CT (0.83)	AE (0.79)
Amotivation (AM)	−0.28	−0.22	−0.45	−0.26	−0.20	−0.41
External Regulation (EXT)	0.45	0.29	0.28	0.42	0.28	0.17
Introjected Regulation (ITJ)	0.12	0.11	0.28	−0.09	−0.03	0.15
Identified Regulation (IDT)	0.36	0.26	0.45	0.28	0.15	0.32
Integrated Regulation (ING)	0.54	0.37	0.61	0.49	0.32	0.51
Intrinsic Motivation (IM)	0.58	0.51	0.69	0.50	0.50	0.65

Note: SMS-6 = Sport Motivation Scale-6; DFS-2 = Dispositional Flow Scale-2; CS = Challenge-Skill Balance; CT = Concentration on the Task at Hand; AE = Autotelic Experience; CFA = confirmatory factor analysis; ESEM = exploratory structural equation modelling. In the first model, both SMS-6 and DFS-2 factors were specified as CFA factors. In the second model, the SMS-6 and DFS-2 factors were specified as ESEM and CFA factors, respectively. Absolute correlation values above 0.10 are significant at $P < 0.05$ in both the CFA and ESEM solutions. Coefficient alphas of the DFS-2 subscale scores are presented in parentheses. Each SMS-6 subscale consists of four items except for Identified Regulation (2 items).

were not detected with modification indexes in the confirmatory-factor-analysis procedure, loaded on non-target factors more than target factors. This finding was cross-examined by conducting exploratory structural equation modelling on a published data set and the poor loadings of Items 15 and 20 on Identified Regulation were consistently observed across the independent samples. By eliminating the items, the confirmatory-factor-analysis model fit to the present study's data satisfactorily and all six factors were adequately differentiated even though the size of inter-factor correlations in confirmatory factor analysis was somewhat inflated compared to the exploratory-structural-equation-modelling solutions. These results, together with the findings of the concurrent validity analyses, generally supported the validity of the SMS-6 responses.

The present study revealed that the discriminant validity issue of Identified Regulation was attributable to Items 15 and 20. Identified Regulation is internally regulated or self-determining because the person considers the behaviour as important and endorsed even though the individual pursues particular valued outcomes. Item 20 ("Because training hard will improve my performance") loaded onto Intrinsic Motivation and Integrated Regulation. This item was developed from previous research (Mallett & Hanrahan, 2004) that reflected a strong behaviour of elite athletes. Perhaps part of Item 20 "improving performance" was associated with a sense of accomplishment – a form of intrinsic motivation. Replacing "will" with 'is necessary' in Item 20 might emphasise its instrumental aspect. Item 15 ("Because it is one of the best ways to maintain good relationships with my friends") from the original SMS loaded onto External Regulation. Perhaps the participants perceived little autonomy in this statement. To lessen the aspect of external contingencies and emphasise partial internalisation, it is suggested to insert the phrase 'I have chosen' into Item 15, thus reading, "Because I have chosen it to be one of the best ways to maintain good relationships with my friends." Considering the inadequate loading on their target factor (i.e., Identified Regulation) was observed in exploratory-structural-equation-modelling solutions across two independent Australian samples (i.e., the present study and Mallett, Kawabata, Newcombe, et al., 2007), it could be suggested to exclude these two items from analyses when data are collected from Australian samples or to modify the two items as mentioned above. Further research would be required to determine if the items are problematic for samples from other English-speaking communities.

With regard to the correlations among the SMS-6 factors, External Regulation did not follow the expected simplex pattern, consistent with the study by Standage et al. (2003). They suggested that the four items of the original SMS measuring External Regulation did not map well onto this form of motivation as conceptualised in SDT (Deci & Ryan, 1985). Specifically, they argued that the items are not reflecting the controlling aspects of External Regulation. For example, the item proposed as measuring External Regulation, "For the prestige of being an athlete" might reflect a sense of accomplishment (Intrinsic Motivation) and relate to the psychological need of competence. The perceived need of competence is related to self-determined forms of motivation (Deci & Ryan, 1985). For the revised SMS-6, three of four items measuring External Regulation were from the original SMS, including Item 4. The positive relationships between External Regulation and the three subscales of self-determined motivation in the current study support the findings of Standage et al. (2003) and the lack of clarity around the controlling nature of External Regulation as measured by the items may explain these unexpected positive relationships. In contrast, some recent measures of External Regulation highlight the controlling nature of this non-self-determined form of motivation associated with coaching practice. For example, the following items reflect the controlling aspect of External Regulation: "Because I want to be appreciated by others" in the Coach Motivation Questionnaire (McLean, Mallett, & Newcombe, 2012) and "My coach tries to motivate me by promising to reward me if I do well" in the Controlling Coach Behaviors Scale (Bartholomew, Ntoumanis, & Thøgersen-Ntoumani, 2010).

As for the concurrent validity of the SMS-6 responses (22-items), latent factors between the SMS-6 and the DFS-2 were correlated in the expected way. Intrinsic Motivation was substantially positively correlated with the flow factors. Vallerand, Donahue, and Lafrenière (2012) were concerned that the Integrated Regulation factor of the SMS-6 may lack discriminant validity because the correlations between Integrated Regulation and flow factors reported in Mallett, Kawabata, Newcombe, et al. (2007) were highly similar to Intrinsic Motivation and Identified Regulation. With the present sample, however, the correlations between Integration Regulation and flow factors were different from those of Intrinsic Motivation and Identified Regulation. These results supported the concurrent validity of the SMS-6 responses as well as the discriminant validity of the Integrated Regulation factor.

Finally, the current study indicated that a comparison of the confirmatory-factor-analysis and exploratory-structural-equation-modelling solutions is most useful to interpret individual parameters in the quest for the development of valid measures in sport psychology. Construct validation is an ongoing process and it is proposed that those developing measures continue to examine relevant validity issues to ensure the research undertaken has integrity. Although exploratory structural equation modelling is currently only available in the M*plus* statistical package, it is recommended to consider exploratory-structural-equation-modelling solutions as a part of multivariate strategies for construct validity assessment.

Acknowledgements

We are grateful to anonymous reviewers for constructive comments on the earlier drafts of this article.

References

Asparouhov, T., & Muthén, B. (2009). Exploratory structural equation modeling. *Structural Equation Modeling*, *16*, 397–438.

Bagozzi, R.P., & Kimmel, S.K. (1995). A comparison of leading theories for the prediction of goal-directed behaviours. *British Journal of Social Psychology*, *34*, 437–461.

Bartholomew, K., Ntoumanis, N., &Thøgersen-Ntoumani, C. (2010). The controlling interpersonal style in a coaching context: Development and initial validation of a psychometric scale. *Journal of Sport & Exercise Psychology*, *32*, 193–216.

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

Bollen, K.A. (1989). *Structural equations with latent variables*. New York, NY: Wiley.

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K.A. Bollen & J.S. Long (Eds.), *Testing structural equation models* (pp. 445–455). Newbury Park, CA: Sage.

Csikszentmihalyi, M. (1985). Emergent motivation and the evolution of the self. *Advances in Motivation and Achievement*, *4*, 93–119.

Deci, E.L., & Ryan, R.M. (1985). *Intrinsic motivation and self-determination in human behaviour*. New York, NY: Plenum Press.

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

Hu, L., & Bentler, P.M. (1998). Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychological Methods*, *3*, 424–453.

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

Jackson, S.A., & Eklund, R.C. (2002). Assessing flow in physical activity: The Flow State Scale-2 and Dispositional Flow Scale-2. *Journal of Sport & Exercise Psychology*, *24*, 133–150.

Mallett, C.J., & Hanrahan, S.J. (2004). Elite athletes: What makes the "fire" burn so brightly? *Psychology of Sport and Exercise*, *5*, 183–200.

Mallett, C.J., Kawabata, M., & Newcombe, P. (2007). Progressing measurement in sport motivation with the SMS-6: A response to Pelletier, Vallerand, and Sarrazin. *Psychology of Sport and Exercise*, *8*, 622–631.

Mallett, C.J., Kawabata, M., Newcombe, P., Otero-Forero, A., & Jackson, S.A. (2007). Sports Motivation Scale–6 (SMS-6): A revised six-factor sport motivation scale. *Psychology of Sport and Exercise*, *8*, 600–614.

Marsh, H.W., Hau, K.-T., & Wen, Z. (2004). In search of golden rules: Comment on hypothesis-testing approaches to setting cutoff values for fit indexes and dangers in overgeneralizing Hu and Bentler's (1999) findings. *Structural Equation Modeling*, *11*, 320–341.

Marsh, H.W., & Jackson, S.A. (1999). Flow experience in sport: Construct validation of multidimensional hierarchical state and trait responses. *Structural Equation Modeling*, *6*, 343–371.

Marsh, H.W., Lüdtke, O., Muthén, B., Asparouhov, T., Morin, A.J.S., Trautwein, U., & Nagengast, B. (2010). A new look at the big-five factor structure through exploratory structural equation modeling. *Psychological Assessment*, *22*, 471–491.

Marsh, H.W., Muthén, B., Asparouhov, T., Lüdtke, O., Robitzsch, A., Morin, A.J.S., & Trautwein, U. (2009). Exploratory structural equation modeling, integrating CFA and EFA: Application to students' evaluations of university teaching. *Structural Equation Modeling*, *16*, 439–476.

McLachlan, S., Spray, C., & Hagger, M.S. (2011). The development of a scale measuring integrated regulation in exercise. *British Journal of Health Psychology*, *16*, 722–743.

McLean, K.M., Mallett, C.J., & Newcombe, P. (2012). Assessing coach motivation: The development of the Coach Motivation Questionnaire (CMQ). *Journal of Sport & Exercise Psychology*, *34*, 184–207.

Morin, A.J.S., & Maïano, C. (2011). Cross-validation of the short form of the physical self-inventory (PSI-S) using exploratory structural equation modelling (ESEM). *Psychology of Sport and Exercise*, *12*, 540–554.

Muthén, L.K., & Muthén, B. (1998–2010). *Mplus user's guide (6th ed.)*. Los Angeles, CA: Muthén & Muthén.

Muthén, L.K., & Muthén, B. (2011). *Mplus (Version 6.12). [Computer software]*. Los Angeles, CA: Muthén & Muthén.

Myers, N.D., Chase, M.A., Pierce, S.W., & Martin, E. (2011). Coaching efficacy and exploratory structural equation modelling: A substantive-methodological synergy. *Journal of Sport & Exercise Psychology*, *33*, 770–806.

Pelletier, L.G., Fortier, M.S., Vallerand, R.J., Tuson, K.M., Brière, N.M., & Blais, M.R. (1995). Toward a new measure of intrinsic motivation, extrinsic motivation, and amotivation in sports: The Sport Motivation Scale (SMS). *Journal of Sport & Exercise Psychology*, *17*, 35–53.

Ryan, R.M. (2011, April 22). Re: [SDT] Clarification - high interscale correlations for satisfying or thwarting styles [Electronic mailing list message]. Retrieved from https://lists.rochester.edu/wa.exe?RESET-COOKIE&X=08ED0F739E80558235.

Ryan, R.M., & Deci, E.L. (2007). Active human nature: Self-determination theory and the promotion and maintenance of sport, exercise and health. In M.S. Hagger & N.L.D. Chatzisarantis (Eds.), *Intrinsic motivation and self-determination in exercise and sport* (pp. 1–20). Champaign, IL: Human Kinetics.

Standage, M., Duda, J.L., & Ntoumanis, N. (2003). A model of contextual motivation in physical education: Using constructs from self-determination and achievement goal theories to predict physical activity intentions. *Journal of Educational Psychology*, *95*, 97–110.

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

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

Vallerand, R.J., Donahue, E.G., & Lafrenière, M.A.K. (2012). Intrinsic and extrinsic motivation in sport and exercise. In G. Tenenbaum, R.C. Eklund, & A. Kamata (Eds.), *Measurement in sport and exercise psychology* (pp. 279–292). Champaign, IL: Human Kinetics.