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Examining gender invariance of the Sport-Multidimensional Perfectionism Scale-2 in intercollegiate athletes

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Running Head: SPORT-MPS-2 VALIDITY EVIDENCE
Objectives. The purpose of the present study is to examine gender measurement invariance of the Sport Multidimensional Perfectionism Scale – 2 (Sport-MPS-2; Gotwals & Dunn, 2009) with intercollegiate athletes.

Methods. Canadian intercollegiate athletes (N=531, women=47.4 %) completed the Sport-MPS-2.

Results. Analysis of men, women, and combined samples using both independent clusters confirmatory factor analysis (ICM-CFA) and exploratory structural equation modeling (ESEM) procedures found supportive evidence for the hypothesized 6-factor lower order model. ESEM analysis fit the data slightly better than ICM-CFA. Progressive gender invariance analysis using ESEM found evidence for configural, weak, and strong, but not strict invariance.

Conclusions. The gender invariance results suggest internal structure of the Sport-MPS2 can be confirmed as invariant across gender, and individuals who have the same score on perfectionism would obtain the same score on the instrument independently of their gender. The lack of strict invariance may imply differences in precision that warrant caution in interpretation in certain situations, but support for gender comparisons using the Sport-MPS-2 in this population is largely supported.

Key words: sport, perfectionism, construct validity, measurement invariance
Examining gender invariance of the Sport-Multidimensional Perfectionism Scale-2 in collegiate athletes

Perfectionism is a multidimensional personality disposition or trait that is characterized by very high performance standards, striving for perfection, perceptions of pressure and apprehensions over making mistakes, and a tendency to engage in overly critical self-evaluations (Flett & Hewitt, 2002; Frost, Marten, Lahart, & Rosenblate, 1990; Stoeber, 2011). Researchers in sport and exercise psychology have demonstrated that perfectionism is linked to motivation, stress, coping, emotions, and performance (Crocker, Gaudreau, Mosewich & Kljajic, 2014; Gotwals, Stoeber, Dunn, & Stoll, 2012; Hall, 2016; Stoeber, 2011), although there is ongoing controversy over whether high levels of perfectionism have functional or maladaptive consequences (Hall, Hill, & Appleton, 2012; Gotwals et al., 2012). Despite this scholarly debate there is a general consensus that perfectionism can be captured by two higher-order dimensions: perfectionistic strivings and perfectionistic concerns (Hill, 2016; Stoeber & Otto, 2006).

Perfectionistic strivings refer to a self-oriented striving process related to perfection and setting very high goals. Perfectionistic concerns involve a person’s apprehension over negative social evaluation and are reflected in excessive self-criticism, apprehensions over making mistakes and high doubts about performing required actions.

A major challenge in evaluating the impact of multidimensional perfectionism in sport and exercise settings is measurement. Although researchers have used various global and sport-specific perfectionism measures in sport, the Sport-Multidimensional Perfectionism Scale-2 (Sport MPS-2; Gotwals & Dunn, 2009) and its predecessor, the Sport-MPS (Dunn, Caugrove Dunn, & Syrotuik, 2002), are commonly used measures in the sport domain (Gotwals et al., 2012; Stoeber & Madigan, 2016). The Sport-MPS was fashioned after the Frost-MPS (Frost et al., 1990), a global measure of multidimensional perfectionism. To increase relevance in the
sport context, Dunn et al. (2002) pointed to a need to consider content and latent dimensionality that was relevant to the athletic context. Thus the original Sport-MPS included Personal Standards (PS) and Concern over Mistakes (COM), as well as Perceived Parental Pressure (PPP) and Perceived Coach Pressure (PCP). Subsequently, Gotwals and Dunn (2009) proposed the Sport-MPS-2 that added scales to capture the perfectionism dimensions of Organization (ORG) and Doubts about Action (DAA). Dunn and colleagues have argued that subscales from both the Sport-MPS and the Sport-MPS-2 have demonstrated acceptable psychometric properties such as lower order and higher order latent dimensionality, concurrent validity evidence, and predictive validity evidence (see Dunn et al., 2016; Gotwals et al., 2012; Stoeber, 2011).

A careful perusal of the empirical evidence, however, suggests further psychometric evaluation of the Sport-MPS-2 in terms of gender invariance is warranted. Researchers are often interested if there are meaningful differences in psychological constructs across gender. For example, Dunn, Gotwals, & Causgrove Dunn (2005) found that men intercollegiate athletes reported higher levels of self-oriented perfectionism and other-oriented perfectionism in sport contexts compared to women. In a study examining perfectionism dimensions in former higher school athletes, Anshel, Kim, & Henry (2009) reported that women scored higher on levels of parental expectations / criticism whereas men reported higher levels of neatness / organization. There are a few important points. First, neither study used the Sport MPS nor the Sport MPS-2. Second, there are no published studies that have examined gender differences using the Sport MPS-2. Third, any examination of gender differences requires that the selected perfectionism measure demonstrate gender invariance; there is no published evidence that the Sport MPS-2 demonstrates measurement invariance across men and women athletes.
Gender measurement invariance examines if items from an instrument can be interpreted with the same meaning across gender groups (see Wu, Li, & Zumbo, 2007). Measurement invariance has often involved independent clusters confirmatory factor analysis (ICM-CFA) that has been criticized as being too restrictive for multidimensional constructs such as perfectionism (Marsh, Morin, Parker, & Kaur, 2014). In particular, ICM-CFA fixes crossloadings of items of non-target factors to zero. Measurement papers have increasingly suggested using exploratory structural equation modeling (ESEM) to examine model fit and measurement invariance (Asparouhov & Muthen, 2009; Marsh et al., 2014; Myers, Ntoumanis, Gunnell, & Gucciardi, 2017; Schellenberg, Gunnell, Mosewich, & Bailis, 2014). ESEM allows items to cross-load on non-target factors. We examined model fit using both ICM-CFA and ESEM procedures and selected the procedure that had the superior fit indices in order to confirm if the instrument measures perfectionism equally across gender and interpretations and decisions can be made based on valid test scores.

Method

Participants

Participants included 531 intercollegiate athletes ($M_{age} = 20.02$, $SD_{age} = 1.73$, range = 17 – 25 years; Men: $n = 279$, $M_{age} = 20.23$, $SD_{age} = 1.73$, range = 17 – 25 years; Women: $n = 252$, $M_{age} = 19.80$, $SD_{age} = 1.68$, range = 17 – 25 years). All athletes were in their regular competitive season at the time of the study [baseball: $n = 55$ (male = 55), basketball: $n = 74$ (male = 23), cheerleading: $n = 4$ (male = 0), cross country: $n = 33$ (male = 18), cross country and track and field: $n = 7$ (male = 2), field hockey: $n = 15$ (male = 0), football: $n = 63$ (male = 62 male), golf: $n = 16$ (male = 8), ice hockey: $n = 40$ (male = 17), rugby: $n = 14$ (male = 0), soccer: $n = 28$ (male = 28)].
8), softball: \( n = 15 \) (male = 0), swimming: \( n = 42 \) (male = 19), track and field: \( n = 58 \) (male = 24), and volleyball: \( n = 67 \) (male = 43)].

**Procedure**

After obtaining ethical approval from two Canadian university research boards, athletes from varsity sports teams from universities and colleges located in two Canadian provinces were recruited through team visits and emails. Athletes completed a questionnaire package\(^1\) at a time convenient to them and the team (e.g., before/after practice or a team meeting). Informed consent was obtained from all participants.

**Measures**

**Demographics.** Information including age, gender, and type of sport was collected.

**Sport Multidimensional Perfectionism Scale 2.** The Sport Multidimensional Perfectionism Scale-2 (Sport-MPS-2; Gotwals & Dunn, 2009) is a 42-item measure consisting of six subscales rated on a 5-point scale from 1 (strongly disagree) to 5 (strongly agree): personal standards (7 items), concern over mistakes (8 items), perceived parental pressure (9 items), perceived coach pressure (6 items), doubts about actions (6 items), and organization (6 items).

**Data Analysis**

All analyses were done using Mplus version 7.3. Missing data were removed from original database because they represented a small number of cases (less than 5% of the total sample). To confirm the six-dimension original structure of the Sport-MPS-2 questionnaire and obtain validity evidence in relation to its internal structure, we used both ICM-CFA and ESEM for the men, women, and total samples. Robust maximum-likelihood estimation was used as the

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\(^1\) Data for the present study came from two separate, but related studies. Both studies were part of a research program on stress and coping, and both employed a two-time point, prospective design. The perfectionism measures employed in this study were delivered at Time 1. In study 1, athletes \( n = 276 \) also completed measures of self-compassion and global perfectionism. In Study 2 \( n = 255 \), self-compassion, global perfectionism and athletic contingent self-worth were assessed. Athletes were compensated $10 for Study 1 and $5 for Study 2.
extraction method. All ESEM analyses were conducted using target rotation (Marsh et al., 2014), allowing for specification of a priori hypotheses about the factor structure and use of ESEM for confirmatory purposes (Asparouhov & Muthén, 2009). The evaluation of the goodness of fit of the data to the model considered multiple sources of evidence including \( \chi^2 \) divided by degrees of freedom, Root Mean Squared Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Tucker Lewis Index (TLI). In all the cases, acceptable fitting models are achieved when the coefficient \( \chi^2 / \text{degrees of freedom} \) is lower than 3, RMSEA \( \leq .08 \), and CFI and TLI approach or exceed .90 (Asparouhov & Muthén, 2009; Hu & Bentler, 1999; Marsh et al., 2010). For the present study, adequate model fit was assumed for all the cases if two or more of these fit indices supported model fit (Mosewich, Hadd, Crocker, & Zumbo, 2013).

Measurement invariance of the Sport-MPS-2 across gender was analyzed using the ESEM framework (Asparouhov & Muthén, 2009). This analysis was carried out in a progressive way. First, the hypothesized structure (item to intended factor match) was examined for model fit with each group separately and in both samples simultaneously (i.e., configural invariance; Model 0). After that, several nested models were performed to confirm the factor loadings invariance (i.e., weak invariance; Model 1), thresholds invariance (i.e., strong invariance; Model 2), and error variances and factor variances held equal across groups (i.e., strict invariance; Model 3), which corresponds to models 1, 2, 5, and 7 proposed by Marsh et al. (2014). Evaluation of invariance was conducted based on both model fit and by interpreting changes in CFI and RMSEA values. Following the recommendations of Cheung and Rensvold (2002) and Chen (2007), a CFI decrease of \( \leq .01 \) and an RMSEA increase of \( \leq .015 \) from less-constrained to more-constrained models were used as evidence of measurement invariance between nested
models. The robust maximum likelihood chi-square statistic (MLRχ²) is also provided, but it is not considered highly informative due to its sensitivity to sample size (Wu et al., 2007).

Results

Measurement Invariance of Sport-MPS-2 across Gender

The indices of fit for the six-dimensional model (in each gender group separately and in the total sample) using both ICM-CFA and ESEM are shown in Table 1. Based on the global fit indices, there is statistical support for the six-dimension model in both groups. The fit indices are slightly better for the ESEM procedure. Thus, subsequent gender invariance analysis was reported for only ESEM².

Progressive evaluation of factorial invariance. The results of the multiple steps in gender invariance are shown in Table 2. The first step was to check configural invariance (i.e., equivalent factor structure) across groups. This information was previously obtained by applying a CFA in each group. However, it is still necessary to check this result using ESEM since equivalent factor structure serves as a baseline model (Model 0; unconstrained multi-group model) for the subsequent test required by this progressive assessment. The fit of the model can be considered acceptable, so configural invariance was supported (Table 5), and the model can be considered as invariant across groups.

Weak invariance was tested by constraining the factor pattern coefficients to be equal (Model 1; Factor loadings invariance; weak invariance). Evidence of the model fit was adequate (CFI = .899, TLI = .882, RMSEA = .044). In comparison with the fit indices from Model 0, the differences between Models 0 and 1 were small (ΔCFI < .01, ΔRMSEA = −.003), providing statistical support for weak invariance.

² Factor loadings for the 42 items of the Sport MPS-2 for men and women using both ESEM and CFA procedures are available in the supplementary files.
When assessing invariance in measurement structures (Model 2; Factor loading and thresholds invariance; strong invariance), the threshold for each indicator is estimated. In this case, factor loadings and thresholds can be considered as invariant across Men and Women. These specifications resulted, again, in marginally acceptable model fit (CFI = .892, TLI = .882, RMSEA = .045. In comparison with Model 1, the $\Delta$CFI (< .01) and $\Delta$RMSEA (-.006) values provided statistical support for strong invariance.

In the final step of invariance testing (Model 3; strict invariance) factor loadings, factor variances, and the residual variances are held invariant across groups. Overall, no support was found for strict invariance as the model did not yield acceptable fit indices (CFI = .749, TLI = .727) and, in comparison to model 2, $\Delta$CFI (> .142) and $\Delta$RMSEA (+ .022) were larger than the guidelines.

**Discussion**

An important and unique contribution of the present study was the examination of gender invariance for the 42-item, 6 subscale Sport-MPS-2. In sport psychology, researchers are often interested in comparing various groups, with the assumption that the data is comparable across groups (Payne, Hudson, Akehurst, & Ntoumanis, 2013). However, it should not be assumed that the same set of items that assess specific latent constructs have the same meaning for different groups (Marsh et al., 2014; Schellenberg et al., 2014). Support for measurement invariance is a prerequisite for meaningful comparisons across groups. With this goal, an ESEM measurement invariance analysis was applied to the Sport-MPS-2 across gender on the present sample.

Based on the progressive assessment of measurement invariance of Sport-MPS-2, there was evidence for configural, weak, and strong invariance. However, support for strict invariance was not upheld. The following conclusions can be reached. First, men and women conceptualize
perfectionism in the same way and the six-dimension structure of Sport-MPS-2 can be considered invariant in male and female athletic populations. Second, the strengths of relations between the items of Sport-MPS-2 and the construct of perfectionism are the same across both groups. Thus, factor loadings can be considered equivalent across both groups. Third, individuals who have the same score on perfectionism would obtain the same score on the instrument independently of gender. So, test scaling is also equivalent among men and women athletes. Fourth, strict invariance cannot be assumed. Each item shows a different level of measurement error in between groups. This could imply different sources of biases related to the metric of the Sport-MPS-2, which could affect the precision of the scale between groups.

The present study has some limitations. The participants were Canadian intercollegiate athletes from a number of team and individual sports. Much of the validation work on the Sport MPS-2 has occurred with Canadian athletes, although the present work is independent of the instrument developers. Additional types of invariance testing (e.g., temporal, cross-cultural, sport type, and competitive level), as well as other ongoing construct validity evaluation, need to be considered in future research to gather new evidence on sport perfectionism.

In conclusion, it seems that factorial structure, factor loadings and thresholds were invariant across gender, but error variances and factor variances were not invariant in this sample of athletes. This implies that the structure and the relevance/weight of each of the items are equal across both groups, but precision could perform slightly different when the construct is measured across men and women. The lack of strict invariance should evoke caution when using the Sport-MPS-2 to assess gender differences under conditions where conditional independence is violated or when residuals are correlated. Nevertheless, the present study provides new evidence for the Sport MPS-2 based on gender invariance.
Table 1.

Single ICM-CFA and ESEM for Men, Women and Total Sample for Six Dimensional Sport-MPS-2 Model.

<table>
<thead>
<tr>
<th>Model</th>
<th>SB$\chi^2$ (df)</th>
<th>MLR$\chi^2$ (df)</th>
<th>CFI</th>
<th>TLI</th>
<th>RMSEA [CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men CFA</td>
<td>1187.81 (798)</td>
<td></td>
<td>.885</td>
<td>.876</td>
<td>.043 [.038 -.048]</td>
</tr>
<tr>
<td>Men ESEM</td>
<td>962.20 (624)</td>
<td></td>
<td>.910</td>
<td>.876</td>
<td>.045 [.039 -.500]</td>
</tr>
<tr>
<td>Females CFA</td>
<td>1351.63 (798)</td>
<td></td>
<td>.859</td>
<td>.848</td>
<td>.054 [.049 -.058]</td>
</tr>
<tr>
<td>Females ESEM</td>
<td>1077.29 (624)</td>
<td></td>
<td>.894</td>
<td>.854</td>
<td>.055 [.049 -.060]</td>
</tr>
<tr>
<td>Total CFA</td>
<td>2537.95 (1596)</td>
<td></td>
<td>.871</td>
<td>861</td>
<td>.048 [.045 -.052]</td>
</tr>
<tr>
<td>Total ESEM</td>
<td>1965.13 (1248)</td>
<td></td>
<td>.900</td>
<td>.862</td>
<td>.047 [.043 -.051]</td>
</tr>
</tbody>
</table>

Note. SB$\chi^2$: Satorra–Bentler scaled chi-square fit statistic under robust maximum-likelihood estimation; DF: degrees of freedom; MLR$\chi^2$: chi-square fit statistic under robust maximum-likelihood estimation; CFI: comparative fit index; TLI: Tucker-Lewis Index; RMSEA: root mean square error of approximation; CI: 90% confidence interval
Table 2

Progressive Factorial Invariance Analysis of Sport-MPS-2 using ESEM

<table>
<thead>
<tr>
<th>Invariance Model</th>
<th>MLRχ² (df)</th>
<th>CFI</th>
<th>TLI</th>
<th>RMSEA [CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0. Configural</td>
<td>1965.13 (1248)</td>
<td>.900</td>
<td>.862</td>
<td>.047 [.043 - .051]</td>
</tr>
<tr>
<td>1. Weak</td>
<td>2184.96 (1464)</td>
<td>.899</td>
<td>.882</td>
<td>.044 [.040 - .048]</td>
</tr>
<tr>
<td>2. Strong</td>
<td>2275.265 (1500)</td>
<td>.892</td>
<td>.876</td>
<td>.045 [.041 - .049]</td>
</tr>
<tr>
<td>3. Strict</td>
<td>3385.668 (1584)</td>
<td>.749*</td>
<td>.727*</td>
<td>.067 [.064 - .070]</td>
</tr>
</tbody>
</table>

Note. MLRχ²: chi-square fit statistic under robust maximum-likelihood estimation; df: degrees of freedom; CFI: comparative fit index; TLI: Tucker-Lewis Index; RMSEA: root mean square error of approximation; CI: 90% confidence interval; * invariance would be rejected.
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**Highlights**

- Examined validity evidence of scores for the Sport-MPS-2 in 531 intercollegiate athletes
- Support for latent dimensionality of 6-factor lower-order model
- Evidence for configural, weak, and strong, but not strict gender invariance
- Support for gender comparisons using the Sport-MPS-2 is largely held