**Invariance of the bifactor structure of mild traumatic brain injury (mTBI) symptoms on the Rivermead Post-Concussion Symptoms Questionnaire across time, demographic characteristics, and clinical groups: A TRACK-TBI study**

**Supplemental Material**

*Contents*



**Input syntax and output for *Mplus*:**

Multiple group (Sex at T1) measurement invariance syntax and output:

Configural invariance (RPQ_Sex_2W_biCFA_4fac_config_InpOut.pdf)

Weak Invariance (RPQ_Sex_2W_biCFA_4fac_weak_InpOut.pdf)

Strong Invariance (RPQ_Sex_2W_biCFA_4fac_strong_InpOut.pdf)

Strict invariance (RPQ_Sex_2W_biCFA_4fac_strict_InpOut.pdf)

Longitudinal (T1 – T4) measurement invariance syntax and output:

Configural invariance (RPQ_Time_biCFA_4fac_config_InpOut.pdf)

Weak Invariance (RPQ_Time_biCFA_4fac_weak_InpOut.pdf)

Strong Invariance (RPQ_Time_biCFA_4fac_strong_InpOut.pdf)

Strict invariance (RPQ_Time_biCFA_4fac_strict_InpOut.pdf)

**Group Measurement Invariance (MI) Model Specifications**

Group MI models were identified by freeing the first loading of each factor (i.e., general and specific factors) and fixing the factor variances two one for both groups; factor correlations were fixed to zero within groups to specify the bifactor parameterizations.

Configural group MI analyses additionally specified the factor means to equal zero for both groups; item loadings, thresholds, and residual variances were freely estimated across groups.

Metric group MI analyses additionally specified the factor means to equal zero for both groups; item loadings were constrained to equivalence across groups; item thresholds and residual variances were freely estimated across groups.

Strong group MI analyses additionally fixed the factor means to equal zero in the reference group and allowed for their free estimation in the second group; item loadings and thresholds were constrained to equivalence across groups; item residual variances were freely estimated across groups.

Finally, strict group MI additionally fixed the factor means to equal zero in the reference group and allowed for their free estimation in the second group; item loadings, thresholds, and residual variances were constrained to equivalence across groups.

Note that in the three-group MI analyses for age, the same syntax was used for the second and third groups as were used in the second group in two-group analyses.

**Longitudinal MI Model Specifications**

Longitudinal MI modeling analyses were patterned after Mplus syntax provided in Liu et al (2017) for ordered categorical variables but modified to specify the bifactor structure of the domain. Longitudinal MI models were identified by 1) freeing the first loading of each factor (i.e., general and specific factors), 2) fixing one item's loading to one for each factor within each time point, 3) fixing the second threshold of each item to equivalence across time points, and 4) fixing the second and third thresholds to equivalence across time for those items specified to have loadings of one. Factor correlations were fixed to zero within each time point to specify the bifactor parameterizations; all factor correlations were freely estimated across time points.

Configural longitudinal MI analyses additionally specified the factor means to be zero and item residual variances to be one for T1 and freely estimated for T2, T3, and T4; item loadings, thresholds, residual variances, and residual correlations were otherwise freely estimated across the four assessment time points.

Weak longitudinal MI analyses additionally specified the factor means to be zero and item residual variances to be one for T1 and freely estimated for T2, T3, and T4; item loadings were constrained to equivalence over time; item thresholds, residual variances, and residual correlations were otherwise freely estimated across the four assessment time points.

Strong longitudinal MI analyses additionally specified the factor means to be zero and item residual variances to be one for T1 and freely estimated for T2, T3, and T4; item loadings and thresholds were constrained to equivalence over time; item residual variances and residual correlations were otherwise freely estimated across the four assessment time points.

Finally, strict longitudinal MI analyses additionally specified the factor means to be zero for T1 and freely estimated for T2, T3, and T4; item loadings, thresholds, and residual variances were constrained to equivalence over time; item residual correlations were freely estimated across the four assessment time points.

Note that all available item-level data from each of the four times points were utilized simultaneously in longitudinal MI analyses; allowing for item residual correlations to be freely estimated was done to take into account the dependence of observations across time points; fixing the unstandardized estimates of item residual variances to one at each time point held them to equivalence (as reflected in the standardized output for strict longitudinal MI analyses).