Abstract

In testing factor replicability (or factorial invariance) with Procrustes rotation, congruence coefficients are usually measured to indicate the resemblance of two factors. A major difficulty in evaluating the goodness of fit after Procrustes rotation lies in the unknown sampling distribution of these congruence coefficients. McCrae, Zonderman, Costa, Bond, and Paunonen (1996) proposed a permutation method to solve this problem. However, their method only indicated the existence of dependencies between two factor structures. The present study developed a bootstrap procedure which could generate the distribution of congruence coefficients empirically under the null hypothesis of factorial invariance. Statistical significant test for congruence coefficient was then allowed. Several Monte Carlo studies were conducted to evaluate the effectiveness of the bootstrap procedure. The results provided a strong support for this bootstrap procedure as a powerful tool to assess factor replicability. Flexibility of the bootstrap procedure was also shown which allowed testing factorial invariance hypothesis for a fully or a partially specified target; when the raw data of the target samples were available or not; when factor loading matrices were based on either covariance or correlation matrix. From the Monte Carlo studies, it could be observed that the factor congruence was very powerful in detecting cases in which both structures had the same number of factors but different factor loadings on some variables. In cases when the number of factors between the two structures were different, the factor congruence coefficient was still excellent in detecting such differences if the factors were moderately or weakly correlated. Two variants of factor congruence coefficients, variable congruence coefficients and total congruence coefficient, proposed by McCrae et al. (1996), were included in this study. Simulation results suggested that the total congruence coefficient was as powerful as the factor congruence coefficient for testing factorial invariance. Variable congruence coefficient was proposed to be a modification index to identify misbehaved item when the full factorial invariance could not be achieved (McCrae et al., 1996). However, its statistical performance was not as good as the other two congruence

coefficients. The present simulation results did not recommend its usage in studying factorial invariance. Practical guidelines of utilizing the congruence coefficients were suggested. Limitations and future directions were discussed.