A comparison of factor-matching techniques

J.M.F. ten Berge, Subfakulteit Psychologie, R.U. Groningen

Factor-matching is concerned with rotating factor-loadings or factor-scores from various investigations or experimental conditions to maximal agreement (invariance). It requires repeated measurements on the same variables or for the same persons. Factor-matching is mainly used in explorative factor analysis for the identification of possibly invariant factors. For confirmative factor analysis in several investigations/conditions quite different techniques are available (e.g., Jöreskog's). However, factor-matching sometimes does have confirmative implications. For instance, when factor-matching fails to produce invariant factors, then it is often concluded that no invariant factors exist. On the other hand, if invariant factors are obtained this may be the result of capitalization on chance.

In the literature dozens of factor-matching methods can be found. The methods can be distinguished in two respects: the measure of agreement being optimized (Tucker's coefficient of congruence, the least-squares criterion, and so on) and the type of rotation one wishes to employ (orthogonal or oblique; simultaneous or successive; one-sided or two-sided). By crossing the various measures of agreement with the various types of rotation a taxonomy of factor-matching problems is generated in which a large number of methods from the literature can be located. The taxonomy permits

1. relating the various methods;
2. avoiding repetitions in derivations and algorithms;
3. making a deliberate choice from the available methods.

For the sake of the third point a number of methods were compared in an empirical research. The question was how to maximize the sum of congruence coefficients by a simultaneous two-sided rotation, a problem for which no straightforward solution is available. In general it can be concluded that an orthogonal least-squares rotation combined with some kind of varimax rotation yields the best results. In addition, such a method kills two birds with one stone: one obtaines factors that are both invariant and interpretable. These conclusions also hold if more than two sets of factors are involved. More details can be found in J.M.F. ten Berge: Optimizing factorial invariance (dissertation). R.U. Groningen, 1977.