Latent Trajectory Modeling (LTM) for Quality of Life

Latent trajectory modeling (LTM) permits variation between individuals regarding intercepts (initial status) and change factors in the repeatedly measured variable of interest. This type of analysis represents the search for an appropriate *unconditional model*. Because quality of life (QoL) was measured three times, only two latent factors (intercept and change) could be estimated in the unconditional model (see figure). The following individual trajectory equation provides the basis for modeling hypotheses regarding different trajectories of QoL:

$$\mathbf{y_{it} = \alpha_i + \beta_i * \lambda_t^c + \varepsilon_{it}}$$

y_{it} stands for QoL of individual i at time t, α_i is the *intercept* (i.e. baseline value) of the underlying trajectory of individual i, β_i is the *change factor* of the underlying trajectory of individual i (note that with decreasing QoL over time β_i is negative), λ_t is the value of time at t, exponent c reflects the different shapes of the trajectory, and ε_{it} is the residual for individual i at time t. Three common hypotheses about the course of QoL-change were tested: In the case of c = 1 (linear change) QoL is linearly related to the passage of time. In the case of c = 2 (quadratic change) there are small initial changes of QoL that accelerate with the passage of time. In the case of c = 0.5 (square-root change) there are large changes of QoL early in the trajectory that diminish later on.

To model these three forms of trajectories in LTM, change factor loadings on the repeated measures of QoL are fixed to predefined values. As an example, the figure illustrates these values for the case of the linear latent trajectory model. The loadings are 0, 0.25, 1 (i.e. 0^2, 0.5^2, 1^2) for the quadratic model, and 0, 0.71, 1 (i.e. $0^{0.5}$, $0.5^{0.5}$, $1^{0.5}$) for the square-root model. The appropriateness of the three trajectory models is evaluated by fit indices. LTM estimates for each model a mean intercept and a mean change factor by pooling data across all individuals. Thus, estimated trajectories can be contrasted with observed data (see fig. 1 of the article).

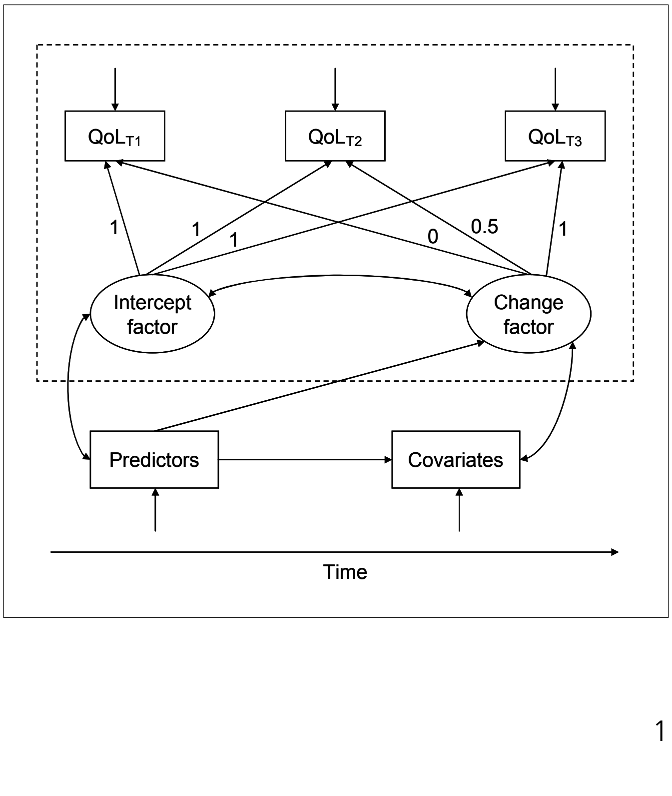

Figure. *Conditional model* of change in quality of life (QoL) including the *unconditional model* (inside of the dashed rectangle). Ellipses stand for latent, and rectangles for observed variables. Change factor loadings (0, 0.5, 1) on the repeated measures of QoL reflect a linear latent trajectory model.

If the unconditional model fits the empirical data well and the variances of intercept and change factor are statistically significant, the model is completed to attain a *conditional model* by adding predictors and covariates that predict or correlate with the initial status and the change factor.

Analysis of Missingness, Multiple Imputation, and Model Fit Evaluation

Overall, 9.4% of observations of the eleven variables included into the conditional latent trajectory modeling were missing. As analysis of missingness confirmed the assumption of data missing at random (MAR), multiple imputation was applied. Four complete data sets were imputed by the Markov Chain Monte Carlo algorithm included in the LISREL program and accordingly four structures were estimated for every model specified before. As multisample analysis indicated the absence of significant differences between the four imputed data sets, parameters and fit indices were combined and tested for significance. Model tests applied maximum likelihood (ML) estimation. Model fit to the observed data was evaluated based on a selection of fit parameters and cut-off criteria. Tests for model coefficients were two-tailed with a significance level of $p \leq .05$.

Internal Consistencies

The internal consistencies of the instruments used in this study were comparable to those reported in the literature. Cronbach's alphas were .80 for QoL (FLZ^M), .82 for the SOC, .77 for the CAPS, and .74 for the HADS depression score.