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Performance of Contextual Multilevel Models for Comparing Between-Person and Within-Person Effects

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The comparison of between- versus within-person relations addresses a central issue in psychological research regarding whether group-level relations among variables generalize to individual group members (Molenaar, 2004). Between- and within-person effects may differ in magnitude as well as direction, and contextual multilevel models can accommodate this difference. Contextual multilevel models can be applied to longitudinal data where level-1 effects represent within-person relations and level-2 effects represent between-person relations (Hoffman, 2015; Hoffman & Stawski, 2009). Estimating the contextual effect allows direct evaluation of whether between-person and within-person effects differ. Furthermore, these models, unlike single-level models, allow within-person slopes to vary across individuals. This study examined the statistical performance of the contextual model with a random slope for longitudinal within-person fluctuation data.

Data were simulated in Mplus 7 according to the equation

$$Y_{ti} = \gamma_{00} + \gamma_{10} \left(X_{ti} - \bar{X}_i \right) + \gamma_{01} \bar{X}_i + u_{0i} + u_{1i} \left(X_{ti} - \bar{X}_i \right) + r_{ti},$$

where Y_{ti} and X_{ti} represent outcome and predictor scores, respectively, for person i at time t . I varied the number of observations per person (t), number of persons (i), within-person fixed effect size (γ_{10}), between-person fixed effect size (γ_{01}), random slope variance effect size (τ^2_{11}), and intraclass correlation (ICC_X) of X . I assessed the performance of the contextual effect ($\gamma_{01} - \gamma_{10}$) and the slope variance parameter estimates by calculating parameter bias, parameter variability, and standard error accuracy. I also compared the observed contextual effect to a standardized contextual effect (Hoffman, 2015; Hoffman & Stawski, 2009).

Larger ICC values increased power to detect the contextual effect, although power remained under .60 for all conditions examined. Larger ICC values corresponded to an increase in 95% coverage for $n = 50$ observations per person but a decrease in coverage for $n = 100$ observations per person. Larger ICC values also decreased Type I error rates for $n = 50$ observations per person but increased Type I error rates for $n = 100$ observations per person. Type I error rates were close to nominal values (.05). Smaller slope variance increased power for the contextual effect. Larger ICC values increased coverage of the slope variance

estimate for $n = 50$ but decreased coverage for $n = 100$. In this simulation, the test of the contextual effect was generally underpowered for sample sizes and effect sizes encountered in longitudinal research studies. Real contextual effects that exist in the population may be difficult to detect with multilevel models.

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