

Using a multivariate, multi-level model to understand how youths' in-the-moment engagement predicts changes in youths' interest

Joshua M. Rosenberg¹, Patrick N. Beymer³, Tom M. Houslay², & Jennifer A. Schmidt³

¹University of Tennessee, Knoxville ²Cambridge University ³Michigan State University

Background

- Though many have argued that out-of-school-time (OST) programs are important to the development of youth's interest, little is known about how youths' interest develops in such contexts.
- Theory suggests that interests emerge from the an individual's interactions in a specific context, rather than residing within the individual (Hidi, Renninger, & Krapp, 2016).

Research Question

How does youths' in-the-moment engagement relate to changes in their interest in STEM from before to after their involvement in OST STEM programs?

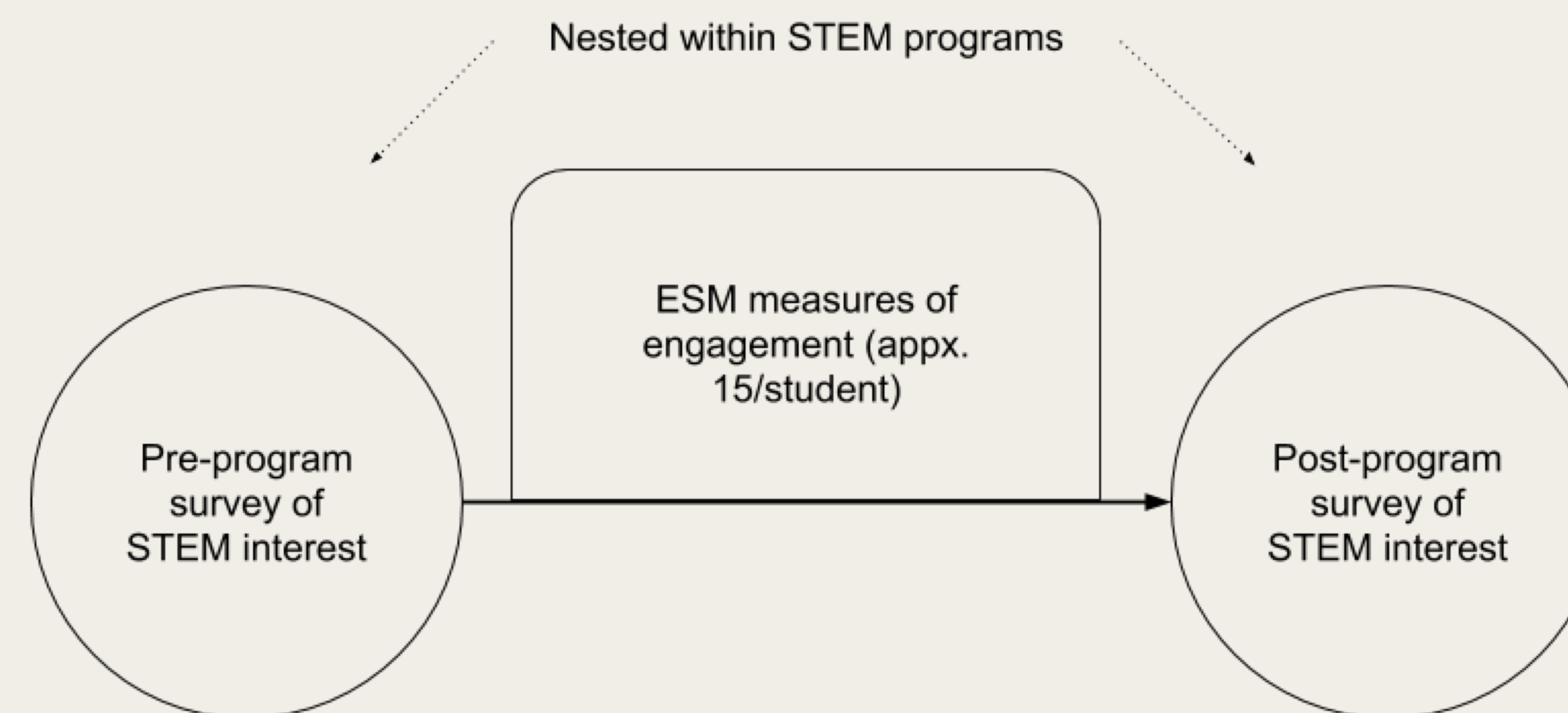
Context, Procedure, and Measures

- 204 youth participating in nine, three-week OST STEM programs.
- Experience Sampling Method (ESM) procedure

Measures:

- Pre-program STEM interest ($n = 181$)
- Post-program STEM interest ($n = 159$)
- ESM measures of students' engagement ($n = 2,970$)

Data Structure



Methodological Approach

- Estimated a **multivariate, multi-level model** using Markov Chain Monte Carlo (MCMC) via the *MCMCglmm* R package (Hadfield, 2010)
- Key outcomes: Correlation between engagement and post-interest at the youth and program levels.
- The model includes both youths' engagement (nested within youth) and their post-program interest in one model, **which can be challenging to do when using a multi-level modeling approach.**
- Also, a feature of MCMC is that its use allows for the recognition of complex data structures, such as the nesting within students (or the *program* or the *moment*), **which can be challenging to do when using a latent variable modeling approach.**

Results

- At the youth level, engagement was significantly, positively related to youths' post-program interest in STEM ($r = .30$ [.14, .43], $p < .001$).
- At the program level, engagement and post-program interest in STEM were not related ($r = -.04$ [-.62, .61]).
- Pre-program interest in STEM was positively related to engagement ($\beta = 0.12$ [0.01, 0.22], $p = .033$) and post-program interest in STEM ($\beta = 0.36$ [0.21, 0.51], $p < .001$).

Significance

- **Use of MCMC methods may be a natural fit for analyses of multivariate, multi-level data**, a type of data that is increasingly analyzed as part of studies of youths' (and students') motivation and engagement.
- At present, similar models have been estimated with commercial software (e.g., Muthén & Muthén, 1998-2017), though such applications are not yet very widely-used.
- Accessibility of MCMC methods is expanding across scientific fields as capable and flexible general-purpose tools are developed (Carpenter et al., 2017).