









## Analysis

**Missing Data:** Data collected by each school only reports the number of disciplinary incidents for students who are in attendance; therefore, there are missing data points for students who may not have attended the target school for all three years. Multiple imputation is a general approach to the problem of missing data that is available in several commonly used statistical packages (Sterne, Carlin, Royston, & Carpenter, 2009). It aims to allow for the uncertainty about the missing data by creating several different plausible imputed data sets and appropriately combining results obtained from each of them.

Using SPSS version 25, we were able to create 5 multiple copies of the dataset, with the missing values replaced by imputed values. These are sampled from their predictive distribution based on the observed data—thus multiple imputation is based on a Bayesian approach. The imputation procedure must fully account for all uncertainty in predicting the missing values by injecting appropriate variability into the multiple imputed values; we can never know the true values of the missing data.

The second stage was to apply hierarchical linear modeling to fit the model of interest to each of the imputed datasets. Estimated associations in each of the imputed datasets will differ because of the variation introduced in the imputation of the missing values, and they are only useful when averaged together to give overall estimated associations. Standard errors are calculated using Rubin's rules (1987) which take account of the variability in results between the imputed datasets, reflecting the uncertainty associated with the missing values. Valid inferences are obtained because we are averaging over the distribution of the missing data given the observed data.

**Hierarchical Linear Modeling:** The best way to investigate teacher- and student-level effects is to use different levels of analysis, or hierarchical linear modeling (HLM; Raudenbush & Bryk, 2002). This method also prevents a violation of the assumption of independence, given that students in the same class are not really independent of school effects, which would otherwise deflate standard errors and Type I errors. Principles of HLM modeling were applied for total number of disciplinary incidents for each student over the course of three school years (2015, 2016, and 2017). Incidents over three years was modeled at three different levels: time (Level 1), student (Level 2) and teacher beliefs at each school (Level 3).













