Paper #2 Abstract

Title
Using the Student Attrition Lookup Tool (SALT) to Plan for Attrition in School-Based Evaluations

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Background
Student-level, school-based longitudinal evaluations of educational practices and interventions often encounter study attrition when students move away from, or drop out of, study schools. This mobility-induced attrition decreases sample size, weakening the study's power to detect a treatment effect. While the research methodology literature includes empirical benchmarks for effect sizes (Hill, Bloom, Black, & Lipsey, 2008; Bloom, Hill, Black, & Lipsey, 2008) and intraclass correlations (Hedges & Hedberg, 2007; Schochet, 2008) to help researchers determine adequate sample sizes through power analysis, it does not include similar benchmarks to assist proper planning for attrition. If a power analysis does not take possible attrition into account, the planned study could be underpowered. Figure 1 shows how student attrition can affect the minimum detectable effect size (MDES) under different study designs.

Purpose
This paper describes and demonstrates a new online resource developed to help researchers proactively plan for student attrition: the Student Attrition Lookup Tool (SALT). With SALT, researchers can access student mobility estimates for different student and school subpopulations and for different transition periods from kindergarten to grade 12. The paper has three main objectives: (1) describe the data and methods behind SALT; (2) demonstrate how to navigate SALT; and (3) demonstrate how to use student attrition benchmarks in a power analysis. The paper is primarily intended for applied researchers planning school-based studies that follow students over time.

Data
SALT is based on four longitudinal data sets from the National Center for Education Statistics (NCES). The use of multiple data sets allows us to examine rates of student mobility for students across a range of grade levels—with two data sets covering mobility during the elementary school years and two data sets covering mobility during the high school years—and present findings across different U.S. public school student populations relevant to applied researchers. Important aspects of each data set are provided in Table 1.

Methods
With the four NCES surveys, we constructed analytic files to examine student mobility across six transition periods (see Figure 2). To examine student mobility during each transition period accurately, we restricted the analytic files to students in the appropriate longitudinal follow-up waves and to public schools with a grade range that includes the transition period (e.g., the ECLS-K:98 grade 1 to 3 analytic file is restricted to schools with grades 1 and 3).

Since applied researchers increasingly utilize data from district or state student information systems, we estimated three types of student mobility rates (for each transition period) to reflect three different levels of data coverage (see Figure 3):

- Any mobility (left baseline school / outside school data)
- Left the district, state, or public school system (outside district data)
- Left the state or public school system (outside state data, including dropouts)

We estimated mobility rates for the total sample, as well as for student and school subgroups (see Table 2 and Table 3). When calculating student mobility rates, we used Taylor-series linearization to account for survey weights and the multistage nature of the survey designs. Using the survey sampling weights allows us to calculate mobility rates that are generalizable to the U.S. public school student population.

Results

Researchers can access SALT through an interactive website that is currently under development, and will be publicly available before the SREE conference. Through the SALT website, researchers can get student mobility rates for any of the student or school subgroups listed in Tables 2 and 3, as well as different subgroup combinations (e.g., students with low math achievement in urban schools). A sample screenshot of the SALT website is provided in Figure 4. Users have the option to add confidence intervals to the graph, and can request a table with the mobility rate estimates and standard errors.

To demonstrate how researchers can use SALT in power analyses, we walk through an example power analysis for an individual random assignment design. We use the following formula to determine how student attrition influences the minimum required sample size (MRSS) for a given MDES:

$$MRSS_{\mu} = \left(\frac{M_{\alpha,\beta,df}}{MDES}\right)^2 \left(\frac{1-R^2}{P(1-P)}\right)\left(\frac{1}{(1-\mu)}\right),$$

where $M_{\alpha,\beta,df}$ is the multiplier for a given alpha-level (type I error), beta-level (type II error), and degrees of freedom (*df*); R^2 is the proportion of variance explained by covariates; P is the proportion of units in the treatment group; and μ is the student attrition rate.

Since the student attrition rate is unknown prior to conducting the study, we can get estimates of the rate using SALT. On the SALT website, we use the pull-down menus to request student mobility estimates that align with our sample of interest. Results from this query are displayed in Figure 4. Depending on the type of data collection, the expected student mobility rate is 26% (data from schools), 18% (data from districts), or 12% (data from state).

By plugging these attrition estimates into the above MRSS equation (and assuming R^2 = .50 and P = .50), we get the power analysis results presented in Figure 5. If we ignored attrition and wanted an MDES of 0.10, we would target a sample size of 1,576 students. That would, however, result in an underpowered study given attrition. If we only collect data from students who stay in the study schools through 11th grade, the actual sample size needed for an MDES of 0.10 is 2,130 students. If, however, we can get student data from a statewide database, the sample size needed for an MDES of 0.10 is 1,922 students. With this information, we can

determine whether having 208 fewer students in the study (2,130 – 1,922) is worth the effort of gaining access to statewide data, rather than collecting data directly from the study schools.

The paper will also demonstrate how attrition benchmarks from SALT can be incorporated into existing power analysis software, such as PowerUp! (Dong & Maynard, 2013), and discuss the use of student attrition benchmarks in block and cluster randomized designs.

Conclusions

This paper addresses a limitation in current power analyses by providing researchers with information about natural rates of mobility-based attrition. Student mobility represents the attrition rate one can expect under conditions in which factors such as consent and survey response are not an issue. In addition, mobility is a major source of attrition in studies that rely on extant administrative data (e.g., state assessment data). By making student mobility rates across different student and school characteristics, as well as different degrees of mobility that correspond to different data collection options accessible, researchers can proactively plan for normative attrition rates in longitudinal studies.

References

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Dong, N., & Maynard, R. (2013). PowerUP!: A tool for calculating minimum detectable effect sizes and minimum required sample sizes for experimental and quasi-experimental design studies. *Journal of Research on Educational Effectiveness, 6*(1), 24–67.

Hedges, L. V., & Hedberg, E. C. (2007). Intraclass correlation values for planning group-randomized trials in education. *Educational Evaluation and Policy Analysis*, *29*(1), 60–87.

Hill, C. J., Bloom, H. S., Black, A. R., & Lipsey, M. W. (2008). Empirical benchmarks for interpreting effect sizes in research. *Child Development Perspectives*, *2*(3), 172–177.

Schochet, P. Z. (2008). Statistical power for random assignment evaluations of education programs. *Journal of Educational and Behavioral Statistics*, *33*(1), 62–87.

Tables and Figures

Table 1. Summary of data sources and analytic file sample sizes

Data source	Transition period	Survey waves (child weight)	Analytic file sample
ECLS-K:10	Kindergarten (spring 2011) to grade 1 (spring 2012)	Wave 2 to wave 4 (W4C4P_20)	10,300 students in waves 2 to 4 longitudinal sample and in a wave 2 public school with kindergarten and grade 1
ECLS-K:10	Kindergarten (spring 2011) to grade 2 (spring 2013)	Wave 2 to wave 6 (W6C6P_20)	9,350 students in waves 2 to 6 longitudinal sample and in a wave 2 public school with kindergarten and grade 2
ECLS-K:98	Grade 1 (spring 2000) to grade 3 (spring 2002)	Wave 4 to wave 5 (C45CW0)	10,220 students in waves 4 to 5 longitudinal sample and in a wave 4 public school with grades 1 and 3
ECLS-K:98	Grade 1 (spring 2000) to grade 5 (spring 2004)	Wave 4 to wave 6 (C456CW0)	7,280 students in waves 4 to 6 longitudinal sample and in a wave 4 public school with grades 1 and 5
HSLS	Grade 9 (fall 2009) to grade 11 (spring 2012)	Wave 1 to wave 2 (W2W1STU)	15,160 students in waves 1 to 2 longitudinal sample and in a wave 1 public school:
ELS	Grade 10 (spring 2002) to grade 12 (spring 2004)	Wave 1 to wave 2 (F1PNLWT)	10,900 students in waves 1 to 2 longitudinal sample and in a wave 1 public school

NOTE: All sample sizes are rounded to the nearest 10 per IES publication policy.

Table 2. Student subgroups included in SALT, by data source

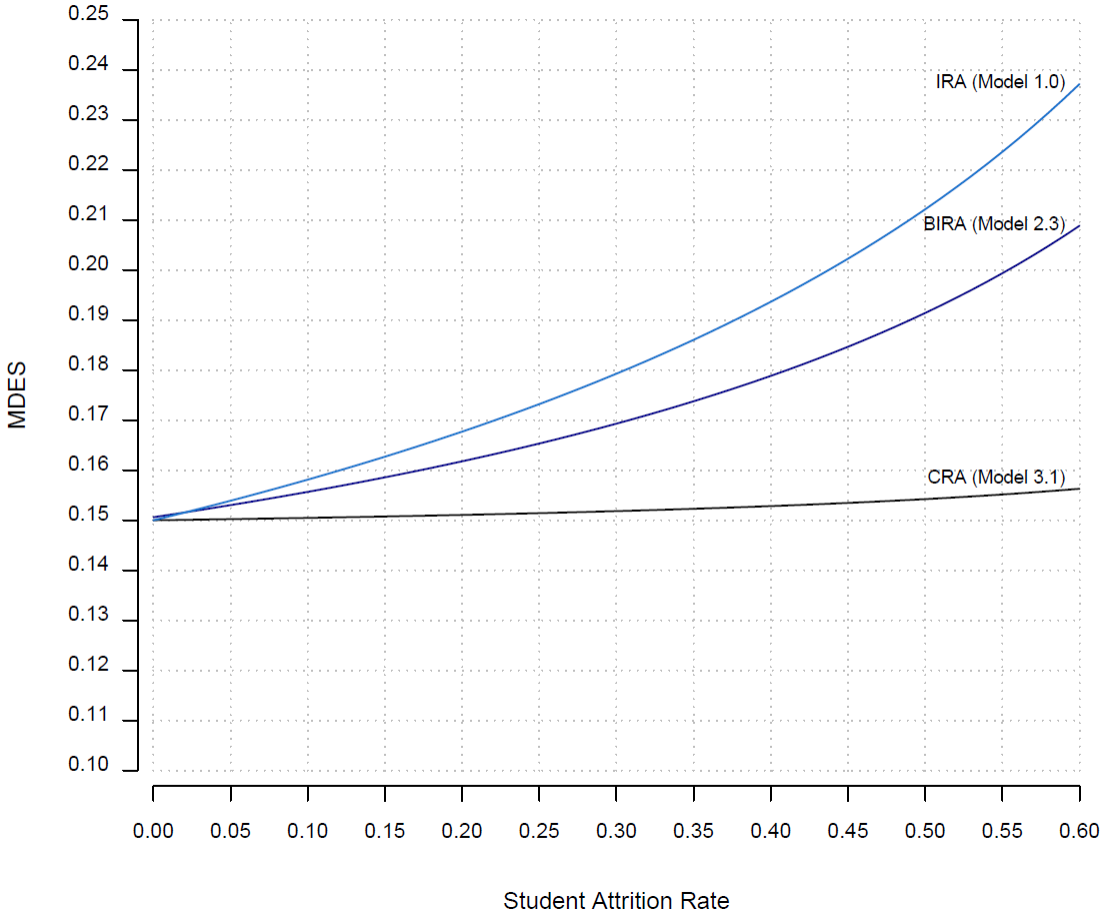
Characteristic	Subgroups Included in SALT	ECLS-K:10	ECLS-K:98	HSLS	ELS
Gender	Female Male	✓	✓	✓	✓
Race	African American Asian/Pacific Islander Latino/Hispanic White	✓	✓	✓	✓
SES (NCES-defined quintiles)	Low (bottom two quintiles) High (top two quintiles)	✓	✓	✓	✓
Baseline reading achievement	Low (bottom two quintiles) High (top two quintiles)	✓	✓		✓
Baseline mathematics achievement	Low (bottom two quintiles) High (top two quintiles)	✓	✓	✓	✓
Student disability status	Student with a disability Student without a disability	✓	✓	✓	✓
Home or native language	English is home/native language English is not home/native language	✓		✓	✓

NOTE: SES = socioeconomic status.

Table 3. School subgroups included in SALT

Characteristic	Subgroups Included in SALT
Title I status	Title I school Not a Title I school
Geographic region	Northeast Midwest South West
Location	City Suburb Rural or town
School size (enrollment)	Small (less than 500 students for elementary schools; 1,500 for high schools) Large (500 or more students for elementary schools; 1,500 for high schools)
Concentration of underrepresented minorities	Low (less than 25% of total enrollment) Medium (25-49% of total enrollment) High (50% or more of total enrollment)
Concentration of students eligible for Free/Reduced Price Lunch program	Low (less than 25% of total enrollment) Medium (25-49% of total enrollment) High (50% or more of total enrollment)
District size (number of schools in the district with a grade range that includes the transition period)	Small (less than 5 schools) Medium (5-19 schools for elementary schools; 5-9 schools for high schools) Large (at least 20 schools for elementary schools; 10 for high schools)

Figure 1. Relationship between student attrition and MDES for select research designs



NOTE: Example power analysis parameters set to detect an MDES of 0.15 (significance level alpha = 0.05, statistical power beta = 0.80) under a condition with no student attrition.
IRA = individual random assignment design
BIRA = block individual random assignment design
CRA = cluster random assignment design
Model numbers in parentheses refer to the model numbering used in Dong & Maynard (2013).

Figure 2. Transition periods included in SALT

Source	K	1st	2nd	3rd	4th	5th	MS	9th	10th	11th	12th
ECLS-K:10	● →										
ECLS-K:10	● →		→								
ECLS-K:98		● →									
ECLS-K:98		● →									
HSLS								● →			
ELS									● →		

NOTE: All surveys were administered during the spring of the school year, with the exception of the HSLS ninth-grade survey, which was administered during the fall of grade 9.

Figure 3. Mobility classification for SALT

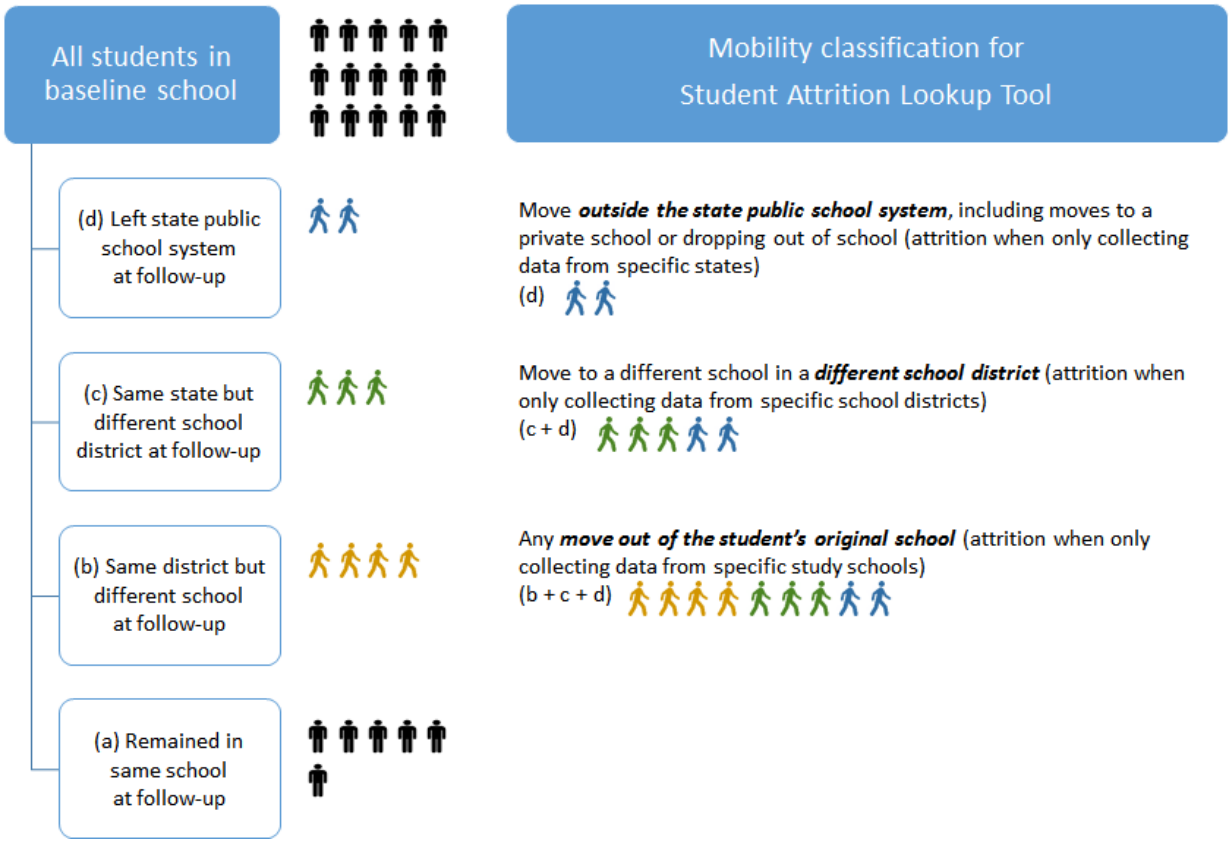
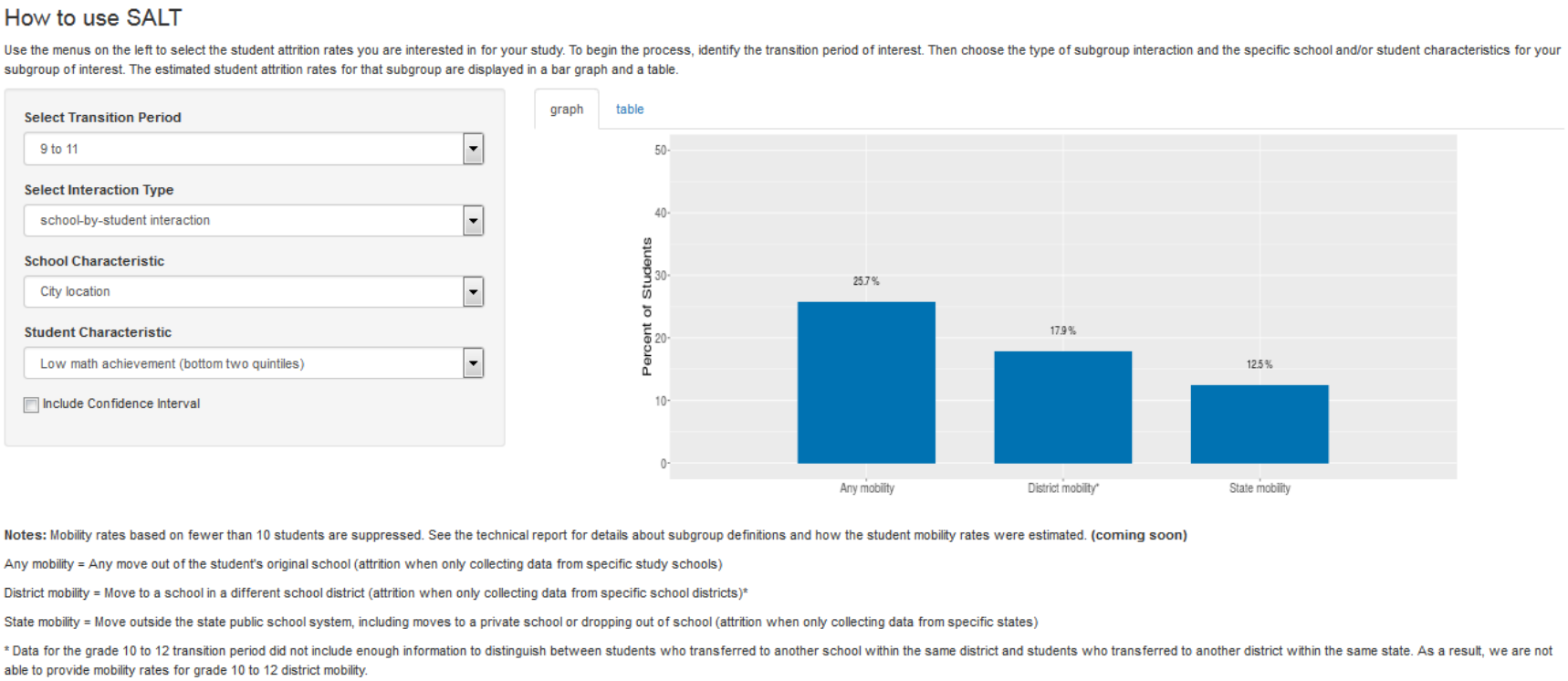


Figure 4. Sample screenshot from preliminary version of SALT website



Notes: Mobility rates based on fewer than 10 students are suppressed. See the technical report for details about subgroup definitions and how the student mobility rates were estimated. **(coming soon)**

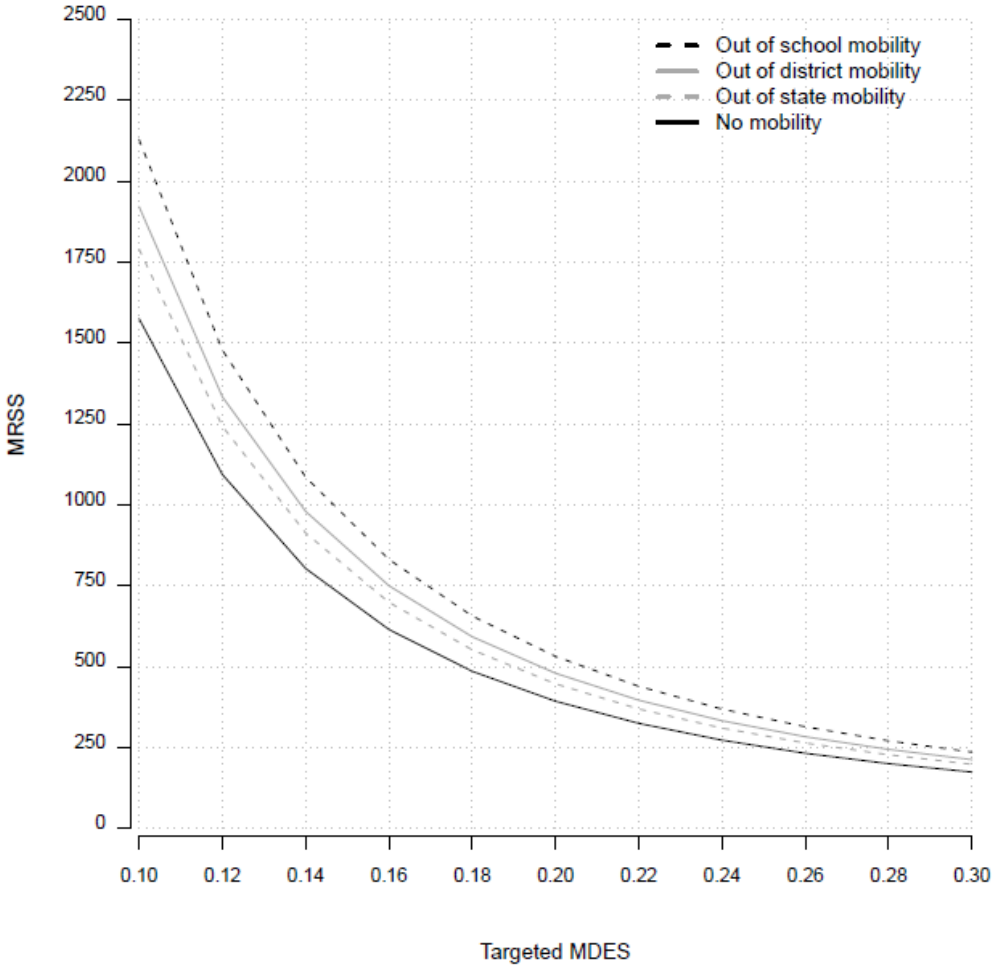
Any mobility = Any move out of the student's original school (attrition when only collecting data from specific study schools)

District mobility = Move to a school in a different school district (attrition when only collecting data from specific school districts)*

State mobility = Move outside the state public school system, including moves to a private school or dropping out of school (attrition when only collecting data from specific states)

* Data for the grade 10 to 12 transition period did not include enough information to distinguish between students who transferred to another school within the same district and students who transferred to another district within the same state. As a result, we are not able to provide mobility rates for grade 10 to 12 district mobility.

Figure 5. Sample power analysis results that account for student attrition



Notes: MRSS estimates are based on the following power analysis assumptions: alpha=.05 (two-tailed test), beta=0.80, R^2 =0.50, and P=0.50.
MRSS = minimum required sample size
MDES = minimum detectable effect size