Student Mobility and Academic Achievement

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Dissertation

Submitted to the Faculty of the

Graduate School of Vanderbilt University

in partial fulfillment of the requirements

for the degree of

DOCTOR OF PHILOSOPHY

in

Leadership & Policy Studies

January 31, 2021

Nashville, Tennessee

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ACKNOWLEDGEMENTS

After a decade of work, I am incredibly excited and humble to submit this dissertation to complete the requirements for a Ph.D. in Leadership and Policy Studies. Since this journey started, I have been so fortunate to marry my wonderful wife, Haley, and watch my two children, Riley and Seamus, grow and am excited to embark on the next steps with a daughter on the way. I would have given up a long time ago had it not been for Haley's support. I am forever grateful. I am thankful for my family who has supported and pushed me from the beginning, from St. Brigid's to the John W. McCormack to Roxbury Latin and through all the trips around New England to watch me play football at Amherst. When I moved to Nashville without a plan and chose to stay to attend Vanderbilt instead of coming home, you supported me. Thank you, Mom and Dad, and to my brothers, Brendan, Liam, Daniel and my sister-in-law, Kayla, for that encouragement and support; I hope to always return the favor. I am appreciative to Gary Henry for advising me through this challenging process and for my committee and cohort members for their support over the years. Finally, I am grateful for the many colleagues that I have been fortunate to learn from at the Tennessee Department of Education and the Office of Evidence and Impact, where I have learned so much about how good research can directly inform and create sound policy.

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CHAPTER 1: INTRODUCTION

Between one autumn and the next, over a third of American students attend multiple schools. Some of these moves are part of the system, such as moves from elementary to middle school. Other students might change schools during the school year or move to a new school over the summer. Research has consistently shown that each of these moves impacts student achievement, but the extent to which students respond different types of moves and the primary avenues through which mobility affects achievement remain an open question.

Nonetheless, students changing schools is embedded within the structure of the American education. In 2010, the U.S. Government Accountability Office reported nearly 95 percent of students changed schools at least once between kindergarten and eighth grade. The ubiquity of changing schools is not surprising—most school districts operate elementary schools that end in fifth or sixth grade (around age 11) and middle schools through eighth grade. If that sort of planned mobility—structural moves within a system of operating schools—was the sole source of transfers between schools, then research on student mobility could focus on different grade structures of schooling and how those system-level decisions to separate students at certain ages relate to student outcomes. However, the same report details that one-third of students change schools at least three times over that same grade span (GAO, 2010). This concentration of more mobile students suggests that students are not simply moving according to the structure mapped out by the education system, but that certain students are changing schools more frequently.

For comparison, we examine mobility rates in Tennessee of students who were enrolled in elementary and middle school between 2009-10 and 2013-14 and display the rates in Table 1. About 18-19 percent of students change schools structurally--students who have reached the terminal grade that their origin school offers and must transfer to a new destination school. Annually, another 11%-12% of students change schools over the summer but had the option of staying at their origin school—these are between year nonstructural movers. Finally, about 9% of students who started the year in one school exited during school year. Taken together, approximately the same number of students are nonstructural movers and within year transfer students as structural movers. Nearly 40% of all students change schools over the course of a year. And while the data are not available for the same timeframe as the GAO report, within the five years of available data, anywhere between one in five and one in six students in Tennessee change schools at least 2 times.

Table 1. Rates of Mobility by Type of Move Over Time

	Type of Move	2011	2012	2013	2014
Single year	Structural	19%	19%	19%	18%
	Between year nonstructural	12%	11%	11%	11%
	Within year nonstructural	10%	9%	10%	10%
Cumulative	+ 2 nonstructural before 4th grade	NA	18%	21%	21%
	+2 nonstructural moves between 4th and 8th grade	NA	14%	13%	16%
	Total Students	693,163	698,247	703,437	703,955

With so many mobile students, most school policies or practices to improve student outcomes have a reduced chance of impacting the target population if the student does not receive the full treatment. There are other policies that may ease the transition for mobile students, such as shared curricula across schools or transportation patterns that ease the burden for families as the student enrolls in a new school. This challenge intensifies in an era of increased accountability, where researchers and policy makers seek to understand all possible factors, including student mobility, that may impact student achievement. Mobility interrupts a child's educational experience. For some students, that mobility means they can transition to a better school for them; but for others, the move can be detrimental as they adapt to their new environment. Thus, different types of moves may result in a mixed response to mobility. When those types of moves are combined, research consistently has shown direct and indirect negative impacts on student outcomes across multiple studies in different contexts. Yet, these different types of student mobility—and how they relate to academic outcomes—have not been a central focus of much education policy research. This dissertation seeks to begin to fill that gap and demonstrate how different types of student mobility influence student achievement.

While student mobility can simply be defined by the act of a student changing schools, not all moves are equivalent. Changing schools can often accompany another change— either a positive (e.g., a parent receiving a promotion and moving to a new neighborhood) or negative (e.g., a home foreclosure) shock—that occurs in the student's life that leads to the move. As researchers, we are often not aware of the reason for moving, but we can often track where, when, and whether the move was structural or nonstructural. Much previous research has not differentiated between structural and nonstructural moves nor the timing of moves, but this information can inform how the variety of school changes impact students differently (Grigg 2012; Schwartz, Stiefel, and Cordes 2017).

Certain students appear to be more likely to experience certain types of moves that occur at different times and exhibit a pattern of mobility into certain schools. Low-income and underrepresented minority students are more likely to engage in nonstructural moves and are more likely to move to a lower-achieving school than their higher income and white peers (de la

Torre and Gwynn 2009b). Not only are low-income and minority students more likely to change schools, the impact of the move for these students appears to be disproportionately harmful to academic outcomes for these students relative to their peers (Hanushek, Kain, and Rivkin 2004; Xu, Hannaway, and D'Souza 2009; de la Torre and Gwynn 2009a). Other studies focus on the deleterious behavioral effects of student mobility (Engec 2006).

The impact of mobility on the mobile student can be classified as the direct effect on his or her academic achievement, but student mobility may also produce spillover effects for non-mobile students, in both the origin school and the destination school for the mobile student (Hanushek, Kain, and Rivkin 2004; Imberman, Kugler, and Sacerdote 2012). When a student leaves one school, breaking social ties may impact student engagement in the origin school for the remaining students (Ream 2005). In the destination school, the entry of new students may disrupt systems or curricula for the stable peers as teachers adapt their practice to meet the needs of the new students (Kerbow 1996). The impact of mobile students on their stable peers appears to disproportionately impact poor, minority students, who are more likely to attend schools that experience high rates of mobility (Hanushek, Kain, and Rivkin 2004; de la Torre and Gwynn 2009). These impacts extend to lower test performance, higher dropout rates, and increased disengagement for non-mobile students in highly mobile schools (South, Haynie, and Bose 2007).

Moreover, the students are not the only ones affected by the decision to change schools: teachers and administrators of mobile students also respond to these moves. Administrators attend to mobile students to arrange access to the appropriate services and resources, which may include the assignment of the student to the appropriate teacher or coordination of services with a school counselor. The teacher determines whether certain strategies are needed to integrate the mobile student into the classroom—often without adequate or timely documentation of the student's academic or behavioral history—so that the student can effectively access the new material in the new environment. Often, the moves result not only in new adults and peers for the mobile student, but also new norms and school practices. The mobile student may encounter different curricula or have been accustomed to different classroom routines and social practices in their origin school (Kerbow 1996).

Parents, students, teachers, and administrators are central to both the decision to change schools as well as the response, but for policymakers, a strong understanding of student mobility can inform policy decisions. One obstacle for policymakers may have been that it was believed that student mobility is simply an issue of residential mobility, which is outside of the control of the education system (Swanson and Schneider, 1999). In fact, just a quarter of residential moves—of families with school-age children that change residences—result in a change in schools, but that number may grow to as high as 42 percent in urban areas (Swanson & Schneider, 1999). Between a half and two thirds of nonstructural school moves are accompanied by a residential move. Thus, a large share of the moves that students make are not driven by families' residential decisions.

From a policy and practitioner perspective, student mobility offers unique challenges that may be systematically addressed, but for which research has not yet provided clear guidance. From an equity perspective, with nonwhite students transferring at higher rates than white students, especially in racially diverse and segregated schools, a stronger understanding of how mobility impacts achievement can inform efforts to close achievement gaps and benefit historically underserved students. While outside the scope of this research, student mobility may also relate to non-academic outcomes in both the short- and long-term: namely students who change schools nonstructurally may be more likely to have decreased attendance rates and a higher likelihood of suspensions as well as increased depression symptoms and likelihood of being arrested (Engec 2006; Herbers, Reynolds, and Chen 2013). Other studies have focused on the loss of social capital and networks that can accompany a mobility decision, particularly for certain ethnic and racial groups (Ream 2005; Kirshner, Gaertner, and Pozzoboni 2010).

Yet, even with somewhat limited guidance from the research community on how mobility relates to student achievement outcomes, policymakers have embedded student mobility in education policies. Some policies encourage mobility of students to new schools, while other policies seek to reduce student mobility. School choice systems (either through open choice systems or district portfolio models) encourage students and families to exercise student mobility options to find a better fit than their neighborhood schools (Nathan, 1996; Buckley, Henig, and Levin, 2010). In early accountability policies, schools were only accountable for students who spent the bulk of the year in that school, but policies have shifted to be inclusive of all students, regardless of how long they have been enrolled in a single school. This shift has meant that state education agencies hold schools accountable for student success on end-of-year tests, regardless of whether they arrive in August, October, or March. With more unplanned student mobility in low-income and minority schools, within year mobility appears to increase the challenge of educating underserved students at scale.

In this dissertation , the focus on student mobility can seek to inform responses to that challenge. After developing clear definitions for measuring different types of student mobility, this dissertation seeks to describe how frequently different types of student mobility occur and how the frequency of those occurrences varies across student groups and schools that have different demographic and academic composition. Then, this dissertation aims to address the extent to which different types of moves impact student achievement. Finally, this dissertation explores how available administrative data can measure the paths through which mobility affects student achievement and determine whether those primary avenues mediate the effect of mobility.

Relevant Research on Student Mobility

One of the primary challenges in studying student mobility is articulating a clear definition and understanding the extent to which timing and context matter. Student mobility refers to a child or adolescent being enrolled in one school at any point during the child's education after previously being enrolled in a different school. Student mobility is often labeled as primarily an exit phenomenon: the student exiting one school and leaving behind a set of peers (Kerbow 1996). Yet, to consider both the exit and entry context for a mobile student informs how mobility relates to student achievement. A new school may create some disjuncture in a child's learning experience as mobile students must adjust to new teachers, peers, and school customs while peers and teachers in the destination school must also adjust to the new student.

Student mobility falls into two broad categories: structural and nonstructural. Students that change schools between school years when their school does not offer the next grade ("structural movers") may differ from students who change schools when they could continue to be served by their current school ("nonstructural movers"). Students who change over the summer may also differ than those who exit during the year in both observed (e.g. demographics, prior achievement) and unobserved (e.g. parental influence, motivation) ways.

Structural mobility is embedded within the system to group similar age students and is mandated when a student completes the terminal grade at her current school and moves onto a new school (e.g. elementary to middle school). Structural mobility is embedded in the system and the most common type of mobility—students tend to move as a large bloc within a cluster of schools. Even small districts tend to offer multiple elementary schools that feed into a smaller number of middle schools, from where they progress to a comprehensive high school.

Nonstructural moves, on the other hand, occur when a student changes schools, but has not completed the terminal grade at her previous school (e.g. a student moves from 2nd grade at one school to 3rd grade at another despite 3rd grade being offered at the previous school). In contrast to structural moves, nonstructural moves may occur within or between school years and may be strategic or reactive (Rumberger 1998). Strategic moves occur "to achieve some desired end" and tend to be voluntary on the part of the students or their families. Strategic nonstructural moves may happen when a family moves or decides that a new environment is a better setting for their child. Between-year nonstructural moves are more likely to be strategic than within-year moves, and more advantaged students are more likely to engage in these types of moves (Rumberger 1998; Hanushek, Kain, and Rivkin 2004; Xu, Hannaway, and D'Souza 2009). The strategic, between-year, nonstructural moves suggest that an informed family will select a school that matches the needs (e.g. school quality; access to resources; location; preferences for values, customs or curricula) interests of the student and her family in a way that the previous school does not without disrupting the student's academic year.

Within a school year, a student may be engaging in a more reactive move, due to "negative events beyond the control of the student or family, necessitat[ing] a school change" (Rumberger 1998). The timing of the move within the year may also bring different challenges for the student. Students who exit their origin school and enter their destination school in the first few weeks of the year have more time to assimilate to the new environment before end of year testing. If a student is moving in the latter part of year, we might posit that these students are either more likely to face academic challenges in their new school where they may have to respond to new curriculum or instructional practices as they prepare for the end of the year assessment. In much of the research on student mobility, the timing and nature, structural and nonstructural, of the moves are often grouped together, but each move presents different challenges for the student, her peers, family, teachers, and administrators who experience the move firsthand, which may affect their academic performance in different ways. While future research could explicitly explore the timing of the move within the school year, this study focuses on comparing within year nonstructural, between year nonstructural, and structural moves.

Table 2. Glossary of Terms (from National Research Council and Institute of Medicine (2010:4-5) Cited in Grigg 2012)

Type of Move	Timing of Move	Definition
Nonstructural	Within Year	Compulsory (residential, school preference, school quality) or non-compulsory (due to discipline) move where a student enrolls in a new school after the first 20 instructional days of school
	Between year	Student/Family Choice to exit despite school offering next grade; Student/family movement due to residential change, school quality, access to resources such as special education services.
Structural	Between year	Next grade is not offered, forced to change schools and enters earliest grade at destination school

This student mobility classification system provides a lens through which to understand how previous research has sought to estimate how student mobility relates to student achievement.

Hanushek, Kain, and Rivkin (2004) provide a useful theoretical basis for how mobility impacts student achievement, integrating the act of changing schools into the education production function using a value-added framework. The education production function framework posits that a student's cognitive achievement is the sum of the school and family inputs over the course of that child's life (Todd and Wolpin, 2003). Our model for achievement seeks to account for family and school inputs by including proxies for those inputs that are available to researchers. By estimating the education production function with a value-added specification, we are able to account for the omitted family and schooling inputs by including prior performance measures that measure the cumulative effects of prior inputs as a proxy these unobserved inputs.

For the purposes of this framework, student mobility is at once a family input—representing the values and motivations of the family that are reflected in the choice of school—and a schooling input—the people, the place, the policies, and practices within the building. As researchers, we seek to control for the variables related to the students and their families, on one hand, and school inputs, on the other hand, in order to isolate the effect that mobility has on student performance based upon an operationalizing of the education production function. The question remains, however, whether the act of mobility itself has a direct relationship with student achievement, our measure of cognitive skills, or whether observable changes in the student's schooling inputs as a result of mobility drive that relationship. Hanushek, Kain, and Rivkin (2004) describe three potential mechanisms through which mobility can affect student achievement: pure Tiebout, disruption, and school assimilation. In their paper, the framework of mobility assumes that mobility's impact on student mobility is fully accounted for by the three mechanisms and subsuming the possibility that the change in schools itself has a direct effect on student achievement. Prior estimates of student mobility on student achievement assume that variation induced by each of these mechanisms account for the gross mobility effect on student achievement, as laid out in the following model:

Gross Mobility Effect = □School Quality + Assimilation + Disruption.

To understand how these avenues make up the gross mobility effect, we must explain how each relates to student achievement in the education production function framework. The pure Tiebout effect refers "to changes in overall school quality determined by school operations, peers, and turnover" (pp. 1727). Henceforth, we will use the term school quality effect to represent this Tiebout effect. Students change schools for a variety of reasons, one of may be school quality. It is likely that families do not have perfect information about school quality, and even if they did, the measures would be the average school quality and may not reflect how a particular student will be affected by the school. Hanushek, Kain, and Rivkin (2004) include multiple factors into their construct of school quality, but for achievement models, it may confound estimates of the effects of school quality to include factors such as class size, peer composition, or achievement levels as measures for quality when these factors have inconsistent relationships with student achievement growth. Instead, the contribution of that school to student achievement, as measured through a value-added specification, can directly account for school quality without recourse to the composite or correlated measures such as peer achievement and other factors that relate to quality. De la Torre and Gwynn (2009b) find that the heterogeneous impacts of mobility in Chicago may be in part driven by the quality of the receiving school, while Engberg et al. (2012) find no consistent impact for students whose origin schools were closed.

Nonetheless, if a student moves to a higher performing school and sees gains in performance in the year following the move, it is possible that the change in school quality, rather than the act of moving resulted in higher achievement. Conversely, if a student moves to a school of lower quality and less growth is measured, it would be problematic to argue the achievement loss was due to the move rather than the persistent lower school quality that resulted in less gains for students before the mobile student entered.

Disruption refers to the transition costs that are independent of the school quality. Hanushek and colleagues describe the disruption category as the temporary shocks that influence achievement in the year of the move, but do not persist past that point. Previous research has consistently demonstrated that while often unaccounted for, student attendance has a direct effect on student achievement (Gottfried 2010), but attempts to estimate a causal effect of student mobility on academic outcomes have failed to include this loss of instructional time in their analyses, but descriptive differences exist between nonstructural movers, depending on the amount of days missed in their destination school (Parke and Koyongo 2012). To account for disruption in the student's schooling, we use the missed instructional time that occurs when a student transitions from one school to the next. While other, unobserved factors such as divorce or job loss that are related to the choice to move and to the later achievement of the mobile student may play a role, by accounting for the time lost, we can begin to proxy the transitional disruption costs in the function and account for the lost time that is associated with the move and the later achievement.

The third avenue, assimilation, is referred to as the destination school's "treatment of new students" (Hanushek, Kain, and Rivkin 2004, pp. 1727). Certain schools have different systems of support when integrating new students into the new environment that may be separate from the overall school quality of the school. For example, measures of school quality address the average contribution of the school across all students but it is still likely that the school may serve mobile students and non-mobile students differently. Value-added specifications for mobile and non-mobile students permit us to observe the destination school's history of assimilating mobile students. By accounting for this assimilation effect, we can differentiate in our models from the overall school quality effect on mobile students and test whether policy makers can use value-added specifications focused on mobile students to consider what practices should be considered to increase the likelihood that a student is best served in her destination school.

However, the change in schools itself may also have a direct effect on students and therefore, student achievement. Changing schools can affect students' motivation or their sense of purpose and confidence, potentially changing a student rather than the school inputs. It could also signal a change in their families' values or motivation for their children's future. Consider this new model that expands upon the Hanushek, Kain, and Rivkin (2004) framework to account for a residual effect of mobility after inclusion of the primary avenues:

Gross Mobility Effect = ***Residual effect of mobility*** + *School Quality* + *Assimilation* + *Disruption.*

This model provides an option to improve our theoretical understanding of mobility. By operationalizing and measuring the school-based mechanisms through which mobility impacts student achievement as well as a residual effect of mobility in the education production function, we can test the assumptions laid forth by Hanushek and colleagues through a formal mediation analysis and potentially improve upon previous estimates of student mobility's impact on student achievement. If the avenues through which mobility affects student achievement are fully mediated by the school quality, disruption, and assimilation associated with the move, then the model described by Hanushek, Kain, and (2004) can be used to provide a more policy and practical response to student mobility decisions. If the estimates reveal a partial mediation by these avenues, then we would be able to estimate a residual effect of student mobility less the avenues which are accounted for in the model.

The next section will describe prior research on the relationship between student mobility and student performance, with a focus on the most cited analyses from prior empirical research. Early research operationalizes and describes the scale of student mobility but tends to focus on descriptive outcomes rather than pursuing a causal estimate of the effects of a move. Research consistently highlights that mobile students perform worse than non-mobile students on a variety of student outcomes, such as standardized tests, retention, and dropout (Alexander, Entwisle, and

Dauber 1996; Kerbow 1996; Rumberger 1999). Using National Education Longitudinal Survey of 1988 to follow 1,114 California eighth graders, Rumberger (1999) finds students who changed schools were twice as likely to drop out of high school, but the prevalence of missing test scores made achievement analyses more problematic. The authors point to lower test scores of mobile students but are unable to determine the extent to which these differences are due to changing schools or differences in the students who changed schools. While this research provided a strong foundation for more recent work, limitations in the available data and application of more advanced methods inhibit more nuanced measures of mobility and the quality of the estimates of mobility's impact on student achievement.

Using statewide longitudinal data from Texas from the three consecutive cohorts of students who are between 4th and 7th grade from 1994 to 1996, the Hanushek, Kain, and Rivkin's (2004) student fixed effects model addresses the concern that students who change schools nonstructurally are somehow different than students who choose to stay in the same school. Earlier studies compared mobile and non-mobile students, but by estimating a within-student effect of mobility on the student's academic gains, they eliminate a confounding factor of selection that is unobserved in the administrative data to the extent that unobserved differences influencing selection are time invariant, whereas the choice to change schools varies over time. By estimating the deviation of the student's test score growth after he or she changes schools from his or her average achievement in the years when the student did not change schools, the authors find a small, negative relationship between within-district, non-structural moves and student math achievement, on the order of 0.024 to 0.088 standard deviations.

Hanushek, Kain, and Rivkin's (2004) estimates improve upon previous analyses because they use an improved measure of mobility. The authors have access to six 6 week enrollment periods so they are able to observe the approximate time of the move, whether the move occurs within or beyond the district, and the frequency of moves to attempt to account for any differences in those factors that might influence the student's later achievement. By classifying moves in these ways, the authors attempt to address the concern using the type and timing of the move as a proxy for the changes in school quality. For example, they assume that students who change districts are moving to better schools. Their model, however, does not include measures of school quality that can confirm or deny this possibility, nor do they account for instructional time missed that accompanies the move.

The authors also find that because high-poverty and high-minority schools experience more turnover, the cumulative effects of mobility on peers are more damaging for those students than for more advantaged groups of students. Their estimates, however, are potentially biased because the administrative data fails to account for the mechanisms that they describe in their theoretical model. Their research stops short of measuring each of these mechanisms and assessing how they relate to student mobility, leaving open the potential that these omissions confound their estimates of mobility's effect on academic achievement. The authors are unable to document whether any changes in student achievement are a result of the move or the result of the school's impact on mobile students, whether the student was able to adjust to her new surroundings or due to a change in school quality.

Nonetheless, the model and function presented by Hanushek, Kain and Rivkin (2004) has consistently been adopted to estimate the effect of mobility in other contexts. Xu, Hannaway, and D'souza (2009) also use a student fixed effects specification to model the impact of nonstructural moves on six cohorts of third graders in North Carolina. Their analysis demonstrates that while minority and disadvantaged students were more likely to move, mobility had differential impacts both by the outcome of interest, the type of move, and the demographic characteristics of the mobile students. Mobility had no effect on the reading performance of black students but was related to improved performance for white students. In math, however, the inverse was measured: black and Hispanic students were negatively impacted by a move but had no relationship with performance for white students. These differences may be due to the context of the move and correlations between demographics and the type of move. White students, who on average were less likely to be economically disadvantaged, were more likely to employ strategic, which they define as moving across districts and between-year nonstructural moves, whereas within district, reactive (e.g., nonstructural within-year) moves were related to negative consequences for all students.

In contrast, Burkam, Lee, and Dwyer (2009)—using the Early Childhood Longitudinal Study, Kindergarten Class of 1998-99—found that moves in kindergarten have a negative relationship with student achievement, but for students in first through third grades, the effects on math and reading achievement in the year following the move, even multiple moves, had negligible effects on cognitive skill growth. The authors observe that despite a negligible overall effect, certain subgroups (students with disabilities, economically disadvantaged students, and black students) experience more mobility and more deleterious impacts. Thus, the "complexity of [their] results makes any simple statement about the cognitive impact of school mobility impossible" (pp. 7). Together, these studies demonstrate the heterogeneity of impacts across types of moves and for different groups of students.

Another significant contribution of the North Carolina analysis by Xu, Hannaway, and D'Souza (2009) is to attempt to measure school quality using an outcome rather than solely based on an assumption about between district mobility. They write, "in addition to student fixed effects, our models control for school quality (as measured by percentage of students performing at grade level or higher), school size, locale and Title I eligibility" (pp. 11). While this combination of outcomes and inputs builds upon the conceptual framework outlined in Hanushek, Kain, and Rivkin (2004), as a measure of school quality, proficiency rates fail to account for the contribution of the school. Instead, these rates reflect the combination of the students' academic performance and the school's contribution. Any correlations found that might arise from including this measure in the model may not be the result of the change in school quality, but instead the change in peer groups. This limitation raises questions about how Xu, Hannaway and D'Souza (2009) can differentiate between the effects of the move from the change in school quality. In addition, this research does not explicitly address the extent to which assimilation and disruption, the other two paths hypothesized by Hanushek, Kain, and Rivkin (2004) to mediate the relationship between student mobility and academic achievement.

More recent analyses seek to isolate effect of the move from the changes in school quality by adopting different methods. Using data from New York City Public Schools, Schwartz, Stiefel, and Cordes (2017) employ an instrumental variable framework to derive a causal estimate of student mobility on student achievement. The authors employ three instruments—variation in grade span of the student's first grade school, the assigned middle school, and building sales data—that they contend are related to the likelihood of mobility, but not to the changes in achievement or school quality that result from the move. The authors illustrate that the instruments meet both the exogenous and correlational conditions for valid instruments for the endogenous variable of mobility. The authors attempt to use a fourth instrument, building sale, and find that the relevance condition, that building sale was predictive of within-year mobility, was not met and the instrument was not valid. Each of the three valid instruments is described in detail in the following paragraphs.

First, the authors use variation in grade span of the student's first grade school as well as the assigned middle school as an instrument for student mobility. The grade span will influence when the student is expected to move from elementary to middle school but should not directly influence student achievement. In their sample, 58 percent of schools were K-5 schools, 19 percent were K-6 schools, and 11 percent were K-8 schools, while the remaining schools had other grade configurations. The authors stress that the grade span in each student's first grade will inform subsequent nonstructural mobility decisions—if a school's final grade offered is fifth grade, a potential mobile fifth grade student may be more likely to "stick it out" than if the final grade were sixth—but that this influence has no direct impact on student achievement.

Second, the authors use building sales data to predict the likelihood of student mobility for students in rental housing. With nearly 80 percent of NYC public school students living in rental housing, this data can exploit an idiosyncratic nature of student housing to estimate a causal impact of mobility. Due to these differences in modeling decisions, data availability, and conceptual framework, Schwartz, Stiefel, and Cordes (2017) results that differ from previous analyses. By focusing on both structural and nonstructural moves, Schwartz, Stiefel, and Cordes (2017) attempt to address a slight variation of the questions that Hanushek, Kain, and Rivkin (2004) pursue. Their instrumental variable using student fixed effects analysis finds that structural moves have a causal, significant, and negative effect on student achievement—a loss of between 0.096-0.113 Standard Deviation Units (SDU) in ELA and between 0.182-.20 SDU in math—while nonstructural moves appear to have direct positive effect on student achievement in math in the year of the move, but not in English. Furthermore, the effect of the nonstructural move diminishes over time, leading them to conclude essentially a null effect for nonstructural student mobility. These results conflict with previous research, suggesting that the omitted variable bias from previous analyses was strong enough to change the direction of the point estimates. Structural moves, rather than nonstructural moves, represent the greatest threat to student achievement of the different mobility classifications, highlighting a heterogeneous response that had not previously been detected.

Third, Schwartz, Stiefel, and Cordes (2017) find that their results are robust to specifications of school quality using a regression-adjusted, value-added model, an improvement over the Xu, Hannaway, and D'Souza estimation strategy. Yet, for some of their estimates, accounting for this change in school quality, the significant causal relationship of mobility is reduced to a null effect. By including this as a sensitivity test, they are attempting to disentangle the impact of moves from changes in school quality. By exploring whether this mechanism, school quality, mediates the estimates of mobility, the authors advance our understanding of student mobility, but they fail to account for the disruption and assimilation effects which may continue to confound their null effect estimate.

While the causal estimates of student mobility in the New York City context provide a novel approach and important contributions to the conceptual framework, their estimates and identification strategy for plausible instruments lack generalizability to other mobility research. Other states/districts do not have 80% of students who live in rental housing and changes in school grade span are district level decisions which may not be exogenous. In other states, it may not be plausible that variation in grade span across districts is exogenous to the student performance, resulting in a failed condition for the instrument. This limitation suggests that this specification to deduce a causal claim may not generalizable to other contexts outside of the New

York City. To address these limitations, the study proposed herein will focus on nonstructural student mobility and focus on estimating the gross effect on student achievement growth and the extent to which mobility can be mediated by changes in school quality, assimilation, and disruption or whether a residual mobility effect remains.

Nonetheless, this body of research demonstrates that even as researchers have identified and accounted for key mechanisms through which mobility relates to student achievement in their analyses, our understanding of the effect of student mobility has not been settled. In total, these conflicting results suggest that more research is needed on the effect of student mobility on student achievement, with special attention on how the primary mechanisms—school quality, assimilation, and disruption—mediate the relationship between student mobility and achievement and the heterogeneity of those estimates across different types of mobility and for different groups of students.

To build upon this body of research, we intend to explore the extent to which student mobility relates to student achievement, seeking to account for these avenues which may mediate the relationship and exploring the patterns of mobility that have practical implications for research and policy. To do this, we address four main research questions:

1. To what extent do nonstructural (between- and within-year) and structural moves occur? What are the rates of mobility for different groups of students and across school contexts?
2. To what extent do observed student and school characteristics predict student mobility? To what extent do observable student and school characteristics differ between nonstructural between-year, nonstructural within-year, and structural movers?
3. To what extent does student nonstructural mobility affect academic performance outcomes?

4. To what extent do school quality, assimilation, and disruption mediate the effect of student mobility on student achievement?

The answers to this set of questions will inform the current role of student mobility in education policy research. The analysis seeks to build off previous analyses to identify policy malleable avenues through which schools and districts can address the impact of student mobility. The next section describes the sample of students included in the analysis, the data, and the methods to answer these questions.

CHAPTER 2: DATA AND MEASURES

The aim of this study is to understand the extent to which and how student mobility is related to changes in student achievement. To answer this question, we rely upon administrative data from Tennessee, provided by the Tennessee Education Research Alliance, a research-practice partnership formed with the Tennessee Department of Education and housed at Vanderbilt University's Peabody College. This study brings together student-level enrollment, demographic, discipline, attendance, and achievement data, as well as school-level variables and effectiveness data.

Sample

I draw on administrative longitudinal data from 2009-10 to 2014-15 from Tennessee public schools. Each of the three sets of research questions outlined above draws from this population of students to analyze student mobility. The first two questions—the descriptive analysis of student mobility and the predictors of student mobility—employ a sample of all students in grades K-12. These data will document descriptive rates of mobility rates across different student groups and contexts and investigate which observed factors influence student mobility, and whether that relationship differs by the type of mobility. The third and fourth questions restrict the sample to students in grades 4-8 with math and English assessment scores to estimate the impact of student mobility on student achievement gains. Overall, we observe 1,373,244 students in our data. Of that population, 855, 270 attend more than one school over this period, with 630,208 students engaging in structural moves, 353,027 engaging in nonstructural within year moves, and 233,824 with within year nonstructural moves. It is also important to consider that these measures are non-exclusive, with 418,852 students engaging in multiple moves over this time period. Despite five school years of data, we have just three cohort of students, beginning with those that entered 3rd grade in 2008-2009, 2009-2010, and 2010-2011, who have a full set of assessment scores for each year in grades 3 through 8.

Measures

The following section will detail the measures used in this analysis. To begin, we will describe the way that student mobility is operationalized at the student level and how that informs the calculation of a school mobility rate. We will move onto the other independent variables of interest, focusing on how those factors inform how mobility relates to student achievement. Finally, we will describe the potential mediators of student mobility that may explain how mobility relates to achievement before describing the assessment data that the study uses as its key outcome variables.

Independent Variables of Interest

The three measures of student mobility in this study are constructed using longitudinal student enrollment data that details the date that the student enrolls in a school and the date that the student exits the school. Mobility measures rely on the characteristics of the school and the timing of the move. Structural mobility occurs when a student completes the terminal grade at her current school and moves into the entry grade at the destination school the following year.

We operationalize structural mobility as a dichotomous variable for when a student, who is enrolled in the terminal grade *g* at origin school S_1 in year *t-1*, enrolls in grade *g+1* at a destination school S_2 at the beginning of year *t* where grade *g+1* is the entry grade at destination school S_2. Nonstructural mobility, moves that are not the result of grade configurations at the student's school, can occur between and within year. For between-year nonstructural mobility, we create a dichotomous variable which is given a value of 1 for students who are enrolled in origin school S_1 in year *t-1*, who enroll in a destination school, S_2, at the beginning year *t*, where the student does not enter into the earliest grade offered in that destination school, S_2. The choice to employ the destination school as the determinant for structural versus non-structural resides in that all students within school, $S_{2'}$ aside from the new student—or a subset of students who move together—have become accustomed to the destination school. However, the students exiting school, S_1, may enroll as a group into school, S_2, which may mitigate any potential negative effect if there is concern about whether non-structural mobility effects are related to the scale at which mobility occurs within the school. An instance of this would be where an origin school terminates in grade 5, but the destination school serves grades 5 through grade 8 where a large influx of new students would occur in sixth grade. For this reason, our models include lagged mobility rates to account for schools with large numbers of non-structural movers that are due to structures within the enrollment system. Within-year nonstructural mobility is specified when a student begins school year *t* in origin school, S_1, and at some point during that school year *t*, withdraws from origin school S_1 and enrolls in destination school S_2 before year *t* ends. It is important to note that while between-year mobility is a discrete event, it does not preclude a student from engaging in within year nonstructural mobility, even multiple times, in the same school year. Consistent with previous research, a separate indicator is created for students who engage in multiple within year structural moves within the same academic year.

Taken together, these measures of student mobility permit a calculation of a school's overall mobility rate. To calculate this, we focus on the entry patterns, rather than the exit patterns, of a school. For example, a school *S* at the end of year *t* divides the number of students (*N*) who entered school *S* at any point during year *t*—if a student engaged in any type of mobility: all structural between year (*SBY*) or nonstructural movers, either between (*NSBY*) or within (*NSWY*) years—divided by the cumulative number of students enrolled at any point during year *t* at school *S*, as shown below:

$$MobilityRate_{S,t} \frac{(N_{SBY,S,t} \mid N_{NSBY,S,t} | N_{NSWY,S,t})}{(N_{SBY,S,t} \mid N_{NSBY,S,t} | N_{NSWY,S,t}) + N_{Stayers,S,t}}$$

To illustrate this calculation, consider a school S_1 where 100 students began in the fall of year *t*, all of whom were enrolled at school S_1 in year *t-1* and no new students entered in year *t*—this group of students would be considered stayers. In this simple example, assume 25 students exited school S_1 during year *t* and 25 students entered school S_1 during year *t*. At the end of year *t*, school S_1 still has an enrollment of 100 students, but 125 students were enrolled at some point during that school year *t*. The mobility rate at school S_1 in year *t* is 20%, or 25/125. In a second example, imagine a second school, S_2 where of the 100 students who started in the fall in year *t*, 75 of them finished year *t-1* at school S_2 and 25 were not enrolled at school S_2 at the end of school year *t-1*. During school year *t*, 25 of the stayers exited school S_2 and 25 different students replaced them. At the end of year *t*, we would calculate the mobility rate of school S_2 as 40%, with 25 nonstructural movers between-year and 25 nonstructural movers within year out of 125 total enrollees in year *t*, or 50/125. Further examples could include specifications that have the student engaging in multiple moves over the course of a single school year.

We track student enrollment by observing the day the student enters a school and the day that a student withdraws from a school. If a student is enrolled in a public school at any time, then the dates of enrollment are documented in the administrative data file. Using this data, we create separate, non-exclusive binary variables to indicate whether a student is a structural mover, a nonstructural between year mover, and separate indicators for each within year move. This structure permits students who change schools multiple times to be tracked for each move, within year and across years. If a student changes schools nonstructurally during the summer, transfers out of the school early in the fall to a second destination school, then to a third school in the spring, each move would be observed. Furthermore, if a student engages in a within year nonstructural move, then changes schools nonstructurally during the following summer, each move would be operationalized, but the first move—within year nonstructural—would be linked to the test score for that school year and the second—between year nonstructural—would influence the next year's assessment performance. If a student changed schools structurally or nonstructurally between years, then changed schools again during the school year, we would be able to include information about each move as it relates to that year's student achievement growth. In the case where a student engages in multiple non-structural within year moves, we would place that student in the school in which he or she takes her assessments and include an indicator variable for the year in which multiple moves occur and include an indicator that the student engaged in multiple moves.

Other Independent Variables

The models account for individual characteristics of the student—race/ethnicity, economic disadvantage, whether the student has an IEP, and English learner status—and these variables can act as independent variables of interest in the first set of models or covariates to reduce bias or increase precision of the estimates of key independent variables in others. To measure mobility's impact on student achievement, the models also include a student's prior achievement measure for that subject that permits an estimate of a short-term change in performance after the move occurs. Prior test scores are included as covariates in all models for each research question.

To account for instructional time lost, we also include measures of attendance and discipline. Attendance data is captured at the school day level, where a student is marked as absent if she missed more than half the day of school. The attendance rate, the number of days absent divided by the number of days enrolled, is captured for each enrollment spell. The discipline measure is captured by a binary indicator for whether a student received an in-school suspension or a separate binary indicator for whether the student received an out of school suspension. A third discipline indicator for whether the student is expelled, which in Tennessee means that the student went 10 or more consecutive academic days without academic services as a result of a discipline infraction, is included in the models. For within-year nonstructural moves, the number of days absent and whether a student was involved in a disciplinary incident (in-school suspension, out of school suspension, expulsion) prior to the move are captured at the student-school level and are included for both the origin school and the destination school.

Other Covariates

Other differences between the destination school and the origin school are included to account for any differences in local context that might relate to student achievement and the propensity to move. Several school-specific factors are included: school enrollment, per-pupil expenditure, school demographics, suspensions per 100 students, and prior academic achievement. These factors are included as they are related to the propensity to change schools as well as the student test performance, improving the quality of the estimate of student mobility on academic performance.

Mediators

While the aforementioned covariates improve the estimate of the effects of mobility, previous analyses fail to directly account for the three factors from the theoretical model that may explain the extent to which mobility relates to student achievement. We refer to the credible causal estimate of mobility derived from student fixed effects models as a gross effect of mobility. As described above, Hanushek, Kain, and Rivkin (2004) describe three primary "avenues", or as this analysis refers to them, mediators—school quality, disruption, and assimilation—that may affect the magnitude of this estimate. We seek to operationalize these mediators to reduce the bias of the net causal estimate and estimate the extent to which these measures explain variation in student outcomes (Baron & Kenny, 1986; Preacher, 2015).

To understand the role that the mediators play in this analysis, let's assume that there is a gross effect of mobility on student achievement that is derived from estimating the independent variable of interest on our primary outcome. By including the following mediators in the model, we are able to disentangle the residual effect of changing schools from the gross effect of student mobility.

Gross Mobility Effect = School Quality + Assimilation + Disruption + Residual Effect of Mobility

The gross mobility effect accounts for all the changes that are associated with the move and how those factors influence student achievement growth. Prior analyses of student mobility present a gross mobility effect but fail to include the theoretical avenues through which mobility impacts student achievement. By implementing a model that enables us to test whether the mediators subsume the residual effect of mobility or act as partial mediators of mobility, our understanding of student mobility and can be improved. These mediators play an important role in understanding the extent to which student mobility can be addressed through policy amenable means. Within the description of each mediator, we will explain how this avenue distinctly informs our estimates of the effect of mobility and possible ways to address that avenue through policy and practice.

First, this analysis seeks to account for whether disruption—instructional time lost as a result of the move--drives any changes in student achievement post-move. In a mediation analysis, we can test the paths through which mobility impacts disruption, and then in turn, the disruption impacts student achievement. To capture how mobility disrupts the learning experience of the student, we include measures of how much instructional time the student loses when she changes schools.

A student may not enroll immediately after she withdraws from her initial school, resulting in days or weeks of lost instructional time. Previous analyses do not account for this loss of instructional time. To capture this, we calculate the number of school days missed between the student's exit date at her origin school and the entry date at the destination school for all mobile students. The totality of missed instructional time—prior to the move, during the move, and post-move—capture a more complete picture of the disruption of a student's instructional time that accompanies changing schools. In our sample, approximately 15 percent of within year nonstructural movers miss more than 5 days of school between enrollments when they transfer while a quarter of nonstructural movers enroll within the first twenty days but are not enrolled on the first day of school. Our assumption is that these students would have otherwise attended school and not experienced lost instructional time in the counterfactual that there was no change in school for those students.

The number of school days, both while enrolled and between enrollments, are calculated using school calendar files and attendance data. We can observe each day that a student was not present for more than half the day. For school days missed between enrollments, we refer to the calendar of the destination school. Figure 1 documents two students—Student A and Student B—who leave the origin school on the same day, but enter the destination school at different times, leading to missed instructional time for Student B. Student A exited her origin school on a Friday of Week 1 then enrolled in a destination school on the following Monday: she missed 0 days of school. Student B exited on that same Friday but did not enroll in her destination school for 10 calendar days, or a full week of school after that first student; we would attribute 5 missed days of instructional time. These counts incorporate professional development or holidays occurred during that missed week of school so we only count days where the student would have been in school had she not transferred. By focusing on the lost instructional time between moves, we hope to provide guidance to schools and districts about ensuring that transition plans are in place when students exit their origin school and that there are clear expectations for mobile students about lost instructional time when changing schools.

Week	Student	Sun.	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.	Days Missed	Days Enrolled
Week 1	Student A	X	School 1	______	______	______	Last Day School 1	x	0	5
	Student B	X	School 1	______	______	______	Last Day School 1	x	0	5
Week 2	Student A	X	First Day School 2	______	______	______	School 2	x	0	5
	Student B	X	*No school of record*	______	______	______	*No school of record*	x	5	0
Week 3	Student A	X	School 2	______	______	______	School 2	x	0	5
	Student B	X	First Day School 2	______	______	______	School 2	x	0	5

Figure 1. Illustration of Lost Instructional Time Due to Disruption

Aside from the student-specific factors, the characteristics of the schools that serve mobile students may account for differences in how students perform on standardized assessments after the move. As Hanushek, Kain, and Rivkin (2004) detail, aside from disruption, the two other potential mediators through which mobility impacts achievement are changes in school quality and assimilation, which is defined as how a school serves mobile students.

To estimate a change in school quality for a mobile student, we subtract the destination school's value-added from the origin school's overall value-added in the year prior to the move. We use publicly reported school-level growth data, known as the Tennessee Value-Added

Assessment System, to capture the school's contribution to student learning each year (Sanders & Rivers 1996). Previous studies have attempted to use the proficiency levels of students, but this measure does not distinguish between the characteristics of the students and the contribution of the school to the academic growth of its students. This specification allows us to differentiate between the performance of the origin school from the performance of the destination school that accounts for differences in the characteristics and prior ability of peers in each school. If changes in school quality subsume the gross effect of mobility—a finding that is suggested by Schwartz, Stiefel, and Cordes (2017)—then student mobility may not represent the significant challenge that has been documented in previous research. Instead, information about school quality could be better tailored to inform mobility decisions.

Schools also vary in their ability to assimilate new students. Assimilation, for this paper, derives from the destination school's value-added on mobile and non-mobile students. School-specific value-added for previously mobile students can help understand whether certain schools are more adept at integrating new students. To capture the school's ability to assimilate mobile students, we estimate a value-added model using a student by school fixed effects specification that only includes mobile students in the years prior to the school year that the student changes schools and a separate model for stable students in that same year. This measure is calculated separately for English and math scores and is included in the aligned subject-specific analyses. To calculate this metric, we must have multiple prior years of data. Furthermore, concerns about any bias introduced by comparing movers and non-movers is addressed by only comparing movers to other movers and non-movers to other non-movers. Essentially, this value-added model seeks to isolate the contribution of the school to each group of students' education growth. It is a lagged measure: if a student moves in year t, then the value that is included in the model is the metric associated with all moves for mobile and non-mobile students separately in year *t-1, t-2…t-n* for all years of the data. Our estimates reveal significant variation in how schools serve mobile students. By including this metric, we can account for any differences in structure, onboarding, communication, and curriculum that constitute efforts, both purposeful and not, that impact the school's ability to educate mobile students. To our knowledge, previous research has not sought to measure the effect of schools on mobile students specifically.

After producing the value-added estimates of mobile and non-mobile students in a student-school fixed effect model, we would then use this information to create our measure of assimilation. We incorporate the difference between the value-added of the mobile students and the value-added captured for non-mobile students. If a school serves its mobile students as well as it does its non-mobile students relative to other schools, then we could assume that the school assimilates its mobile students as well as it serves their stable peers. In future research, we will also test the value-added for mobile students as a separate measure of assimilation. Yet, by differencing the value-added for non-mobile and mobile students, we can ensure we are calculating a different measure than overall school quality and test whether the school serves its mobile and non-mobile students (assimilation) equitably. In the case that estimates of assimilation mediate the residual effects of mobility, then a new strand of research could further this work to understand the characteristics of and conditions under schools better assimilate mobile students.

In total, a full list of the measures outlined in this study are provided in Table 3.

Table 3. Measures Used in Analysis

Student Characteristics	**School Characteristics**
Prior test scores	Student enrollment
Race/ethnicity	Racial/ethnic composition
Poverty status	Concentration of poverty
Has an IEP	Suspensions/100 students
Limited English proficiency	Lagged school level mobility rates
Structural mobility	School-level value-added (School Quality)
Within year nonstructural mobility	School-level value-added for mobile students (Assimilation)
Between year nonstructural mobility	School-level value-added for stable students (Assimilation)
Suspension/Expulsion prior to move	Classmates' prior test scores
Chronically absent prior to move	
Days lost between enrollment spells (disruption)	

Outcome Variables

Beginning in third grade, students participate in the Tennessee Comprehensive Assessment Program (TCAP) in English and math, which includes grade-level end of year assessment. Thus, the primary outcome for this study will be the student gains scores in English and math that are standardized by subject, grade, and year. In order to measure a growth score, we need previous assessment data for students, so the impact of mobility can begin to be analyzed in fourth grade. Separate models are run for English and math achievement growth.

Using these different measures as covariates and independent variables of interest, this study seeks to answer four primary research questions. The first question provides a descriptive landscape of student mobility in Tennessee. First, we calculate the scale of mobility in Tennessee across each of the three primary definitions of mobility: structural, nonstructural between year, and nonstructural within year. We estimate the number of disruptions, differences in school quality and assimilation by type of move. Second, we describe the student and school characteristics of mobile students and explore the extent to which those characteristics predict the likelihood of mobility overall and whether they differ by type of move. In the third question, we seek to estimate the gross impact of student mobility on academic achievement and the extent to which the credible causal effect of mobility varies by the type of move. Finally, in our fourth research question, we estimate the extent to which school quality, assimilation, and disruption mediate the effect of student mobility on student achievement.

CHAPTER 3: EMPIRICAL STRATEGY

Research Question 1: Descriptive analysis of student mobility

To what extent do nonstructural (between- and within-year) and structural moves occur? What are the rates of mobility for different groups of students and across school contexts?

The first research question provides a descriptive overview of the scope of student mobility in Tennessee. A series of mobility rates for different groups of students aims to help us understand who moves, where they move, and when they move. For each calculation, we compute the percent of students who engaged in nonstructural within year move, a nonstructural between year move, a structural move, and multiple moves to understand when and how often they move.

The first set of calculations focuses on mobility rates for all students over time. we calculate overall mobility rates for all students in grades K-12 for each year that data are available. we then compare rates of within year nonstructural mobility, between year nonstructural mobility, and structural mobility for each year. Finally, we show mobility rates for each type of student mobility by grade.

The next set of analyses describes mobility rates by various student characteristics to understand who changes schools. We calculate mobility rates by student race/ethnicity, English learner status, special education status, economic disadvantage, and at different achievement levels in the year prior to the move. We will also compute mobility rates for students who have been previously chronically absent and have been identified as having received a disciplinary infraction in the previous academic year. Last, we will show cumulative mobility rates for different groups of students over the entire panel of data

I then describe the scope of mobility across different school contexts. We calculate and compare mobility rates across school districts, disaggregating mobility rates by within and across district moves. We calculate mobility rates by the quintile of black/Hispanic/Native American (Underrepresented Minority) concentration, economic disadvantage concentration, percent of students who were proficient or advanced on state tests across all subjects, and previous year's school value-added specification. Finally, we compute mobility rates for different groups of students across different school contexts. We will compute the average proficiency rates and value-added calculation of schools, both origin and destination schools, for different groups of mobile students.

Research Question 2: Predictors of student mobility

To what extent do observable student and school characteristics predict student mobility? To what extent do observable student and school characteristics differ between nonstructural between-year, nonstructural within-year, and structural movers?

The previous research question demonstrated descriptive results that allow us to understand the scope and scale of student mobility, but did not go as far as estimating whether certain students are more likely to change schools once the observable factors influencing the decision to change schools are accounted for simultaneously. To answer the extent to which student demographics and school demographics predict the likelihood of mobility, we employ a year and grade fixed effects model. This will allow us to show the extent to which students exit schools in grades by different racial and ethnic groups to test whether low-income or minority students engage in nonstructural moves from schools at higher rates than their peers. The equation to answer this question takes the following form:

$$\Pr(mobility)_{ijgk} = \frac{e^f}{1 + e^f} \quad (1)$$

Where

$$f = \beta_0 + \beta_1 X_i + \beta_2 W_{i,t-1} + \gamma_t + \phi_g + e_i \quad (2)$$

is the odds that student *i* transferred into school *j* in grade *g* in year *k* as a function of their background characteristics (X_i) and origin school characteristics ($W_{i,t-1}$) where within-year movers would include characteristics of that same-year origin school and between-year nonstructural movers would be linked with previous year's origin school characteristics. Models include year (γ_t) and grade fixed effects (ϕ_g) to account time and grade specific correlates of turnover and a random error term, which is clustered at the school level (e_i). In the first model, $mobility$ is coded as a binary variable where one represents any nonstructural move that the student engages and zero represents any stayer or structural mover. We will also use the grade-fixed effect specification to test whether students are more likely to change schools at certain points in time that are outside of the structural moves built into the system. Standard errors for all models are clustered at the school level.

After running each model predicting the likelihood of each type of move separately, the final model is a multinomial logistic regression predicting the likelihood of structural, nonstructural between, and nonstructural within year mobility. The reference group for this model would be students who stayed in their current school during that year. Results from this model will allow us to compare whether the types of student mobility decisions are correlated with observable characteristics of students and schools that they attend. Because a structural mover should not be related to observable characteristics—other than school grade, which should be the primary driver of structural mobility—of the school or student in a given year, we would expect that the student characteristics should not be predictive of a structural move. If student or school characteristics relate to the likelihood of a structural move, then it suggests that there are unobserved factors that relate to those characteristics and to the structure of the schools that are not accounted for in the model. Finally, we will test whether the observable factors that predict mobility are statistically significant and differ from one another depending on the timing and type of student mobility by employing a Wald test of coefficients to compare differences for within year nonstructural, between year nonstructural and structural movers.

Research Question 3: Effect of mobility on student achievement

To what extent does student nonstructural mobility affect academic performance outcomes?

The third set of questions seeks to understand the effect of mobility on academic outcomes. For this set of analyses, we transition from focusing on all moves to nonstructural between year and nonstructural within year movers. In order to document the causal impact of a school move, we would need to observe the counterfactual: outcomes for the mobile student in the absence of the move. To illustrate this true causal effect, we can create a scenario (scenario A) where a student would change schools at time 1, then be assessed in time 2. We would then need to measure how that same student would have performed as a stable student in time 1 on the same assessment in time 2 (scenario B). Calculating the difference between the assessment results in scenario A from the result in scenario B would be the causal effect of mobility, or the treatment on the treated (Smith & Todd, 2001).

Given these limitations of observing a true counterfactual, researchers often rely on randomization of individuals into a treatment and a control group to derive an unbiased estimate of treatment. For this study, we would consider the treatment to be the act of changing schools and we would want to understand its effect on student achievement. Thus, if we were to create a new scenario, scenario C, where students are randomly assigned to attend a different school at a given point in time before time 2 and others randomly selected to be stable, the difference in average achievement between the two groups after that point in time would be considered the average treatment effect of mobility. This average treatment effect would include the gross effect of the changing schools, the change in school quality, the ability of the destination school to support mobile students, and how that move disrupts the students' educational experiences.

A pooled OLS model would be a straightforward attempt at attempting to estimate the gross effect of student mobility, denoted by δ in the equation 2 below. The following model attempts to account for the student and school level characteristics to estimate the relationship between student mobility and student achievement:

$$Y_{igt} = \beta_0 + X_i\beta_1 + W_{st}\beta_2 + \mu_{igt}\delta + \gamma_t + \phi_g + u_{igt} \tag{3}$$

where Y_{igt} represents student standardized test score in grade *g* and year *t*. X_i is a vector of student characteristics, including the student's previous assessment results in the previous year, $Y_{ig-1,t-1}$. The characteristics of the destination school are contained in the vector, W_{st}. The indicator for mobility, μ_{igt} , is coded as 1 if a student ever changes schools nonstructurally, both at the beginning of year *t* or within school year *t*. In this case, δ is the average achievement difference between movers and non-movers in the year following the move. To account for any differences that are the result of grade-year specific factors that influence student achievement, we include a grade and year fixed effect specification, which is represented by γ_t and ϕ_g. Finally, a residual term,u_{igt}, represents a time-constant component and an idiosyncratic component that is assumed to be homoscedastic and uncorrelated with any independent variables. This term captures any student characteristics that are unobserved, such as motivation, out-of-school factors influencing the move, and other context that are not captured in the model that relate both to the propensity to move and to the changes in student achievement. However, these unobserved confounders violate the key assumption for OLS regression of independence between the independent variables and the error term.

While the previous model begins to define the relationship between mobility and achievement, mobile students may differ in observable and unobservable ways that would impact how the treatment relates to the outcome. The pooled OLS model is biased due to the nonrandomness of moving due to the unobserved differences between movers and non-movers. Previous analyses attribute those differences to something other than the move such as the family circumstances that drive the move (divorce, job loss, available resources), school or teacher level context that often goes unmeasured, or other factors that are both related to the outcome, student achievement, and the likelihood that a student changes schools.

In lieu of comparing mobile students to non-mobile students, we use variation in a student's own achievement over time for to compare the same student's performance before and after the move, which is estimated through a student fixed effect model. In order to credibly estimate the effect of student mobility using a student fixed effects specification, we account for other factors related to both the propensity to change schools and student achievement, such as student and school characteristics. Fixed student characteristics, such as gender, race, economic disadvantage, special education status, migrant status, language background, are used to understand how mobile students differ from non-mobile peers, but within a student fixed effects framework, these covariates do not provide any variation that contributes to the changes in student achievement.

The following model allows us to credibly estimate the gross effect of student mobility on student achievement that mitigates the potential biases from comparing movers and non-movers. We estimate a student fixed-effects model:

$$Y_{igt} = \beta_0 + X_i\beta_1 + W_{st}\beta_2 + \mu_{igt}\delta + \gamma_i + g_{gt} + u_{igt} \quad (4)$$

where Y_{igt} represents student standardized test score in grade *g* and year *t*. X_i is a vector of time-varying student characteristics, while W_{st} represents time varying characteristics of school s. The indicator for mobility, μ_{igt} , is coded as 1 if a student ever changes schools nonstructurally, both from the beginning of year t or within school year t. To account for any differences that are the result of grade-year specific factors that influence student achievement, we include a grade-year fixed effect specification, which is represented by g_{gt}. A student fixed effect term,γ_i, accounts for any time-invariant characteristics of student *i*. By comparing a student's deviation from student achievement in the year in which she moved to the year in which she did not change schools, we are able to eliminate the role that these confounding, unobserved and observed fixed characteristics that differ between mobile and non-mobile students play and consistently estimate the relationship between student mobility and student achievement.

Furthermore, the effect of mobility on student achievement growth may be heterogeneous due to the characteristics of the student or the type of the move observed. To understand how different types of mobility relate to student achievement and the extent to which the effect is heterogeneous, we run a second model. We choose to adjust the single mobility variable to multiple non-exclusive binary variables for nonstructural mobility—one for between year, one for within year, and one for multiple moves within the same year—to differentiate between within year and between year student mobility. By evaluating the effect of each type of move, we aim credibly isolate the gross effect for each type of mobility on student achievement gains. The following model demonstrates how we will estimate heterogeneous gross impact of student mobility for each type of move.

$$Y_{igst} = \beta_0 + X_i\beta_1 + W_{st}\beta_2 + \mu NSWY_{igt}\delta_1 + \mu NSBY_{igt}\delta_2 + \mu MULT_{igt}\delta_3 + \gamma_i + g_{gt} + u_{igt} \quad (5)$$

Post-estimation, we will employ a Wald test of the null hypothesis that within year mobility and between year mobility, denoted by $\mu NSWY_{igt}\delta_1$ and $\mu NSBY_{igt}\delta_2$ in the model, are statistically equivalent. The coefficient, $\mu MULT_{igt}\delta_3$, will test whether students who engage in in multiple within year nonstructural moves see any differences in student achievement on top of the estimate of δ_2, the average change in achievement growth for a nonstructural within year move. The coefficients, $\delta_1$andδ_2, represent the gross effect of nonstructural between year and nonstructural within year mobility, respectively.

Research Question 4: Mediation analysis of student mobility

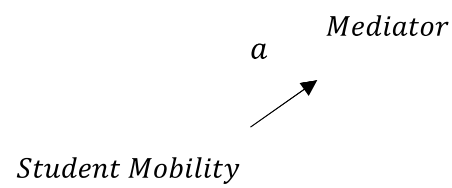
To what extent do school quality, assimilation, and disruption mediate the effect of student mobility on student achievement?

One challenge for researchers is to determine whether the average treatment effect of mobility can be explained by mediators that account for the pathways through which the move relates to academic outcomes. The results from question 3 will provide gross estimates for overall mobility and for each type of nonstructural mobility. Yet, given our theoretical understanding of mobility, estimates of the gross impact of student mobility may be the sum of the primary mediators that influence student achievement: changes in school quality, assimilation, and disruption associated with the move. To account for this, we include factors that seek to operationalize and measure these mediators and determine whether the relationship between mobility and achievement is fully or partially explained by these mediators. A full mediation would confirm the Hanushek, Kain, and Rivkin (2004) theoretical framework for the gross mobility effect, whereas a partial mediation would advance that framework to include a residual effect of mobility. The student fixed effects specification requires variation derived from years in which students experience nonstructural mobility and years in which that same student does not experience a move over the window of the study. Using a mediation framework (the three-variable causal system) displayed in Figure 1 below, we can extract the information about the mechanisms through which the credibly causal estimate of mobility impacts student achievement (Preacher 2015). We run separate models for each mediator due to computational limitations but will present the process that we will take once, as it will be the same for each mediator, which is in line with previous research (Henry et al., 2020).

Model 1:

$$Student\ Mobility \xrightarrow{c} Student\ Test\ Scores$$

Model 2:



Model 3:

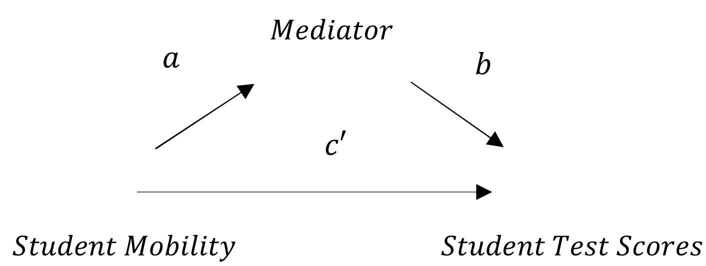


Figure 2. Mediational Framework

The first step of this process is to evaluate the results from our third research question to establish the gross effect of student mobility on student achievement. This relationship is depicted in Model 1 and estimated in through the model described in research question 3. The estimates of this model are depicted as path *c*, which would be δ in the equation below (See equation 4 above).

$$Y_{igt} = \beta_0 + X_i\beta_1 + W_{st}\beta_2 + \mu_{igt}\delta + \gamma_i + g_{gt} + u_{igt} \qquad (4)$$

Then, we implement the same model again, but we replace the student achievement outcome,Y_{igt}, student achievement in year t with each of the mediators to see if student mobility decisions relate to the mediators, the first of three conditions that are necessary to establish mediation. These relationships are measured through the Model 2, via path a, in the figure above.

A separate model is estimated for each of the mediators—school quality, assimilation, and disruption, as defined in the measures section—change in school quality, the value-added difference between mobile and non-mobile students, and the instructional time lost due to mobility. In the model below, we reflect the change of school quality from the origin school and the destination school asΔSQ_{it-1}. As described in the measures section, we will test two measures of assimilation, reflected as A_{it}as the destination school's value-added for only mobile students or the difference in the school's value-added between stable students and mobile students. Finally, we include a measure of instructional time lost between enrollment spells due to the move,D_{it}. The mediation model depicting Model 2 is displayed below for each of our three mediators.

$$\Delta SQ_{it-1} = \beta_0 + X_i\beta_1 + W_{st}\beta_2 + \mu_{igt}\delta + \gamma_i + g_{gt} + u_{igt} \quad (6)$$

$$A_{it-1} = \beta_0 + X_i\beta_1 + W_{st}\beta_2 + \mu_{igt}\delta + \gamma_i + g_{gt} + u_{igt} \quad (7)$$

$$D_{it} = \beta_0 + X_i\beta_1 + W_{st}\beta_2 + \mu_{igt}\delta + \gamma_i + g_{gt} + u_{igt} \quad (8)$$

Finally, we add the mediators to the right-hand side of our primary model, which allows us to test the final two conditions for establishing mediation (Baron & Kenny, 1986; Preacher, 2015). First, we establish whether each mediator has a significant effect on student achievement, our primary outcome, while controlling for student mobility. These models, described in equations 6, 7, and 8, for each of the three mediators, represent the a path in our mediation model. Second, if that relationship is found, we then determine whether the magnitude of the coefficient on mobility (as estimated in research question 3 through equation 6 and via path$c$) decreases, which would confirm mediation (Baron & Kenny, 1986; Preacher, 2015). The model below describes the student fixed effects model that will allow for the residual effect of student mobility (as shown by c' above in model 3 and δ in the equation below) and the relationship between the mediators and student achievement as depicted by path b in our mediation framework.

The final model follows the same structure as the model to estimate the gross effect of student mobility from research question three, which was used to estimate the gross effect of mobility on student achievement. Thus, we estimate the following student fixed effects model:

$$Y_{igt} = \beta_0 + X_i\beta_1 + W_{st}\beta_2 + \mu_{igt}\delta' + \gamma_i + (\Delta SQ_{it-1}\beta_3, A_{it}\beta_3, D_{it}\beta_5) + g_{gt} + u_{igt} \qquad (9)$$

Where Y_{igt} is the student achievement in year *t* for student *i* in grade g. $X_i\beta$ represents time-varying student-specific characteristics and W_{st} the school time-varying characteristics. The mobility indicator,$\mu_{igt}\delta$, accounts for each nonstructural school move taken separately and coded as a binary variable with each year. The student fixed effect component (γ_i) accounts for time invariant factors of the student. Grade-year fixed effects (g_{gt}) that account for any grade-year specific factors influencing both the propensity to move and student achievement and as well as an error term (u_{igt}).

The significant changes are how this model addresses the mediators which seek to explain gross effect of mobility from the previous set of questions. We include each predicted value for each separate mediator ($\Delta SQ_{it-1}\beta_3, A_{it}\beta_3, D_{it}\beta_5$) from the b path of the Model 3 in Figure 1 above. In this model, ΔSQ_{it-1} represents the predicted change in overall school value-added between the origin and destination schools for each move. By including this measure of the differences, we can assess the extent to which differences in school quality explain the effect of mobility, which could inform whether the changes in achievement are due to the move or that the student moved to a higher achieving school.

The assimilation mediator, which is operationalized as the predicted difference between the destination school's value-added between mobile and non-mobile students in the academic year prior to the move, is represented by A_{it-1}. This factor will vary across students to understand how assimilation informs the estimates of student mobility. By failing to account for assimilation, mobile students whose schools have historically struggled with assimilating mobile students would see a negative bias in the estimates of mobility's impact on future achievement. Furthermore, schools with a strong track record of supporting mobile students would result in a more positive estimate of student mobility's relationship with later achievement.

The third key mediator, predicted disruption, denoted by D_{it}, attempts to understand how the students' missed instructional time during the move influences student achievement. If a mobile student misses a lot of instructional time as she transitions to her destination school and we fail to account for this in the model, we would potentially attribute to mobility the effect of missed instructional time. In the equation, path *b* from our mediation model is represented by β_3, depending on the specific model, as the predicted change in achievement due to the difference in the school value-added between origin and destination schools, as the predicted difference in school value-added between mobile and non-mobile students in the destination school in the year prior to the move, or as the estimate for the instructional time lost that accompanies the change in schools.

To complete the steps associated with establishing mediation, we will test whether the mediators reflect a partial mediation or a complete mediation of the effect of student mobility on student achievement. If the coefficient on student mobility, δ', δ or path c in Model 1, is reduced to a null estimate upon accounting for our mediators, we will establish complete mediation. Complete mediation would confirm the theoretical model set forth by Hanushek, Kain, and Rivkin (2004), that the primary avenues through which student mobility impacts student achievement are school quality, disruption, and assimilation. If, however, the estimate on student mobility decreases upon inclusion of our mediators, but remains significant, we can assume that after accounting for these primary avenues, a residual effect of mobility on student achievement persists.

As we explore when analyzing the gross effect of mobility, students who engage in different types of moves may experience a heterogeneous effect and level of mediation may differ for structural and nonstructural moves. For the final set of models, we replace our binary mobility variable with the type of nonstructural mobility that the student experiences. We then undergo the same three steps for establishing mediation (establish the relationship between mobility and achievement, between the type of mobility and the mediators, and finally the avenues through which school quality, disruption and assimilation mediate student achievement growth) in separate models for each type of nonstructural mobility. To test whether the estimates meet the criteria, we repeat the process for each type of nonstructural mobility. In all, the models include two types of mobility and three mediators, resulting in six different tests for model 2 of the mediation model for each mobility type (nonstructural between year and nonstructural within year) with each mediator (change in school quality, assimilation, and disruption).

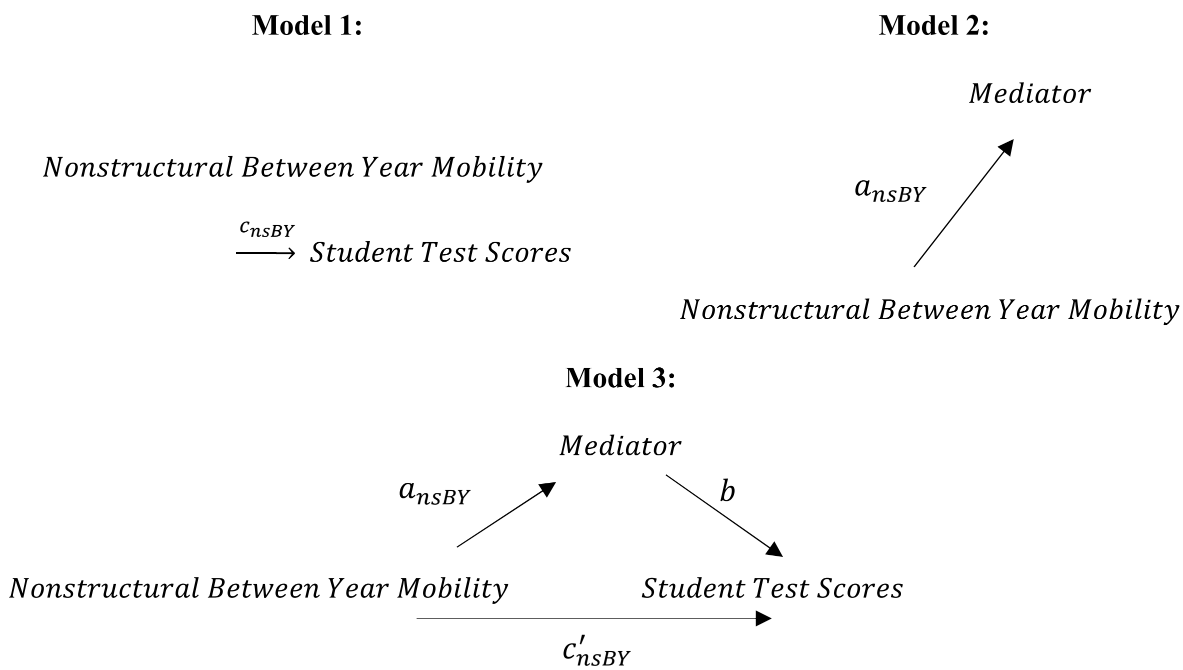


Figure 3. Mediational Framework for Nonstructural Mobility

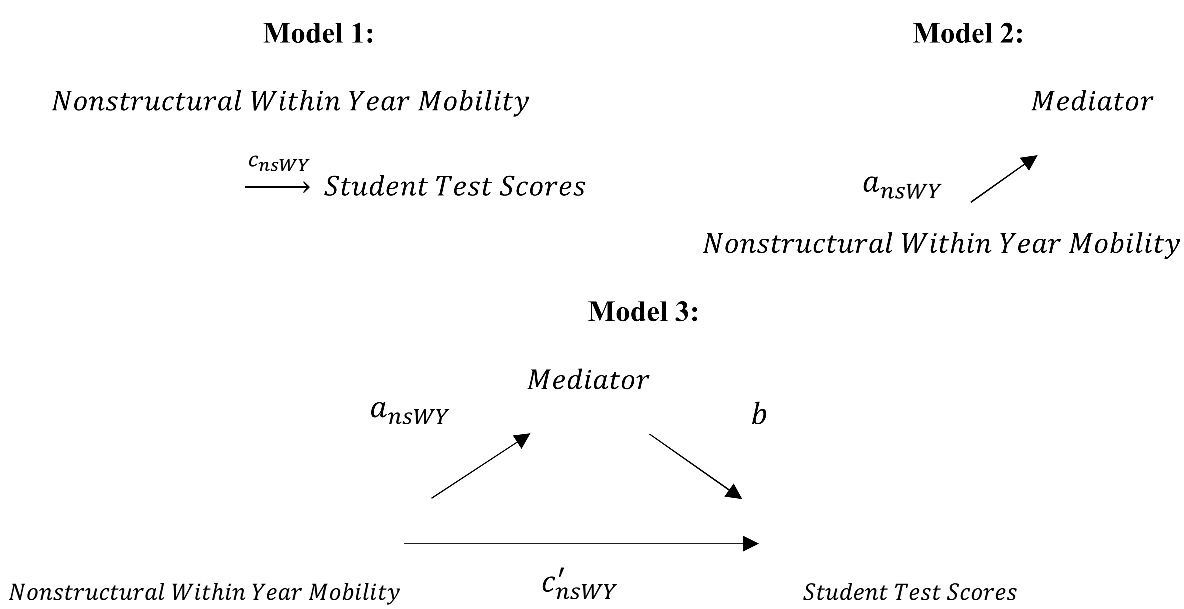


Figure 4. Mediational Framework for Nonstructural Within-Year Mobility

The final student fixed effects model for determining mediation includes nonstructural between year ($\mu NSBY_{igt}$), and nonstructural within year mobility ($\mu NSWY_{igt}$) as well as the three primary avenues through which we aim to test mediation: changes in school quality (ΔSQ_{it-1}), assimilation (A_{it-1}), and disruption (D_{it}).

$$Y_{igst} = \beta_0 + X_i\beta_1 + W_2\beta_2 + \mu NSBY_{igt}\delta'_1 + \mu NSWY_{igt}\delta'_2 + \mu MULT_{igt}\delta'_3 + \gamma_i + (\Delta SQ_{it-1}\beta_3, A_{it-1}\beta_3, D_{it}\beta_3) + g_{gt} + u_{igt} \quad (10)$$

Taken together, these mediators seek to explain the gross effect of mobility to improve our credibly causal estimate for each type of student mobility on academic achievement. Furthermore, it enables us to estimate a separate residual effect for each type of mobility and determine whether the inclusion of these mediators explains the deviation in student achievement in the year of the move for each of our primary mobility variables. For example, if δ'_1 is reduced to a null effect, we could credibly determine that the mediators fully mediate the effect of nonstructural mobility. However, full mediation of one type of mobility effect does not preclude the possibility of partial mediation of a different mobility effect. By estimating the models separately, we can address whether there the mediation effect varies across types of nonstructural student mobility. For example, it might be possible that school quality differences between the origin and destination school may suppress the between year mobility effect, but the instructional time lost between enrollment spells may mediate the effect of within year mobility. Inclusion of these mediators can improve our theoretical understanding of how student achievement is affected by changing schools, but also provides potential avenues through which policy makers and practitioners can target more appropriate supports to improve educational outcomes for mobile students.

Potential Study Contributions

The previous section aimed to describe the methods used to identify the observable factors associated with student mobility decisions, estimate a credibly causal gross effect of changing schools as well as the heterogeneous effects by type of move, and finally, the residual effect of mobility that accounts for the key mediators that previous research has omitted. These findings arrive in light of previous education policy research seeking to understand how student mobility relates to student achievement, which have focused on the gross effect of mobility on student achievement. Yet, we argue that studying this question with improved data quality and a new context may contribute to the literature as well as identify new, practical implications for policymakers and practitioners by estimating the residual effect of mobility on student achievement.

The primary contribution of this research is the use of the mediation model to separate the gross effect of student mobility and the three primary mechanisms through which the effect may be mediated. The bulk of previous research has focused on the gross mobility effect, while recent studies have used student growth information as a proxy for school quality. Nonetheless, those studies did not implement a formal mediation model to understand whether school quality fully or partially mediates student mobility. To our knowledge, no study has sought to operationalize the disruption and assimilation measures that complete the theoretical model of student mobility's relationship with student achievement. Previous analyses' mobility effect represents a gross effect of the changes in school quality, how the student assimilates to her destination school, and the disruption associated with the move. This gross effect provides some guidance, but as Hanushek, Kain, and Rivkin (2004) note, "[a]bsent information about the separate components, both the interpretation and the relevance for policy purposes of direct estimation of [mobility] will be quite limited" (pp. 1728). This study will address that gap in the research and test whether the theoretical model of mobility posited by Hanushek, Kain, and Rivkin (2004) that assumes a full mediation of mobility bears out in practice. To date, research on student mobility has not answered whether the effect of mobility is mediated through the avenues through which achievement is affected by mobility.

By operationalizing these avenues, we hope to disentangle the gross mobility effect into each component and isolate the effect of each type of mobility. This second contribution of this study results comes from the process of disaggregating and testing whether different types of mobility result in heterogeneous effects on student achievement. While previous analyses have tested whether nonstructural within year and nonstructural between year effects differ, by incorporating and testing mediation within this framework, we can test whether we observe differences in the causal relationship of each type, test whether they are equivalent, and whether the mediation effects differ across types of mobility. This knowledge will inform how policy makers and practitioners can better support mobile students as well as the teachers and administrators who serve them. If the large driver of achievement is the disruption associated with the move due to lost instructional time, policies and programs that focus on onboarding and attendance practices might yield significant benefits. If the effect of mobility continues to drive significant changes in student achievement after the effects are mediated by the three key constructs, then policies aiming to curb mobility or adopt short-term transportation policies for students who change schools during the academic year to reduce the burden on families who are transferring within the same district.

From a data access and availability framework, a contribution of this research is the use of enrollment data that tracks student daily enrollment. Much of the previous research was not able to track when students were changing schools, just simply that the student enrolled in multiple schools within a given window of time (Hanushek, Kain, and Rivkin 2004; Hannaway, Xu, and D'Souza 2011). By using entry and exit dates for tracking student enrollment, we can observe when and where students change schools and how much instructional time is lost during this move. Apart from the heterogeneity associated with the type of move, we are also able to observe how the effects of mobility differ for different groups of students by modeling how students of different racial and ethnic backgrounds, low-income, special education, and different levels of achievement respond to changing schools.

Furthermore, this level of detail allows us to understand the context of the mobile student's experience: academic performance and demographic characteristics of peers, the scope of the attendance and disciplinary incidents, trends in mobility in both urban and rural contexts, and a value-added system that allows us to measure schools' average contributions to the student's academic growth. By exploring how these contexts vary across different types of mobility for different groups of students, we improve upon the conceptual understanding of who moves under what circumstances. Data at this level of detail have often been used to study other aspects of the student's educational experience (e.g., the impact of effective teaching), but have not yet been applied to how we understand the heterogeneous impacts of student mobility.

Finally, the timing and location of this study also provide a unique contribution to the literature. Much of the previous research took place before the significant policy changes stemming from the Race to the Top awards that were allocated to states in 2011. This timing is important because it changed the relationship between the state and local education agencies with the lowest performing schools, who have historically served a highly mobile population. Tennessee implemented a new statewide program for improving the lowest achieving schools, creating a new statewide district for some of those schools, the Achievement School District, and using federal School Improvement Grant funds for innovation zones within districts that have been studied elsewhere (Henry, Zimmer, and Kho 2017). Research from other states does not find evidence that the identification of lowest performing schools and establishing turnaround procedures for those schools increases mobility (Dougherty and Weiner 2017). The policy landscape around charter schools also shifted. Previously, charters were only able to serve low-income students and were capped at a certain number; the cap was lifted enrollment opened to all in 2010, leading to more schools serving more students in urban areas. Relevant prior research has explored the extent to which charter schools "push out" lower achieving students or what happens to student achievement when their school is closed for low performance, where the evidence is mixed and often depends on the quality of the destination school (de la Torre & Gwynne 2009b Engberg et al., 2012; Zimmer and Guarino 2013; Brummet 2014). Student mobility practices and policies intersect with policies around school choice and school accountability in ways that can be informed by this research. By furthering our understanding of the conditions under which students are changing schools and incorporating the results of our mediation analyses into the current policy context, we hope to inform practice to address the challenges introduced by student mobility.

CHAPTER 4: RESULTS

This section outlines the key findings for the primary research questions.

Research Question 1: Descriptive analysis of student mobility.

To what extent do nonstructural (between- and within-year) and structural moves occur? What are the rates of mobility for different groups of students and across school contexts?

The first research question provides a descriptive overview of the scale and variability of student mobility in Tennessee. The analyses focus on the types of moves, the characteristics of movers, and how those characteristics vary across location, time, and context.

Mobility remains remarkably consistent across all years in our sample, as shown in Table 4, with approximately 37%-38% of students changing schools at least once between 2009-2010 and 2014-2015. Mobility for 2008-2009 was not included because, as it was the first year of the study, we could not identify nonstructural between-year (NSB) moves. Half of mobile students change schools structurally, with 22% of students beginning in the earliest grade at their destination school. In addition, between 10% and 11% of students change schools over the summer in NSB moves. Approximately 9% of students change schools during the school year and would be classified as NSW movers. NSW moves are not exclusive, as a student could have also changed schools between school years; about 3% of students engage in multiple moves: a between-year and at least one within-year move or multiple within-year moves and are labeled as Multiple.

Table 4. Mobility by Academic Year

School Year	Number of Students	Structural Between Year	Nonstructural Between-Year	Nonstructural Within-Year	Multiple	Overall Mobility Rate
2009-10	978,942	22%	11%	8%	3%	38%
2010-11	985,044	22%	11%	8%	3%	38%
2011-12	987,101	22%	10%	9%	3%	37%
2012-13	991,683	22%	10%	8%	3%	37%
2013-14	994,009	22%	10%	8%	3%	37%
2014-15	993,667	20%	11%	8%	3%	37%

Exploring mobility across grade levels in Table 5, we observe a higher rate of nonstructural mobility in earlier grades than in later grades. The bulk of structural moves occur in kindergarten, fifth grade, sixth grade, and ninth grade. Whereas 91% of kindergartners move structurally (9% attended pre-K or repeated kindergarten in the same school), only 56% of sixth graders and 76% of ninth graders change schools structurally (due to stayers in schools with nonstandard grade structures, e.g., seventh to 12th grade). For NSB moves, approximately 15% of first to fourth graders, 10% to 13% of fifth to 10th graders, and less than 10% of 11th and 12th graders change schools nonstructurally between years. Similarly to NSB moves, the rate of NSW moves also declines steadily as students enter higher grades. In first and second grade, 10% of students change schools within the year, relative to just 8% of students in Grades 3 through 10 and 6% of 11th and 12th graders.

Table 5. Mobility Rates by Grade Level

Grade Level	Number of Students	Structural Between Year	Nonstructural Between Year	Nonstructural Within Year	Multiple Moves	Overall Mobility Rate
K	77629	91%	0%	11%	6%	96%
1	80951	1%	16%	10%	2%	24%
2	80924	1%	15%	9%	2%	23%
3	79228	4%	15%	8%	2%	25%
4	77136	2%	14%	8%	2%	22%
5	75674	16%	11%	8%	2%	33%
6	75284	56%	11%	7%	4%	71%
7	75819	5%	13%	8%	2%	23%
8	75657	1%	12%	7%	2%	18%
9	80484	76%	12%	8%	5%	92%
10	76278	2%	10%	7%	2%	17%
11	70831	0%	9%	6%	1%	14%
12	67773	0%	7%	6%	1%	12%

Black students, English learners (EL), economically disadvantaged (ED) students, and students with previous challenges in school—chronic absenteeism or discipline problems—experience higher nonstructural mobility rates than peers who do not share those characteristics. Comparing racial and ethnic groups, Table 6 shows that Black students are 8 percentage points more likely to pursue an NSB move than their White peers (18% versus 10%) and 5 percentage points more likely to engage in an NSW move (12% to 7%). Relative to non-economically disadvantaged peers, economically disadvantaged students are twice as likely to engage in an NSW move (11% to 5%). English learners are 50% more likely to engage in an NSW move relative to their non-EL peers: 12% of EL students are NSW movers, compared to 8% of non-EL students. Furthermore, students who have shown previous signs of disengagement from school (previously suspended or chronically absent) are 8 percentage points more likely to engage in a NSB move and 12 to 13 percentage points more likely to engage in a NSW move, relative to students who have not been suspended or were not chronically absent. Finally, students who were not on grade level in the previous year are 4 percentage points more likely to have NSB moves and nearly 5 percentage points (150 percent) more likely to have NSW moves than their peers who tested on grade level. Given previous research on negative impacts on nonstructural within-year mobility, this concentration among students who are farther behind potentially exacerbates the challenge of bringing those students up to grade level proficiency.

Table 6. Mobility Rates by Student Observable Characteristics

Student Group	Number of Students	Structural Between-Year	Nonstructural Between-Year	Nonstructural Within-Year	Multiple Moves	Overall Mobility Rate
White	686568	19%	10%	7%	2%	34%
Black	243651	20%	18%	12%	5%	45%
Hispanic	73233	20%	13%	11%	2%	41%
Asian	24465	20%	11%	9%	2%	39%
English Learners	48176	21%	13%	12%	2%	43%
Non-English Learners	945491	20%	11%	8%	3%	36%
Students With Disability	138595	19%	12%	10%	4%	38%
Students w/o Disability	853446	20%	11%	8%	2%	36%
Economically Disadvantaged	558422	20%	13%	11%	4%	40%
Non-Economically Disadvantaged	433619	19%	9%	5%	1%	32%
Chronically Absent in Previous Year	97966	13%	18%	17%	7%	42%
Non-Chronically Absent in Previous Year	776360	14%	9%	5%	2%	26%
Suspended in Previous Year	64636	14%	17%	19%	7%	43%
Not Suspended in Previous Year	857449	13%	9%	6%	2%	26%
Below Basic/Basic Math Previous Year	155396	26%	12%	8%	4%	43%
Proficient/Advanced in Math Previous Year	159587	27%	8%	3%	1%	36%

The next set of analyses transitions from annual snapshots of mobility to following a cohort of students over 5 years. The cohort analysis exacerbates concern about the differential frequency of student mobility of Black and poor students relative to their peers. Table 7 displays cumulative mobility rates across multiple observable characteristics for two separate cohorts: a cohort of kindergarteners and a cohort of fourth graders who entered that grade in the 2007-2008, 2008-2009, or 2009-2010 school year. Forty-four percent of the kindergarten cohort changed schools nonstructurally at least once over 5 years, or before they completed fourth grade. Sixty-three percent of Black kindergarteners changed schools in their first 5 years of school relative to 39% of White students. Black students in the kindergarten cohort were 5 percentage points more likely to move just once than their White peers, and 12 percentage points more likely to change schools three or more times; among Black students, 27% engaged in a single nonstructural move and 16% engaged in two nonstructural moves, whereas for White students, those figures were 22% and 9%, respectively. Just 8% of White kindergarteners changed schools three or more times, whereas 20% of Black kindergarteners enrolled in at least three different schools before the end of fourth grade. Finally, 46% of students with a diagnosed disability in kindergarten and 55% of economically disadvantaged students in kindergarten changed schools at least once during their first 5 years. The frequency of school transfers in the early grades and the disproportionality across racial, ethnic, and socioeconomic status groups highlights the challenge of educating traditionally underserved students as they develop foundational academic skills in elementary school.

While the kindergarten cohort changes schools nonstructurally more than the overall cohort of fourth graders, we continue to observe differences in move frequency by race for that fourth-grade cohort. Relative to their White peers, Black students moved more frequently: They are 7 percentage points more likely to change schools nonstructurally once, 7 percentage points more likely to engage in two nonstructural moves, and 10 percentage points more likely to engage in three or more moves within 5 academic years. Economically disadvantaged students are 3 percentage points greater across each type of move than the overall group.

Table 7. Nonstructural Mobility Among Kindergarten and Fourth-Grade Cohorts Across 5 Academic Years (2008-2010 Cohorts)

School Year	Student group in initial cohort	Number of Students	Percent with 1 move	Percent with 2 moves	Percent with 3+ moves	Percent with ANY move
Kindergarten cohorts 2008-10	Overall	229,149	23%	11%	11%	45%
	White	153,554	22%	9%	8%	39%
	Black	52,530	27%	16%	20%	63%
	Hispanic	17,339	28%	12%	9%	49%
	English Learners	17,217	29%	12%	7%	38%
	Students With Disabilities	25,894	23%	11%	12%	46%
	Economically Disadvantaged	125,382	25%	14%	16%	55%
Fourth grade cohort 2008-10	Overall	231,890	22%	9%	9%	40%
	White	157,500	20%	8%	6%	34%
	Black	54,151	27%	15%	16%	58%
	Hispanic	14,841	27%	11%	7%	45%
	English Learners	12,679	28%	11%	7%	46%
	Students With Disabilities	31,822	24%	13%	13%	50%
	Economically Disadvantaged	124,850	25%	12%	12%	49%

To this point, we have explored the extent to which mobility varies by the characteristics of the mobile student, but concentrations of student groups also point to higher likelihood of mobility in schools that serve more disadvantaged students. Table 8 displays mobility patterns in the 2014-2015 school year[1] for the bottom quartile, middle 50%, and top quartile of the school-level concentration of various student groups including Black students, Hispanic students, White students, and economically disadvantaged students, as well as percent of students scoring on grade level on both the math and ELA tests (in 2013-2014). For students in schools with the lowest quartile of Black concentration, seven percent of students are NSB and seven percent NSW. Yet in the quartile of schools with the highest quartile of Black students, 13% move NSB

[1] Data are similar across other school years, and these results are available upon request of the author.

and NSW, a 5 percentage point difference for each type of move. Similar patterns emerge when we compare the proportion of low-income students and the proportion of students who scored on grade level in the previous academic year. These results suggest that high-minority, high-economic disadvantage, and low-achieving schools see significantly more student churn than low-minority, more affluent, and high-achieving schools. This pattern suggests a need to understand not only the demographic characteristics of the student, but the context in which the student is educated.

Table 8. Mobility Patterns by School Characteristics

Student Group	Quartile	Number of Students	Structural Between-Year	Nonstructural Between-Year	Nonstructural Within-Year	Overall Mobility Rate
Black	Bottom	263276	19%	7%	7%	32%
	Middle	526208	21%	8%	8%	37%
	Top	262495	20%	13%	13%	46%
Hispanic	Bottom	263353	19%	8%	8%	35%
	Middle	525921	21%	9%	8%	37%
	Top	262705	21%	11%	11%	43%
White	Bottom	263501	20%	13%	13%	46%
	Middle	525921	21%	8%	8%	37%
	Top	262557	19%	6%	7%	32%
Economically Disadvantaged	Bottom	263528	21%	8%	5%	35%
	Middle	525698	21%	7%	8%	36%
	Top	262753	19%	13%	14%	45%
Math Achievement	Bottom	257945	20%	12%	13%	45%
	Middle	512699	20%	8%	8%	36%
	Top	256680	20%	8%	6%	34%
Reading Achievement	Bottom	257017	20%	12%	14%	45%
	Middle	514067	20%	8%	8%	35%
	Top	256240	21%	8%	5%	34%

For the final descriptive table in this section, Table 9 highlights that the achievement levels at schools vary more between demographic groups than between origin and destination schools. To compare origin and destination schools, we compare the average proficiency rates in mathematics from 2013-2014 of both origin and destination schools for students who were mobile in 2014-2015. On average, NSB and NSW movers within each racial/ethnic group transferred to destination schools with higher proficiency rates than the origin school. However, the 14.3 percentage point difference between destination schools of White students, where 53.4% of students scored proficient, and of Black students, where 39.1% of students were proficient, suggests that, on average, White students went to school with higher-performing peers than Black students at both their origin and destination schools. Similar gaps between economically disadvantaged and non-economically disadvantaged students are evident. For economically disadvantaged and non-economically disadvantaged NSB movers, the difference in destination and origin schools' average proficiency rates were similar. Non-economically disadvantaged NSW students transferred to destination schools with 2.5 percentage point higher proficiency rates than their origin schools, but a percentage point difference of only 0.5 was observed for economically disadvantaged students. However, non-economically disadvantaged students attended destination schools with 10.4 percentage point lower proficiency rates for NSB movers and 8.6 percentage point difference for NSW movers. The proficiency rates in schools in which Black and economically disadvantaged students enrolled were lower than those of their non-Black and nondisadvantaged peers.

While the proficiency levels may reflect the characteristics of the school and the students therein, value-added differences do not reflect the same type of sorting along observable characteristics between students or mobility type. Value-added measures aim to isolate the direct effect of the school on student learning. Thus, across the same student groups, we explore whether the origin and destination schools differ in school-level value added from the academic year prior to the move. Our results, available in the Appendix, show that neither NSW nor NSB students appear to be strategically moving to higher value-added destination schools.

Table 9. Comparison of Origin and Destination Schools on Proficiency Levels in Math From Previous Academic Year

	Structural Between-Year			Nonstructural Between-Year			Nonstructural Within-Year		
	Average Proficiency Origin	Average Proficiency Destination	Average Difference	Average Proficiency Origin	Average Proficiency Destination	Average Difference	Average Proficiency Origin	Average Proficiency Destination	Average Difference
Non-Economically Disadvantaged	56.9%	57.5%	0.60%	55.6%	55.4%	–0.20%	50.2%	52.7	2.50%
Economically Disadvantaged	45.4%	45.3%	–0.10%	43.8%	44%	0.20%	43.6%	44.1	0.50%
White	55%	54.7%	–0.30%	53.7%	53.4%	-0.30%	50%	50.8%	0.80%
Hispanic	45.6%	44.8%	–0.80%	44.4%	45.4%	1.00%	43.3%	44.4%	1.10%
Asian	58.8%	59.4%	0.60%	57.4%	58.9%	1.50%	53.5%	56.2%	2.70%
Black	40.3%	40.1%	–0.20%	38.2%	39.1%	0.90%	36.5%	37.4%	0.90%
English Learner	42.9%	44.4%	1.50%	43.1%	44.7%	1.60%	42.3%	44.1%	1.80%
Not-English Learner	51.2%	51.1%	–0.10%	47.6%	48.2%	0.60%	44.8%	46.1%	1.30%
Students with Disabilities	49.1%	49%	–0.10%	46.6%	46.4%	–0.20%	44.8%	45.6%	0.80%
Students Without Disabilities	51.3%	51.2%	–0.10%	47.6%	48.3%	0.70%	44.7%	46.1%	1.40%
Below Basic /Basic Math Previous Year	47.1%	44.5%	–2.60%	43.9%	43.9%	0.00%	42.6%	42.8%	0.20%
Proficient/Advanced in Math Previous Year	57.7%	54.6%	–3.10%	53.6%	54.5%	0.90%	49.3%	51.6%	2.30%

Overall, this section explored the extent to which mobility occurs and whether certain groups of students and schools experience mobility at different rates. First, nonstructural mobility does not appear to vary across time, but students in earlier grades are more likely to engage in NSB and NSW moves than those in older grades. Furthermore, Black and economically disadvantaged students, across most measures, are more likely to change schools nonstructurally. The findings for Research Question 1 prompt us to consider the increased likelihood of mobility and its potential relationship with other forms of disengagement (chronic absenteeism, suspensions) for economically disadvantaged and Black students. Finally, these descriptive results highlight the different school experiences, both in terms of the amount of student churn and the proficiency levels of peers, of Black and economically disadvantaged students, highlighting the need to differentiate school-level factors and individual-level characteristics to analyze the likelihood of nonstructural mobility. Research Question 2, discussed in the next section, aims to disentangle and robustly estimate the relative predictive power of these observable characteristics on the likelihood that a student is mobile.

Research Question 2: Predictors of Student Mobility

To what extent do observed student and school characteristics predict student mobility? To what extent do observable student and school characteristics differ between NSB, NSW, and structural movers?

Before estimating the simultaneous relationship between observed student and school characteristics with mobility, Table 10 shows the conditional means for each type of mobility. The table attempts to provide a more definitive answer regarding how the descriptive patterns of mobility across different observable student and school characteristics intersect and inform our understanding of which students change schools nonstructurally under what circumstances. Black students make up a higher percentage of NSB and NSW students (40% and 41%, respectively) than they do structural movers (24%) or stayers (21%). Furthermore, 83% of NSW movers and 69% of NSB movers are economically disadvantaged. A larger percentage of NSW movers have disabilities, were chronically absent, were previously mobile, or were suspended compared to students with other types of mobility, a finding which supports our concerns that there is compounding disadvantage that predicts nonstructural mobility.

Aside from the individual student characteristics, the conditional means highlight the fact that the average schools for NSW and NSB students look different than for stayers and structural movers. Furthermore, in a few important ways, the demographics of NSW and NSB students also differ. NSW students attended schools that are 67% economically disadvantaged and 39% Black, while stayers attended schools that are 53% economically disadvantaged and 22% Black. The gaps for NSB movers are in the same direction, but not as large. When the data are laid out in this way, the pattern of disadvantage emerges: Stayers consisted of, on average, a lower percentage of economically disadvantaged students and a higher percentage of White students and had fewer disciplinary incidents, while NSB movers, on average, had more disadvantages, and NSW movers appeared to have the most challenging school contexts. The average nonstructural school mobility rate for schools that NSW students attend is 22%, and the school nonstructural mobility rate for NSB students is 23%, whereas stayers and structural movers hover between 17%-18% of their peers changing schools nonstructurally, suggesting a slight concentration of student churn in certain schools. Finally, the plurality of NSB students and NSW students attend urban schools (45%), while NSB movers were more likely to attend rural schools than suburban schools (30% to 24%). These distributions suggest that while nonstructural student mobility is more prominent in urban areas, suburban and rural areas also experience student churn.

Finally, the table highlights the indicators that will be used as mediators in Question 4 to understand whether mobility operates through these factors to affect student achievement. The first indicator, school quality, is defined as the difference between the value added in the destination school relative to the origin school in the previous academic year. The table displays that of the four groups of students, NSB movers move to schools with a 0.54 SDU improvement from their origin school, while NSW movers transfer to schools that are more similar, with a difference of 0.08 SDU difference. Structural movers' destination schools report quality of 0.34 SDUs higher on average, while stayers' school quality difference is zero, as the student did not change schools. For the assimilation value, which is the difference in the destination schools' value added for mobile students and for stable students, we see little variation across the stayers, structural movers, or NSB movers, but a 0.03 SDU difference for NSW movers. Finally, 9% of NSB movers started school at least a week after the school year started, while 46% of NSW movers missed a week of school when they transferred within the school year.

Table 10. Conditional Means by Student Mobility Status

	Stayer	Structural Mover	NSM Between-Year	NSM Within-Year
Female	49%	49%	49%	46%
Black	21%	24%	40%	41%
Hispanic	6%	6%	6%	6%
Indian	0%	0%	0%	0%
Asian	2%	2%	1%	1%
White	71%	69%	52%	52%
Economically Disadvantaged	52%	54%	69%	83%
Has Disability	14%	13%	16%	21%
English Learner	3%	3%	4%	4%
Chronically Absent (prev.)	10%	10%	19%	31%
Ever Mobile (prev.)	7%	9%	18%	20%
Out-of-School Suspension (prev.)	6%	7%	12%	23%
In-School Suspension (prev.)	9%	10%	12%	21%
Expelled (prev.)	0%	0%	1%	3%
School ED % (prev.)	53%	55%	64%	67%
School SWD % (prev.)	13%	14%	14%	15%
School Female % (prev.)	49%	49%	49%	49%
School Black % (prev.)	22%	24%	38%	39%
School Hispanic % (prev.)	6%	6%	8%	8%
School Indian % (prev.)	0%	0%	0%	0%
School Asian % (prev.)	2%	2%	2%	2%
Pacific Islander % (prev.)	0%	0%	0%	0%
English Learners% (prev.)	4%	5%	6%	6%
Nonstructural Mobility Rate (prev.)	17%	18%	22%	23%
Urban	25%	28%	45%	45%
Rural	41%	40%	27%	30%
Suburban (%)	34%	32%	28%	24%
School Quality (Destination VA-Origin VA)	0.00	0.34	0.54	0.08
Assimilation (Stable VA-Mobile VA)	–0.03	–0.02	–0.02	0.03
Disruption (Missed Week During Transfer)	0%	0%	9%	46%

To address these factors simultaneously,[2] in Table 10 we present the predicted likelihood of any nonstructural move (NSW and NSB) relative to stayers and structural movers for all students in grades K-12 between 2009-2010 and 2014-2015, accounting for both student and school characteristics with academic-year and grade-level fixed effects. Column 1 displays odds ratios of the likelihood of a nonstructural move relative to staying or structural move for only student-level factors, which include demographics and previous school experiences. The odds ratios for ethnic and racial characteristics are interpreted as the odds that a student changes schools nonstructurally, all other factors equal, relative to White students. With an odds ratio of 1.795, Black students were nearly 80% more likely to change schools nonstructurally than their White peers, controlling for all other variables in the model. A second major predictor at the student level is the student's socioeconomic status. Relative to non-economically disadvantaged peers, economically disadvantaged students are nearly 85% more likely to transfer nonstructurally (OR: 1.849). Having a disability and being an English learner also correlate with higher odds of a nonstructural move than one's non-IEP and non-EL peers. Finally, Column 1 also documents the fact that previous disengagement and school discipline at the student level are highly predictive of nonstructural mobility: A chronically absent student is 135% more likely to move, a previously mobile student 75% more likely, and suspensions and expulsions are highly predictive of a nonstructural move.

[2] Note that these models do not include prior test scores. Models predicting the likelihood of mobility that include prior achievement and thus create a consistent sample with Research Questions 3 and 4 can be found in the appendix.

Table 11. Logistic Regression Odds Ratios for the Likelihood of Any Nonstructural Student Move (Reference Group: Stayers and Structural Movers)

	(1) Any Nonstructural Move	(2) Any Nonstructural Move
Female	1.013***	1.010***
	(0.00274)	(0.00275)
Black	1.795***	1.044***
	(0.00551)	(0.00474)
Hispanic	1.132***	0.835***
	(0.00766)	(0.00599)
Native American	1.408***	1.145***
	(0.0338)	(0.0282)
Asian	1.065***	0.843***
	(0.0125)	(0.0102)
Pac. Islander	1.294***	1.010
	(0.0507)	(0.0404)
Economically Disadvantaged	1.849***	1.725***
	(0.00583)	(0.00585)
Has Disability	1.108***	1.095***
	(0.00405)	(0.00410)
English Learner	1.055***	0.873***
	(0.00842)	(0.00726)
Chronically Absent (Prev. Year)	2.347***	2.208***
	(0.00817)	(0.00782)
Mobile (Prev. Year)	1.752***	1.512***
	(0.00697)	(0.00638)
Out-of-School Suspended (Prev. Year)	1.863***	1.624***
	(0.00882)	(0.00784)
In-School Suspended (Prev. Year)	1.346***	1.364***
	(0.00618)	(0.00630)
Expelled (Prev. Year)	3.363***	2.388***
	(0.0551)	(0.0392)
School ED (Prev. Year)		1.331***
		(0.0124)
School SWD (Prev. Year)		5.263***
		(0.135)
School Female (Prev. Year)		3.172***
		(0.153)
School Black (Prev. Year)		2.116***
		(0.0174)
School Hispanic (Prev. Year)		2.423***
		(0.0883)
School Indian (Prev. Year)		96,515***

		(30,021)
School Asian (Prev. Year)		15.86***
		(1.016)
Pacific Islander (Prev. Year)		291,358***
		(170,159)
English Learner (Prev. Year)		1.200***
		(0.0462)
Nonstructural Mobility Rate (Prev. Year)		3.056***
		(0.0327)
Urban (Prev. Year; Comparison = Suburb)		0.993
		(0.00406)
Rural (Prev. Year; Comparison = Suburb)		0.991**
		(0.00392)
Constant	0.0393***	0.00601***
	(0.000828)	(0.000202)
Observations	5,193,101	5,193,101

Robust standard errors in parentheses

***$p < .01$, **$p < .05$, *$p < .1$

In Column 2, we add origin school-level characteristics to the model, assess the extent to which the coefficients from Column 1 change, and test whether school-level factors relate to nonstructural mobility. Most strikingly, the likelihood that Black students (relative to White students) change schools nonstructurally reduces from nearly 80% increased likelihood of a nonstructural move when no school-level factors are accounted for, to about 4% more likely once those school-level factors are included in the model. Including school-level characteristics confirms the results from the conditional means from Table 8: Black students attend highly segregated schools, and those highly segregated schools see a significant amount of nonstructural student churn. Hispanic and Asian students are now less likely to change schools nonstructurally than White students once school factors are accounted for. Adding school-level factors flips those receiving EL services from nearly 6% more likely (when only student-level factors are considered) to 13% less likely to engage in a nonstructural move. However, incorporating school-level factors does not change the relative odds for economically disadvantaged students,

students with disabilities, or previously disengaged students (chronic absence or exclusionary discipline).

Aside from how the student-level characteristics shift, high odds ratios for the proportion of Black, Hispanic, Native American, and other non-White students suggest that attending a school with a higher proportion of non-White students is correlated with an increased likelihood of student mobility, holding the individual student's race constant. Further, once the demographics of the school are accounted for, attending a school in an urban area (relative to suburban) does not change the likelihood of nonstructural mobility, but attending a school in a rural area does marginally decrease the student's likelihood of nonstructural mobility. Finally, the magnitude of the odds ratio for the proportion of students who were mobile in the previous year (OR: 3.056) suggests that origin schools with a high nonstructural mobility rate see a consistent churn in the next academic year, and that churn is independent of other discrete, observable student, and school characteristics.

The next step in understanding mobility is to explore the extent to which these student and school characteristics vary across the type and timing of the move. To approach this question, we estimate a multinomial logistic regression model for the likelihood of a student pursuing a structural move, a nonstructural between-year move, or a nonstructural within-year move, in reference to staying at the origin school. We include student race/ethnicity, student observable characteristics and school experiences in the previous year (chronic absence, discipline, prior mobility), and origin school aggregates of those measures. We include all students, K-12, who were enrolled for multiple years, and results for only students with test scores are available in the appendix.

Table 12. Multinomial Logistic Regression Results Predicting Structural Move, Nonstructural Between-Year Move, and Nonstructural Within-Year Move (Reference Group: Stayers)

	(1) Structural Move	(2) NSM Between Year	(3) NSM Within Year
Female	0.993*	1.024***	0.989***
	(0.00381)	(0.00359)	(0.00388)
Black	1.116***	1.142***	0.979***
	(0.00737)	(0.00666)	(0.00640)
Hispanic	1.102***	0.903***	0.794***
	(0.0106)	(0.00834)	(0.00829)
Native American	1.011	1.079**	1.223***
	(0.0373)	(0.0357)	(0.0411)
Asian	1.060***	0.883***	0.801***
	(0.0155)	(0.0130)	(0.0156)
Pac. Islander	0.995	1.026	0.994
	(0.0506)	(0.0521)	(0.0590)
Economically Disadvantaged	0.933***	1.306***	2.520***
	(0.00415)	(0.00562)	(0.0135)
Has Disability	0.938***	1.023***	1.158***
	(0.00526)	(0.00508)	(0.00594)
English Learner	0.620***	0.830***	0.779***
	(0.00747)	(0.00880)	(0.00950)
Chronically Absent (Prev. Year)	1.045***	1.822***	2.678***
	(0.00677)	(0.00882)	(0.0126)
Mobile (Prev. Year)	2.108***	1.667***	1.778***
	(0.0125)	(0.00910)	(0.0106)
Out-of-School Suspended (Prev. Year)	0.976***	1.346***	1.904***
	(0.00820)	(0.00906)	(0.0122)
In-School Suspended (Prev. Year)	0.684***	1.090***	1.440***
	(0.00505)	(0.00710)	(0.00894)
Expelled (Prev. Year)	1.311***	2.078***	2.942***
	(0.0477)	(0.0483)	(0.0618)
School ED (Prev. Year)	0.969**	1.148***	1.642***
	(0.0125)	(0.0138)	(0.0223)
School SWD (Prev. Year)	23.18***	4.846***	15.70***
	(1.046)	(0.167)	(0.543)
School Female (Prev. Year)	0.109***	1.222***	4.207***
	(0.00789)	(0.0769)	(0.286)
School Black (Prev. Year)	1.532***	2.545***	1.958***
	(0.0187)	(0.0270)	(0.0232)
School Hispanic (Prev. Year)	0.0104***	1.132***	1.169***
	(0.000514)	(0.0536)	(0.0603)

School Indian (Prev. Year)	4.021e+07***	35,794***	1.334e+08***
	(1.836e+07)	(15,272)	(5.525e+07)
School Asian (Prev. Year)	0.286***	11.24***	8.951***
	(0.0241)	(0.897)	(0.872)
School Pacific Islander (Prev. Year)	1.924e+15***	2,612***	8.889e+13***
	(1.407e+15)	(1,998)	(7.237e+13)
School English Learners (Prev. Year)	2,981***	3.344***	5.283***
	(151.5)	(0.166)	(0.292)
School Nonstructural Mobility Rate (Prev. Year)	0.237***	2.308***	2.568***
	(0.00513)	(0.0324)	(0.0373)
Urban (Comparison: Suburb)	0.946***	0.999	0.957***
	(0.00565)	(0.00516)	(0.00568)
Rural (Comparison: Suburb)	1.063***	0.891***	1.139***
	(0.00551)	(0.00459)	(0.00658)
Constant	0.703***	0.000104***	0.00320***
	(0.0312)	(2.81e-05)	(0.000137)
Observations	5,193,101	5,193,101	5,193,101

Student level characteristics, specifically race and language status, vary in the magnitude and direction with each type of move relative to the reference group, stayers, while economic disadvantage drives nonstructural mobility relative to staying. First, relative to stayers, Black students are 12% more likely to engage in a structural move and 14% more likely to change schools NSB but are marginally less likely to exit within the year, accounting for school-level demographics. The difference between the relationship between being Black and NSW relative to NSB moves is significant according to a Wald test ($chi^2(1) = 311.39; Prob > chi^2 = 0.0000$). Second, English learners (EL) are significantly less likely to be mobile, while we observe a significant, but marginal difference for students with a disability for between-year moves (less likely to engage in a structural move, but more likely to engage in a NSB move) relative to staying in the same school. Students with disabilities (SWD) are also about 16% more likely to engage in a within-year move relative to staying. For EL and SWD students, it is important that the services to address their unique needs, either through EL services or the IEP, follow the student, and transition to a new school may be challenging. And third, in contrast, economically disadvantaged students are 31% more likely to change schools NSB and are 150% more likely to change schools NSW, which is the greatest gap for an observable student demographic characteristic and statistically different from other estimates of mobility relative to staying. A series of Wald tests comparing coefficients between NSW and NSB highlights statistically significant differences between the coefficients of female students ($chi^2(1) = 24.39; Prob > chi^2 = 0.0000$), economically disadvantaged students ($chi^2(1) = 7235.18; Prob > chi^2 = 0.0000$), and those with a disability ($chi^2(1) = 255.69; Prob > chi^2 = 0.0000$), suggesting that each observed characteristic has a different relationship with the type of mobility.

Apart from observable characteristics, a student's previous engagement with school through attendance, discipline, and previous nonstructural mobility highlight a distinct pattern of high likelihood of NSB, but an even larger difference for NSW moves. Students who were nonstructurally mobile in the previous academic year are 67% more likely to change schools nonstructurally between years and 78% more likely to transfer within the next academic year, a small difference between types, but statistically significant ($chi^2(1) = 118.10; Prob > chi^2 = 0.0000$). We also observe a large, positive relationship with being a structural mover, relative to a stayer, if the student was a nonstructural mover in the previous year (OR: 2.108). This suggests that the grade structures are likely not driving significant differences in choices around nonstructural moves—parents are not deterred from changing schools in the highest grade level of one school (e.g., into the fifth grade of an elementary school that ends in fifth grade). It may also result from factors associated with district grade structures and choice—if some schools end in fourth grade, while others end in fifth grade, we might observe that students are entering a destination elementary school as a nonstructural mover, rather than directly into a middle school as a structural mover in a given year. Next, chronically absent students are 82% more likely than non-chronically absent students to engage in an NSB move and 168% more likely to engage in an NSW move, and the difference between those coefficients is statistically significant ($chi^2(1) = 3323.75$; $Prob > chi^2 = 0.0000$). Suspensions and expulsions for students all suggest an increased likelihood of between- and within-year nonstructural mobility. The confluence of these factors appears to be a major driver for student mobility.

Demographically, schools with higher proportions of Black, Hispanic, or Asian students are more likely to be mobile, both within-year and between-year, relative to stayers[3]. The Relative Risk Ratio (RRR) represents the change in the likelihood of a student being mobile (structural, nonstructural between, nonstructural within) relative to a stayer by going from a proportion of 0 students to a proportion of 1 within a certain group in their origin school. Since school-level demographic data tend not to vary to that extreme, the magnitude of the RRR must be interpreted with the caveat that a full shift would be impractical. Nonetheless, the magnitude and direction of the coefficient does indicate the direction and magnitude of the relationship, even with challenges in practical interpretation. For example, post-hoc analyses show that students who attend a school that is 20% economically disadvantaged have a predicted likelihood of staying of .76, whereas students who attend a school that is 80% economically disadvantaged have a predicted likelihood of staying of .68. Figure 4 displays the marginal likelihood of NSB moves and NSW moves with 95% confidence intervals, at different rates of economic disadvantage. In schools at the 10th percentile of economic disadvantage, the marginal likelihood

[3] School-level characteristics are measured as proportions, where a 1-unit change represents a difference from zero students to the entire school, which is implausible; results should be interpreted with that in mind.

of an NSB move is 0.063, and of an NSW move is 0.048, but at the 90th percentile school, the marginal likelihood of NSB mobility is 0.085, and of NSW mobility is 0.074. If students attend a school that is 1 standard deviation below the average proportion of students with disabilities, where 9% of students have a disability, the likelihood of being a NSW mover is 0.05, whereas for one standard deviation above average, where 19% of students have disabilities, the predicted likelihood of a NSW move is 0.07, all other things equal. Like the proportion of students with disabilities, a higher proportion of English learners increases the likelihood of any type of move relative to staying. Finally, the proportion of nonstructural movers in the previous year suggests a large increase in the likelihood of NSW and NSB moves relative to staying, and a decrease in structural moves. In Figure 5, we show that in schools at the 10th percentile of nonstructural mobility rates, the predicted marginal likelihood of NSB is about 0.074, and NSW mobility 0.061, but at the 90th percentile of nonstructural student mobility, the marginal predicted likelihood of NSB moves is 0.08, and of NSW moves is about 0.07, all else equal. The magnitude and direction of those coefficients highlight the churn of students in high-mobile schools, controlling for the other student and school-level factors in our model.

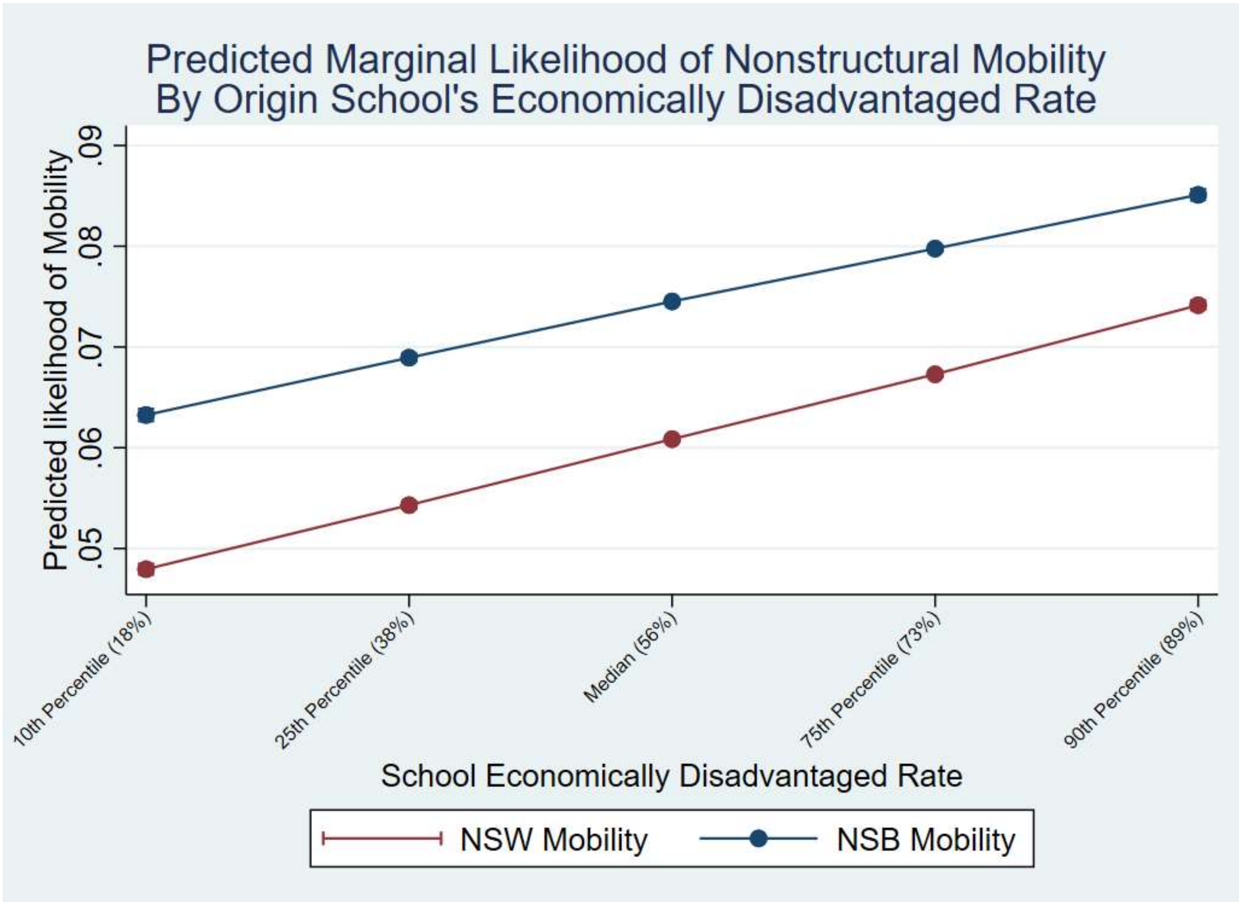


Figure 5. The Predicted Marginal Likelihood of Nonstructural Mobility at Different Levels of the Percent of Economically Disadvantaged Students in Origin School

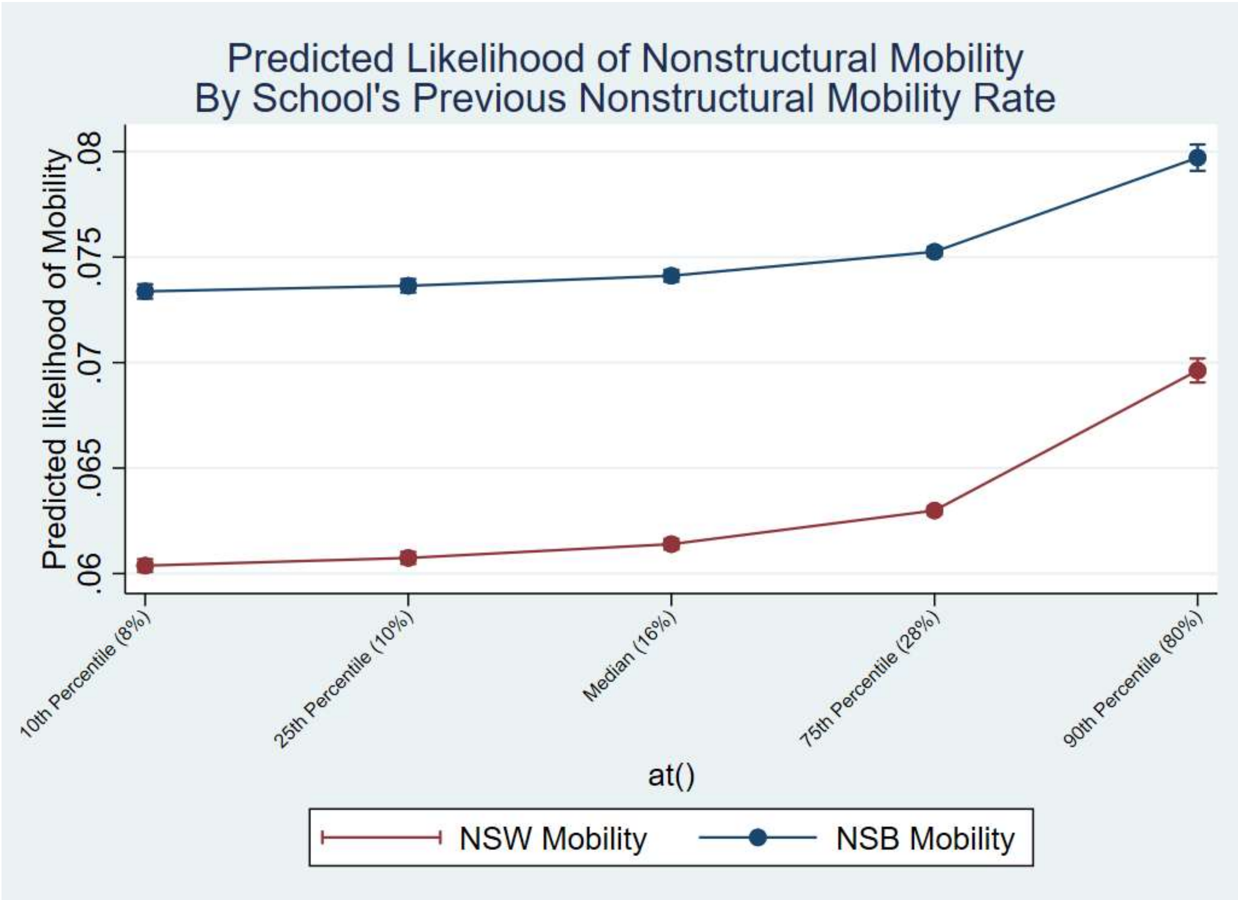


Figure 6. The Predicted Marginal Likelihood of Nonstructural Mobility at Different Levels of Previous Nonstructural Mobility Rates at Origin School

The last set of covariates focus on the school locale of urban, suburban, or rural, while simultaneously accounting for the demographics of that school. Results are interpreted as the change in likelihood of the move relative to a stayer compared to a school in a suburban area. Interestingly, once demographic characteristics are accounted for, a student attending an urban school is about 3% less likely to move NSW in the year than to stay and 5% less likely to be a structural mover than be a stayer, and no difference is observed in the likelihood that the student will change schools NSB, relative to a student in a suburban school. In contrast, attending a rural school, once other demographics are accounted for, increases the likelihood of an NSW move by about 14%, decreases the likelihood of an NSB move by 11%, and has a small, positive increase in likelihood of being a structural mover rather than a stayer, compared to if the student was enrolled in a suburban school.

The previous results exploring whether student and school characteristics predict mobility highlight a few key takeaways. First, we observe a differential relationship between student and school characteristics and the type and timing of move. This difference confirms that mobility should not be treated as a single construct and motivates the disaggregation of mobility into structural, NSB, and NSW. Second, students who were mobile or chronically absent in the previous year have a higher likelihood of nonstructural mobility, leading to concerns around student engagement and connection to school due to repeated churn. Finally, school-level demographic characteristics are related to the increased likelihood of nonstructural mobility and reducing the likelihood of a Back student's engaging in a nonstructural move to null or positive; this difference speaks to the high churn of students in schools that are racially segregated and have a high proportion of Black students. For economically disadvantaged students, however, the effect of the coefficient on nonstructural mobility does not shrink once school-level factors are accounted for, highlighting the more dispersed nature of economic disadvantage, relative to race, in the state. While the next set of questions transition to estimating the impact of these moves on achievement at the student level, the high concentration of disadvantage that correlates to mobility is an important consideration in our discussion.

Research Question 3: Effect of mobility on student achievement

To what extent does student nonstructural mobility affect academic performance outcomes?

The demographic differences described in the previous section can be interpreted in different ways depending on whether the impact of mobility is beneficial, benign, or deleterious to academic performance. For Question 3, we estimate the effect of mobility on student math achievement, beginning with a biased estimate of any nonstructural move and progressing toward a plausibly causal estimate of each type of nonstructural move[4]. We will begin using a pooled OLS model and advance to a student fixed-effect model, which compares student performance in years in which a move of a particular type occurred to years in which a move of that type did not occur, focusing on the within-student variation in academic achievement.

Column 1 of Table 13 displays the Pooled OLS estimates, with the coefficient on mobility representing the average difference in student achievement between nonstructurally mobile students and peers who were structural movers or stayed at the same school, holding individual student and school demographics constant. Comparing any student who engaged in a nonstructural move to a stayer or a structural mover, all else equal, we estimate the pooled OLS model and show that nonstructural movers score about 0.05 standard deviation units (SDUs) lower, and that a student who has multiple nonstructural moves scores an additional 0.073 SDU lower. The magnitude of the coefficient on multiple moves to any move suggests that the additional instability is especially harmful to those students. However, these estimates are likely

[4] The results in this dissertation focus on standardized math test scores (See Chapter 3 for data). However, all the models were also evaluated using reading as the primary outcome. We detect no observable difference between mobile and nonmobile students using Pooled OLS. The estimates for NSB and NSW that include a student fixed effect are in the same direction, but much smaller in magnitude (e.g., –0.089 to –0.007 for NSW for Question 3). The main findings for Question 4 are consistent, but again, differ in magnitude. Results are available in the Appendix. For the purposes of discussion in this section, we will focus exclusively on outcomes related to mathematics.

negatively biased because they compare students who chose to be mobile to either nonmobile students or structural movers. From Table 12, we know that students who engage in nonstructural moves tend to be more disadvantaged and differ in important observable ways from students who do not engage in nonstructural moves. Furthermore, mobile students may also differ from nonmobile students in unobserved ways that are not captured by our data. For example, if a student was forced to change schools due to a traumatic, unobserved event, such as a divorce or eviction, the event could affect both the decision to move nonstructurally (selection into treatment) and poor math achievement (outcome of interest), thus biasing the coefficient negatively.

Nonetheless, other student-level data hint at some carry-over of disengagement from the previous academic year: previous mobility, in- and out-of-school suspensions, and chronic absence in the previous academic year all correlate to lower academic performance, with the likelihood for being chronically absent in the previous year similar to that of any nonstructural move in the current academic year (–0.075 SDU versus –0.073 SDU). Student demographic and intellectual characteristics—being Black, economically disadvantaged, or an English learner, or having a disability—are correlated with lower math scores, even when mobility is accounted for. Furthermore, given the differences between the two types of nonstructural movers described above, we disaggregate nonstructural moves into within-year (NSW) and between-year (NSB) and maintain an indicator for multiple movers.

Using the same Pooled OLS structure in Column 2 of Table 13, we estimate student achievement differences between NSW and NSB movers relative to stayers or structural movers, holding all other covariates constant. NSW students score on average 0.134 SDU lower in math than stayers or structural movers, while NSB students perform no differently, all other things equal; by disaggregating nonstructural mobility, we observe that NSW mobility drives the negative relationship of nonstructural mobility with academic achievement from Column 1. Also, in contrast to Column 1, students with multiple nonstructural moves within the same academic year lose less than 0.01 SDUs. The significant, but imperceptible difference between multiple movers and non-movers contrasts from the 0.07 loss in Column 1 and highlights the problem with failure to disaggregate mobility types for analysis, since we find that the learning differences are greatest between NSW moves and stayers/structural movers, regardless of NSB status. Nonetheless, as in Column 1, these results compare mobile students to nonmobile students, a method that is potentially problematic due to the selection associated with changing schools, which may make mobile and nonmobile students different in unobservable ways, as described above.

Table 13. Effect of Nonstructural Student Mobility on Student Achievement

	(1) OLS	(2) OLS	(3) FE	(4) FE
Any NSM	–0.050***		–0.025***	
	(0.002)		(0.002)	
NSB		0.000		0.011***
		(0.002)		(0.002)
NSW		–0.134***		–0.089***
		(0.003)		(0.003)
Multiple NSM	–0.073***	0.009*	–0.049***	–0.000
	(0.005)	(0.006)	(0.005)	(0.006)
Female	0.016***	0.016***		
	(0.001)	(0.001)		
Black	–0.065***	–0.066***		
	(0.002)	(0.002)		
Hispanic	0.017***	0.017***		
	(0.003)	(0.003)		
Native American	–0.010	–0.010		
	(0.011)	(0.011)		
Asian	0.142***	0.142***		
	(0.004)	(0.004)		
Pac. Islander	0.015	0.014		
	(0.016)	(0.016)		
Economically Disadvantaged	–0.090***	–0.088***	0.002	0.003
	(0.001)	(0.001)	(0.002)	(0.002)
Has Disability	–0.037***	–0.037***	0.100***	0.100***
	(0.002)	(0.002)	(0.005)	(0.005)
English Learner	–0.045***	–0.046***	–0.056***	–0.056***
	(0.004)	(0.004)	(0.006)	(0.006)
Chronically Absent (Prev. Year)	–0.075***	–0.073***	–0.022***	–0.023***
	(0.002)	(0.002)	(0.003)	(0.003)
Mobile (Prev. Year)	–0.010***	–0.009***	0.004**	0.014***
	(0.002)	(0.002)	(0.002)	(0.002)
Out-of-School Suspended (Prev. Year)	–0.053***	–0.051***	–0.016***	–0.016***
	(0.002)	(0.002)	(0.003)	(0.003)
In-School Suspended (Prev. Year)	–0.063***	–0.061***	–0.027***	–0.027***
	(0.002)	(0.002)	(0.003)	(0.003)
Expelled (Prev. Year)	–0.032**	–0.029**	0.021	0.019
	(0.013)	(0.013)	(0.018)	(0.018)
Std. Reading Score	0.162***	0.162***		

(Prev. Year)				
	(0.001)	(0.001)		
Std. Math Score (Prev. Year)	0.591***	0.590***		
	(0.001)	(0.001)		
Constant	0.079***	0.074***	–0.030**	–0.022
	(0.010)	(0.010)	(0.015)	(0.015)
School controls	Y	Y	Y	Y
Student Fixed Effect	N	N	Y	Y
Observations	1,599,564	1,599,564	1,970,496	1,970,496
R-squared	0.545	0.545	0.001	0.002
Number of Students			718,785	718,785

Robust standard errors in parentheses

****p* < .01, ***p* < .05, **p* < .1

To address the concern about unobserved differences between mobile and nonmobile students, we added a student fixed-effect estimate in Models 3 and 4. Model 3 displays the gross effect of mobility on student achievement by focusing on within-student variation in achievement between years in which a nonstructural move occurs and years in which a move does not. This student fixed effect eliminates non-time–varying differences between students who move and those who are stable by estimating within-student effects on math achievement.

Column 4 compares individual students' math achievement in years in which an NSW or NSB move occurred to years in which the same student was stable or a structural mover. We observe that an NSW move has a statistically significant effect on math achievement of –0.089 SD. The NSW effect size is consistent with previous research suggesting the deleterious effect of NSW moves (Hanushek, Kain, & Rivkin, 2004; Schwartz, Stiefel, & Cordes, 2017).[5] However,

[5] Hanushek, Kain, and Rivkin (2004) focus on gain scores, while Schwartz, Stiefel, and Cohodes (2017) estimate levels and include a structural move. The decrease in gain between 0.024 and 0.088 SDUs in Hanushek, Kain, and Rivkin (2004) is in line with our results, but the magnitude of the estimates in Schwartz, Stiefel, and Cohodes (2017) is larger than the estimated effects from our data. Summer movers perform .118 SDUs lower in math and .131 SDUs lower in math during the school year.

the effect of NSB moves on student achievement gains is a small, positive, and statistically significant effect of 0.011 SDU, which falls between the moderate positive gains found in some studies and the moderate negative gains found in others. Over this time period in Tennessee, however, NSB moves appear to be slightly beneficial and NSW moves to be harmful for math achievement in the year of the move. Once again, the compounding effect of multiple moves from Model 3 appears to be driven entirely by the NSW move following the NSB move or multiple NSW moves, as the estimate on multiple moves reduces to null once we separate the NSW and NSB moves in the model. Overall, transforming the SDU estimates to days of learning, we can calculate that an NSB move gains a student approximately 7 days of learning, while an NSW represents the loss of approximately 63 days of learning (CREDO, 2015).

To put these estimates into context, racial demographics and gender are not estimated because these characteristics do not vary within a student over time, yet estimates for within-student variation in malleable factors all point in a logical direction: Estimates for economic disadvantage show no difference in the year announced (likely because family circumstances do not drastically change on either side of the blunt cutoff for free and reduced lunch); students with disabilities are estimated to score 0.1 SDU higher (likely due to the student receiving services they need as part of their IEP), and English learners score 0.05 SDU lower (potentially the result of losing services that are beneficial to accessing mathematics material). The small, lingering effects of prior disengagement through chronic absenteeism and suspension in the previous year highlight the compounding challenge of disengagement and mobility—in years in which the student is suspended out of school, they score about 0.016 SDU lower, 0.027 lower in the year of an in-school suspension, and about 0.22 SDU lower in years in which the student was chronically absent. The magnitude of those coefficients decreases from the Pooled OLS models, a finding which suggests that while these factors have a negative impact on achievement, it is not as large as the impact found on students who did not engage in those behaviors in the same year. Finally, nonstructural mobility in the prior year leads to small estimates that lean in the positive direction, suggesting that any carryover effect of the move is benign to positive, a small but important difference from the biased comparisons in Models 1 and 2.

Research Question 4: Mediation analysis of student mobility

To what extent do school quality, assimilation, and disruption mediate the effect of student mobility on student achievement?

While we observe differences in how NSB and NSW moves affect student achievement, we are still left with a gross mobility effect and without a clear explanation for how mobility drives any variation (or lack thereof) in achievement. As Chapters 1 and 2 describe, Hanushek, Kain, and Rivkin (2004) hypothesize three predominant avenues through which student mobility impacts achievement: school quality (Tiebout sorting), assimilation (how a student is served by the destination school), and disruption (the loss of learning due to mobility). Chapter 3 outlines the details of how these avenues are operationalized as mediators. The final set of models displays the results of the mediation analysis to determine whether hypothesized mediators fully or partially account, or fail to account, for variation in how nonstructural mobility affects student achievement.

One significant challenge arises in testing for mediation. A comparison of the effect estimates between the Pooled OLS models and student fixed-effect models showed that the student FE reduced bias from non-time–varying variables that were excluded from the pooled OLS models. This implies that within-student variation is necessary to estimate a plausibly unbiased, causal estimate of student mobility. In Question 3, we estimate the gross effect of mobility, comparing years in which a student was mobile to years in which the student was not mobile. However, in order for us to determine whether these factors mediate nonstructural mobility, a student must have 2 or more years with nonstructural moves within the study window to test between move variation within the student. The low number of students with variation in these mediators across nonstructural moves adds imprecision into the estimates due to the reduction in power. Nonetheless, the extent to which school quality, assimilation, and disruption mediate nonstructural mobility expands our understanding of mobility and results; in line with previous research, each mediation model is run separately due to computational limitations, as displayed in Table 14 (Henry et al., 2020).

Table 14. Mediation Results for School Quality, Assimilation, and Disruption on Nonstructural Mobility

Mediator:	School Quality ($VA_{dest} – VA_{origin}$)			Assimilation ($VA_{mobile} – VA_{nonmobile}$)			Disruption (Missed a week due to mobility)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Outcome:	Test Scores	Mediator	Test Scores	Test Scores	Mediator	Test Scores	Test Scores	Mediator	Test Scores
NSB	0.011***	0.689***	–0.009*	0.011***	–0.01***	0.005**	0.011***	7960.278***	0.003
	(0.002)	(0.010)	(0.005)	(0.002)	(0.000)	(0.002)	(0.002)	(4597.448)	(0.005)
NSW	–0.089***	–0.069***	–0.087***	–0.089***	0.047***	–0.027***	-0.089***	32379.07***	-0.097***
	(0.003)	(0.013)	(0.003)	(0.003)	(0.000)	(0.009)	(0.003)	(18703.18)	(0.006)
Mult. NSM	–0.000	–0.276***	0.008	–0.000	0.009***	0.012**	-0.000	.0001741***	0.006
	(0.006)	(0.024)	(0.006)	(0.006)	(0.001)	(0.006)	(0.006)	(.0001006)	(0.007)
Mediator			0.027***			–1.327***			0.008
			(0.006)			(0.190)			(0.006)
Constant	–0.022	0.062	0.004**	–0.022	–0.028***	–0.023***	-0.022		0.002
	(0.015)	(0.043)	(0.001)	(0.015)	(0.003)	(0.004)	(0.015)		(0.002)
Observations	1,970,496	1,970,496	1,970,496	1,970,496	1,970,496	1,970,496	1,970,496	129,655	1,970,496
R-squared	0.002	0.016	0.002	0.002	0.013	0.002	0.002		0.002
Students	718,785	718,785	718,785	718,785	718,785	718,785	718,785	37,031	718,785
Student and School Covariates	Y	Y	Y	Y	Y	Y	Y	Y	Y
Student Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y

Robust standard errors in parentheses

****p* < .01, ***p* < .05, **p* < .1

The three columns for each of the mediators in Table 14 show the results from each of the three models required to test mediation, with Column 1 through Column 3 testing school quality as a mediator. The school quality mediator is operationalized as the difference in math value added between the origin and the destination schools. Column 1, which is the same for all mediators, simply reproduces the results from Question 3 that are displayed in Model 4 of Table 13 above, which establishes that NSW moves have a significant negative effect on student achievement, while NSB moves have a small, positive, and significant effect. Model 2 establishes the first condition of mediation, that there is an effect of the treatment variables, NSB and NSW, on the mediator, school quality. We observe that NSB students transfer to destination schools with significantly higher value added relative to their origin schools, with a 0.69 SDU average increase. This finding is consistent with the notion of NSB students strategically selecting higher-performing schools. When students experience NSW moves, however, they move to destination schools with an average 0.07 SDU decrease in value added, which suggests that destination schools for NSW students have a slightly lower value added than the origin schools. Further, if students engage in multiple moves within the school year, on average, the destination schools' value added is approximately 0.28 SDU lower. NSW movers and movers with multiple nonstructural moves within the same year transfer to schools with a small decrease in value added; they are moving to destination schools that contribute less, on average, to student achievement than their origin schools.

Column 3 tests the extent to which student mobility explains variation in math performance through changes in school quality by including the predicted value of school quality from Column 2 as a coefficient in Column 3. For NSB, changes in school quality fully explain the small positive effect of NSB on student math achievement, indeed reversing the direction of the coefficient. Once the effect of school quality is fully adjusted for, we observe a small loss in math achievement due to NSB mobility. For NSW, however, we observe a small reduction of the primary coefficient from –0.089 SDUs to –0.087 SDUs, but these differences are not statistically significant. Moving to higher-performing destination schools does not in any meaningful way mediate NSW mobility.

The next three columns (4-6) in Table 14 examine assimilation, which is defined as the difference between mobile and nonmobile students in the destination school. Column 4 displays the student fixed-effects results from Question 3, while Column 5 establishes assimilation as meeting the first requirement of being a mediator—an effect on student mobility. NSB movers transition to destination schools whose value added for mobile students is small, but statistically significant relative to their value added for the stable student population (–0.003 SDUs). NSW students, however, move to destination schools with slightly higher (.05 SDUs) value added for nonstructural movers relative to their stable peers.

Including assimilation in the model also appears to affect the relationship between nonstructural mobility and math performance, as displayed in Model 6. For NSB movers, the small, positive effect from Column 4 is halved from 0.011 SDU to 0.005 SDU once we account for how schools serve mobile students relative to their stable peers. Thus, while assimilation is a partial mediator for NSB mobility, the effect of NSB mobility continues to be statistically significant, but not practically significant. We are also able to show that assimilation partially mediates NSW mobility, as the effect of NSW mobility reduces from –.089 SDU to –.027 SDU, accounting for nearly 70% of the NSW effect ($\frac{-0.089-(-0.027)}{-0.089}$). Once we account for the difference in the school's effect on mobile students and nonmobile students, NSW mobility's effect on student achievement is substantially reduced but not eliminated.

Lastly, the third mediator focuses on the disruption experienced as a result of nonstructural mobility. Disruption is operationalized as a missed week of school due to mobility, in which the student was not actively enrolled in school between enrollment spells. To estimate the relationship and satisfy the first requirement of mediation, we estimate the likelihood that a student's schooling is disrupted for at least a week using a logistic regression model that includes a student fixed effect. Only 37,031 students were nonstructurally mobile on at least two occasions and had variation in whether they had missed a week of school. For those students for whom an estimate is obtainable, Column 8 depicts the odds ratios for the likelihood that a student missed a week of school in years in which the student was nonstructurally mobile. The findings highlight the large, positive, and significant effect of nonstructural mobility on the disruption mediator. The magnitude of the estimate is no surprise, as a stayer is 0 in all years in which the student is not mobile, and only a small percentage of nonstructurally mobile students have both disrupted and nondisrupted transfers. Table 10 above shows that 46% of NSW movers missed a week of school while transferring, while only 9% of NSB movers started school a week or more late. Column 9 displays the results of the mediation model, and finds that while NSW mobility maintains a negative effect on student achievement, the mediator is not significant, which signals that disruption has no direct effect on student achievement and fails the requirement that the mediator have a direct effect on the outcome.

However, it is possible that the direct effect of disruption on NSW may be masked by having both NSW and NSB movers in the sample. To test whether there is evidence that disruption is a moderated mediator on NSW or NSB mobility, we created two analytic samples:

one for students who were NSB movers, and a second for those who were NSW movers. Column 1 in Table 15 displays the plausibly causal effect of NSW moves on student achievement using a student fixed-effect model for students who were NSW movers at any point in the sample. Column 2 reports that students have a positive and significantly higher probability of missing a week of school between school spells when students are NSW movers, relative to years in which students did not engage in NSW moves (OR: 3.293). Results from Column 3 show that there is a negative, significant effect of NSW mobility, and disruption has a direct and positive effect on student achievement. These results suggest that disruption is a suppressor of the larger negative effect of NSW moves, because the coefficient on NSW (0.132 SDU) is larger and more negative than the gross mobility effect from Column 1 after controlling for disruption. Disruption is a moderated mediator on NSW mobility. For NSB movers, however, controlling for disruption makes no difference regarding the benign, significant effect of NSB moves on student achievement.

Table 15. Mediation Analysis of Disruption for NSW Movers and NSB Movers Separately

	NSW Only			NSB Only		
	(1)	(2)	(3)	(4)	(5)	(6)
Outcome:	Test Scores	Mediator	Test Scores	Test Scores	Disruption	Test Scores
NSB				0.019***	0.925***	0.018***
				(0.002)	(0.018)	(0.006)
NSW	-0.091***	3.293***	- 0.132***			
	(0.003)	(0.025)	(0.011)			
Multiple Moves	0.009	0.165***	0.008	- 0.078***	1.331***	- 0.080***
	(0.006)	(0.030)	(0.006)	(0.005)	(0.028)	(0.010)
Disruption			0.054***			0.004
			(0.013)			(0.022)
Constant	–0.359***		- 0.361***	- 0.192***		- 0.193***
	(0.032)		(0.032)	(0.024)		(0.026)
Observations	331,059	109,113	331,059	548,921	90,084	548,921
R-squared	0.008		0.008	0.002		0.002
Number of Students	112,014	31,056	112,014	183,837	25,221	183,837
Student and School Covariates	Y	Y	Y	Y	Y	Y
Student Fixed Effects	Y	Y	Y	Y	Y	Y

Robust standard errors in parentheses

***$p < .01$, **$p < .05$, *$p < .1$

Taken together, these mediation results contribute to our understanding of how nonstructural student mobility affects student achievement. School quality more than fully mediates and assimilation partially mediates the relationship between NSB and math achievement, while disruption does not appear to mediate the small benefit of NSB. However, for each mediated relationship, the magnitude of coefficients hovers near 0 SDU, even when maintaining statistical significance. Accounting for these differences, we see no evidence that changing schools between years nonstructurally has a large positive or negative effect on student achievement. Increases in school quality reverse the small positive effects of NSB to negative; thus positive changes in school quality fully overcome what would be negative effects of NSB. However, the magnitude of the negative effect of NSW mobility, accounting for changes in school quality, results in the loss of approximately 6 days of learning (CREDO, 2015).

For NSW, however, a negative, significant relationship persists in two of the meditated pathways. Assimilation accounts for 70% of the variation of the NSW effect, while still retaining a significant, negative effect on math achievement for NSW moves. To determine whether the indirect effect of the IV on the DV via the mediator is significantly different from 0, we calculated the Aroian version of the Sobel test, as suggested by Baron and Kenny (1986), which is the effect size for the partially standardized indirect effect of NSW mobility through Assimilation. From this calculation, we determine that the *z-value* is –6.98, with a standard error of 0.008, which gives us evidence that the difference is negative, significant, and greater than zero. The school quality pathway suggests that the causal estimate may be about 5% less negative than originally estimated, but that difference is not statistically significant from the gross effect of NSW mobility from the original model. Disruption, however, is a moderated mediator on NSW mobility, whereby including disruption in models limited to NSW movers exacerbates the negative effect of NSW mobility on student achievement. The consistency of these estimates suggests that NSB mobility negatively affects student math achievement growth in the year immediately after the move, the implications of which finding will be described in more detail in the next chapter.

CHAPTER 5: DISCUSSION

This dissertation expands and deepens the research on students' educational experiences by examining the role of student mobility. Choice of school is one of the most important factors dictating why families locate in certain areas. After that initial choice, students engage in a series of moves between schools, both structural and nonstructural, within and between years. This dissertation highlights the fact that mobility is not merely a simple construct of a student moving between schools, but exists within an environment that increasingly encourages student mobility through factors including school choice, high-stakes accountability policies, and segregated schooling. The ramifications of increased student mobility raise concerns around equitable access to high-quality educational opportunities. That focus on equity leads us to focus on who moves, when moves occur, where they occur, to and from where they occur, and ultimately, the extent to which nonstructural student mobility affects the student's academic achievement. This dissertation aims to untangle the effects of those moves for Grades 4 to 8 in Tennessee by addressing the following four questions about student mobility:

1. To what extent do nonstructural (between- and within-year) and structural moves occur? What are the rates of mobility for different groups of students and across school contexts?
2. To what extent do observed student and school characteristics predict student mobility? To what extent do observable student and school characteristics differ between nonstructural between-year, nonstructural within-year, and structural movers?
3. To what extent does student nonstructural mobility affect academic performance outcomes?
4. To what extent do school quality, assimilation, and disruption mediate the effect of student mobility on student achievement?

In this final chapter, we review the key findings and limitations of our study, discuss implications for policy and practice, and suggest areas for future investigation.

Review of Findings

The four primary research questions build on a body of research that highlights concerns around the deleterious effects of student mobility for historically underserved students. That research highlights the frequency with which students change schools, and that those moves have differential effects on student achievement depending on the timing of the move (Hanushek, Kain, & Rivkin, 2004; Xu, Hannaway, & D'Souza, 2014; Schwartz, Stiefel, & Cordes, 2017). By focusing on which students change schools nonstructurally and the underlying conditions of the schools into which our most disadvantaged students are exiting and entering, we can continue to build a stronger understanding of the scope and impact of student mobility.

The first question descriptively assesses mobility across multiple contexts. Nonstructural student mobility peaks in first through fourth grade, with between 16% of first graders and 14% of fourth graders changing schools nonstructurally between years (NSB) and between 10% of first graders and 8% of fourth graders within years (NSW). Across all grade levels, mobility is prevalent across all student groups, but Black and Hispanic students are more likely to be mobile than their White and Asian peers. Moreover, economic disadvantaged students are also significantly more mobile than peers who are not economically disadvantaged in a given academic year.

As we observe mobility over time, racial differences between Black and White students in the frequency of nonstructural mobility emerge. Nearly 63% of Black kindergarteners change schools before fourth grade, with 20% changing schools three or more times nonstructurally, compared to 39% of White students changing schools at least once, of whom 8% changed at least three times. Following a cohort of fourth graders, 58% of Black students change schools at least once between fourth and eight grade, compared to 34% of White students. Mobility is more prevalent in economically disadvantaged schools with a high population of Black students. We do not see significant differences in the academic quality of the origin and destination schools of mobile students: Students are not exiting origin schools with low proficiency levels to move to high-achieving destination schools, or vice versa. However, we do observe large gaps in average academic proficiency levels between the schools that Black students attend relative to White students. Our findings on demographic differences thus demonstrate that on average, Black students transition at higher rates between lower-performing schools, while White students move at lower rates between higher-performing schools.

The second set of questions aims to explore those student and school demographic factors simultaneously and explore the extent to which they predict the likelihood of mobility. The multinomial logistic results that compare predictors of different mobility types illustrate the disproportionate churn of students in poor, largely Black schools that was observed in the findings for Question 1. The results also raise concern about disengagement because students who are previously nonstructural movers, previously suspended, or previously chronically absent are significantly more likely to engage in NSW and NSB moves. Finally, the results point to statistically significant differences in how observable factors differentially predict NSW and NSB moves relative to staying. Large, statistically significant differences between NSW and NSB moves are estimated for many indicators, with economic disadvantage, prior exclusionary discipline, prior nonstructural mobility, and chronic absence as the largest predictors. We also find that the proportion of Black students and economically disadvantaged students and the prior nonstructural mobility rates within a school predict an increase in the likelihood of NSB moves and NSW moves relative to staying.

These differences support the decision to separate the types of mobility as we attempt to derive plausibly causal estimates of nonstructural mobility on student achievement. By comparing academic performance in years in which the same student was nonstructurally mobile to years the student was not mobile across Grades 3-8, we observe a small positive effect at 0.011 SDUs for NSB, and in contrast, a negative effect of –.089 SDUs for NSW on math achievement. We can thus calculate that an NSB move gains a student approximately 7 days of learning, while an NSW move represents the loss of approximately 63 days of learning (CREDO, 2015). Simply put, we observe heterogeneous effects for nonstructural student mobility: NSW students see a negative effect, while those who engage in NSB moves over the summer see a slight benefit, on average. These estimates, however, are considered the gross estimate of mobility, and the next set of questions aims to account for the variation in how these types of nonstructural student mobility affect achievement.

The mediators of school quality, assimilation, and disruption provide novel evidence about how mobility impacts student achievement. Rather than just as a black-box construct of the gross effect, the mediators help deepen our understanding of student mobility and the paths through which it affects student achievement. These mediators also appear to have a different relationship across the types of nonstructural mobility. For school quality measures, we observe in Table 14 that while NSB students move to higher-performing destination schools, NSW students move to destination schools that have worse value-added scores than their origin school (path *a*, Fig. 1). School quality thus fully mediates NSB mobility but does not work through NSW mobility. The positive effect of NSB mobility without mediation reverses to negative when the school quality mediator is added to the model, while we see almost no change to the effect of NSW mobility. Changes in school quality therefore, drive the impact of NSB mobility, a finding that illustrates the importance of strategically seeking destination schools with higher value-added scores.

In contrast, assimilation—the difference between the school's value added for mobile students and nonmobile students—drives changes in the effects of NSW moves but not NSB moves. The *a* path from Column 5 in Table 14 of our mediation model examining the effect of NSB and NSW moves on assimilation point to no substantial difference (–.003 SDU) for NSB movers, but a 0.047 SDU positive difference in the destination school's added value for NSW movers. When assimilation is then included as a mediator, about half of the variation in NSB moves' effect on achievement is accounted for, but nearly 70% of the effect of NSW moves is mediated ($\frac{-0.089-(-0.027)}{-0.089}$). How the school serves mobile students relative to its stable students thus largely drives the effect of NSW moves on student achievement. Given the conditional means from Table 10, since 83% of NSW students are economically disadvantaged and 21% of NSW students have IEPs, there are significant implications for equity. These results point to clear next steps for guiding practice: Identify high value-added schools for mobile students, identify their best practices for engaging new learners who are NSW movers, and attempt to expand those practices to schools that see less positive difference in value-added estimates for mobile students and nonmobile students.

Finally, disruption exacerbates the negative effect of NSW moves, while meeting the requirements of a mediator for NSB moves. To determine whether the effect of disruption is a moderated mediator, we created two separate samples, one including NSW movers and the other limited to NSB movers. For the NSB movers, disruption did not affect academic achievement because the estimate of disruption was not statistically significant in the *b* path. For NSW mobility, however, the magnitude of the effect increased in magnitude from –0.091 SDU to –.132 SDUs, suggesting that once disruption is accounted for, the negative effect of NSW mobility is more harmful than initially estimated (*c* path relative to *c'* path).

While the mediators provide unique contributions and levers for understanding student mobility, the primary results from the initial model are consistent: NSB moves appear to be benign, while NSW moves result in a negative effect on student learning in the year of the move. Considering these findings, the concentration of NSW moves into certain schools suggests that the churn during the year may have some spillover effects on students and teachers. This externality is explored more by Hanushek, Rivkin, and Kain (2004), who estimate a smaller direct effect of mobility, but find that the negative relationship is exacerbated by the sorting of students into schools with high mobility rates and the consistent churn over time. These concerns echo the findings from the multinomial logistic results from Question 2: Schools with a higher percentage of Black students experience more NSW. Given our knowledge of the negative effect of NSW mobility on student math performance, this dissertation raises significant concerns around equity, and about efforts to close the Black-White achievement gap that fail to consider high levels of NSW mobility.

Limitations

The results of this study are subject to several notable limitations. First, estimating a causal effect of mobility without knowledge of why the student changed schools presents challenges of selection, which may moderate the effect of mobility in different directions based on the reason for the move. We cannot randomly assign students to be mobile, and despite our best efforts, we are unable to detect the circumstances associated with the move: unobserved improvements to housing or schooling conditions, parental preference, closer to home, or conversely, lack of safety, health complications, trauma, loss of home, or job loss that accompany the move. In our administrative data, we do not observe the student's address or whether the change in schools was accompanied by a change in residence. Our most plausible estimate includes the aggregate effect of these variables as part of the gross mobility effect. By applying the student fixed effect to our models, we can eliminate a larger form of bias by removing comparisons to nonmobile students. Yet the analysis of within-student variation assumes that there are no unobservable differences between students that affect student achievement in years that they change schools in comparison to years that they do not.

A second potential limitation derives from the identification of the mediators, which may align with the intention of the mechanisms described by Hanushek, Kain, and Rivkin (2004), but do not capture those ideas in full. The school quality metric captures one dimension of school quality that is directly related to the outcome of interest: the comparison of school value-added scores in the destination and origin school. This metric removes the effects of peers and limits the comparison to the contribution of the school, but the Tiebout sorting of families may not be limited to the academic contributions of the school. Parents may use other information, such as a school's reputation, the school's resources, or proximity to home, that improve the capacity of the school to serve the student in a given year but are not observed in our data. As Hanushek, Kain, and Rivkin describe the Tiebout effect as " changes in overall school quality determined by school operations, peers, and turnover," this possibility opens up new opportunities for future research to test different metrics for Tiebout sorting (2004, p. 1727).

For the assimilation metric, comparing the school's contribution to the academic performance of mobile and nonmobile students using a value-added framework also highlights just one type of assimilation that is directly related to student achievement. Given assimilation's role in reducing the negative effect of NSW, we cannot be certain that unobserved motivations in the sorting of mobile students do not bias the calculations of the value-added measure for mobile students—if there is systematic sorting of mobile students into certain schools, then it is possible the estimate may be correlated with unobserved errors that impact both the historical value-added for mobile students as well as the current performance of the mobile student in that year.

Finally, the narrow definition of disruption accounts for one type of disruption. Disruption may be more than just time missed between enrollment spells, but encompass the disengagement that accompanies a traumatic event that is not captured in the administrative data. To account for whether the disruption carries over into enrollment, we also added indicators for attendance and suspensions in the destination school as part of the mediation model to predict disruption. In this case, the direction of the coefficient of NSW remained negative, but the magnitude continued to increase, suggesting that disengagement and disruption are having a negative effect on student math outcomes. We also used a binary measure of disruption, which may result in missing dosage effects whereby students who miss more time may have worse effects.

Third, these results could represent the upper limit of what the estimate of the effect of student mobility could be due to missingness in test scores. NSW students were significantly more likely to be missing an end-of-year test score, and those who were missing scores appeared descriptively to be more economically disadvantaged and have a lower prior score than students with a test score that followed the within-year move. Over the course of the sample, about 4% of nonmobile students in Grades 3-8 are missing an end-of-year math assessment score each year. However, about 9% of NSB students and 13% of NSW students are missing their subsequent math score. NSW students are thus three times more likely to have a missing test score than their nonmobile peers. If students who are missing scores are more disadvantaged, we might expect those students to see greater learning loss due to the compounding disadvantages associated with the move. However, a separate hypothesis is that because those students are so low-performing, the new environment might engage them in ways that the previous school did not. We found that 66% of NSW students who are missing their end-of-year test scores were economically disadvantaged, but 77% of NSW students who had a test score at the end of the year were economically disadvantaged. However, when we compare prior-year test scores, NSW movers who are missing a test score averaged –.76 SDU below average in the previous year, while those with a subsequent assessment scored –.47 SDU below average in the previous year. Thus, while we see a lower percentage of economically disadvantaged students among those with missing scores, those students score significantly lower than their other NSW peers. A second concern about missingness is that with students who are mobile, but were not enrolled in a school in the previous academic year, we lack information about their behavioral, attendance, and origin school-level data, and thus they are not included in the final models for Research Questions 2, 3, or 4. Future research should more fully address the missingness of historical data and student test scores for mobile students.

Even with test scores, we are potentially limiting our relevant outcomes. One might expect that the outcome of mobility would more directly impact other measures of learning, such as participation in class activities or course grades, where the teacher observes the student each day, assesses the quality of the work, and can better track progress. Our understanding of mobility would be improved if we could follow a student across multiple assessments of learning over the course of a year rather than one assessment at the end of the year. Furthermore, nonacademic outcomes, such as student wellbeing, sense of belonging, comfort in the environment, school culture, and perception of support in the school, would provide more insight into the effects of mobility.

The next limitation concerns the other potential drivers for the negative effect of NSW. Currently, the effect estimates are averaged across the time of year in which the move takes place, which may impact heterogeneity in the effect of mobility. Early in the year, we might anticipate an effect similar to the NSB effect: benign to positive. Later in the year, when students may not be able to assimilate to their new environment, we might expect the disruption to be more present on an end-of-year test.

A final limitation concerns the type of moves studied. We focus on nonstructural moves, comparing between- and within-year moves. However, Schwartz, Stiefel, and Cordes (2017) concluded that the large negative impact of structural moves was more harmful than the causal effect of the nonstructural move. Because it focuses on New York City, their study may not be generalizable. However, it highlights concerns about how schools are structured and which students are more likely to have to change schools and get reacclimated to a new environment. Our analyses do not address the impact of structural moves on student achievement.

Study Contributions

While this research on student mobility aligns with the bulk of high-quality academic research on mobility, we believe that this specific context expands our understanding of the accompanying challenges that mobile students face due to concentration of disadvantage and student churn. It fills a gap in the research in time, in location, and in context. Previous high-quality research on student mobility is nearly 2 decades old in some cases—Hanushek et al. (2004) cover Texas public schools in the late 1990s. That research did not take place in a time where school choice and high-stakes accountability were significant policy hurdles across all schools. More recent research has focused on other states (e.g., New York) or places that have recently undergone significant changes in school governance (e.g., the transition to an open-choice model centered on charter schools in New Orleans) and may not be generalizable to the Tennessee context (Schwartz, Stiefel, & Cordes, 2017; Welsh, Duque, & McEachin, 2016). This study also explores whether different types of mobility result in heterogeneous effects on student achievement. The answer to this question can contribute to developing policies that either facilitate mobility or attempt to curb it.

Finally, to our knowledge, no prior study has attempted to test whether we can mediate the effect of student mobility on academic achievement, and specifically, whether mediators have a heterogeneous effect on the type of mobility. Mediation analyses can be useful for providing clear guidance on the avenues through which policies affect achievement, as has been shown in the school improvement context (Henry et al., 2020). As Hanushek, Kain, and Rivkin write, “Absent information about the separate components [of Tiebout sorting, assimilation, and disruption], both the interpretation and relevance for policy purposes of direct estimation of [mobility] will be quite limited” (2004, p. 1728).

This dissertation operationalizes those separate components. We test for mediation and determine that school quality mediates NSB mobility, while assimilation and disruption are more significant mediators for NSW mobility. For school quality, other studies have used the destination school’s value added as a coefficient and as a robustness check for the effect of mobility, but no study has attempted to test for the difference in value added between the origin and destination school as a mediator for mobility (Schwartz, Stiefel, & Cordes, 2017). We find that NSB movers tend to transfer to destination schools with higher value-added scores, and moving to that higher-quality school accounts for any benefit of NSB moves.

For NSW mobility, the negative effect is larger than in some previous studies that do not observe when the move occurs within districts; the present research thus reveals more about how the negative effect can be ameliorated as well as how the effect becomes worse. With assimilation accounting for 70% of the negative effect of NSB mobility, we draw new attention to the idea that added value for mobile students can improve outcomes for NSB movers. Lastly, to estimate disruption, we contribute a new measure in the literature by accounting for missed academic time between enrollment spells. Policy guidance results from that awareness.

Policy Implications

While this dissertation leverages statewide administrative data to explore the effect of student mobility on student academic achievement, many important policy and practice decisions may be considered at both the state and local level. Due to the heterogeneous effects of nonstructural student mobility, the challenge from a policy level is that there are certain responses that may apply to all types of mobility, while some policies differ for between-year moves versus within-year moves, and finally, some differ between structural and nonstructural between-year moves.

First, given the negative effect of NSW mobility, it is important to recognize the scale of mobility and report on it publicly. If a high-mobility school loses and replaces a high percentage of its students from fall to fall, then it should not come as a surprise if targeted interventions and strategies for school improvement do not appear to work. Student mobility has been shown to suppress school improvement strategies (Henry, Pham, Kho, & Zimmer, 2020).

Schools and districts should thus aim to reduce NSW mobility. Table 9 shows that student suspensions and chronic absenteeism are indicators for disengagement and the largest predictors, alongside economic disadvantage status, of student nonstructural mobility. Thus one way to think about reducing NSW mobility is to consider programs and policies to reduce exclusionary discipline and chronic absence for those students who are at highest risk for NSW mobility. Investments in support services for students, such as Positive Behavioral Interventions and Supports (PBIS) and Restorative Justice practices, may reduce the likelihood of disengagement through lowering suspension rates and chronic absenteeism, which may ultimately reduce NSW mobility (James, Noltemeyer, Ritchie, & Palmer, 2019). PBIS is a preventive framework associated with improved student behavior and academic outcomes through shifts in staff perceptions of how to address and support student behaviors (Bradshaw, Koth, Bevans, Ialongo, & Leaf, 2008; Bradshaw, Waasdorp, & Leaf, 2012; Freeman et al., 2016; Horner et al., 2009). Further, identifying opportunities to foster strong ties between school staff and at-risk students as well as between students could reduce the likelihood of NSW mobility. If a student feels connected and supported within their school, schools may be able to work with families to provide continuous education within the school to address challenges that are happening at home. Schools may not be able to reduce NSW mobility rates to zero, but a focused effort on supporting the student's academic and nonacademic needs may reduce mobility's pervasiveness in schools with high NSW mobility rates.

Similarly, practices that reduce NSW mobility may also serve as frameworks or structures for assimilating students into the destination school. In Model 6 of Table 14, we find that assimilation reduces the NSW negative effect by 70%. The practices associated with assimilating the student should thus be pursued, whether they are the same strategies outlined to reduce mobility, or different ones such as peer support or providing an adult to serve as a mentor for the student. The school quality mediator demonstrated that even moving to a higher-performing school does not mitigate the effects of the NSW move, so we should aim to reduce NSW mobility and identify and scale assimilation practices where possible.

Furthermore, given the larger negative effect of NSW mobility once disruption is accounted for, it is reasonable to assume that many NSW moves may accompany other challenges for students and their families. If a student is missing a large chunk of time between spells, that is likely representative of an unobserved challenge that will accompany the student to the destination school. Data-sharing and coordination for mobile students may be beneficial when shared between the origin and destination schools, but also when the right information is shared with government and community organizations that are in place to address disadvantage and insecurity. Specifically, the integration of data in public housing, courts, the legal system, food services, and health services could provide holistic support to students most at risk of harmful student mobility and support them through the transition to a new school within the year.

However, sufficient reason does not exist for local education agencies to disincentivize NSB moves—in fact, in some specifications, we see evidence of a benefit for students to changing schools between years. School districts can provide parents with better information on schools to support better informed decisions for between-year moves in cases where open enrollment policies exist. In those cases, we may be able to reduce NSW mobility by promoting NSB mobility before the school year begins.

Future Research

First, future research should aim to expand the time frame of the study. The years studied in this dissertation span 2008 through 2015. Given the years and available outcomes (standardized test scores), we are only able to track three full cohorts of students who were enrolled from third through eighth grade. To understand the full picture of a student's experience with mobility, it would be beneficial to explore the totality of the mobility that a student engages in between kindergarten and 12th grade. By focusing on a larger window of time, we would be able to explore other potential outcomes—from early literacy, school engagement, course grades, access to effective teaching, dropping out, and ultimately college and career success—which may inform different policy responses. Future iterations of mobility research should seek to account for the time of year in which the move occurs. Early or late NSW moves may have heterogeneous effects that can be explored.

Furthermore, studies can address not only when within the year, but also when across academic years moves occur. This study focuses on Grades 3-8, but Table 5 highlights that earlier grades see higher rates of nonstructural mobility. We do not focus on the effects of mobility in early grades, where we do not have access to standardized assessments as an outcome. Nor do we focus on high school, where mobility appears to be less common, but due to more defined graduation requirements, may impede student progression more than performance on a single end-of-year test. Future research can focus more on when moves occur and how those moves affect these different outcomes.

In addition to studying the impact of when moves occur, we would also like to expand the definitions of the mechanisms that drive differences in the impact of student mobility. This dissertation focused on three ways to define and measure the mechanisms of school quality, disruption, and assimilation. We leveraged available administrative data and operationalized new measures, which ultimately mediated the effect of mobility on student achievement. We know that these mediators were exploratory and could be improved with different data sources that could inform these latent constructs of school quality, disruption, and assimilation in their relationship with student mobility. For example, parents may value other indicators of school quality that influence both the decision to change schools and academic achievement. Student or staff surveys that provide more insight into practices or school climate may inform the perception of assimilation and disruption, as well as policies and practices associated with those constructs. More localized studies with access to more nuanced data would be able to capture this context, as well as other mitigating factors such as transportation, policies that assign students to a particular school, or local efforts to expand or encourage school choice, that are not available in our statewide data sets. We cannot observe, for example, whether school accountability policies target the specific school, new schools emerged in the same catchment area, or other observable factors that might impact a family's decision to change schools.

Given the magnitude of the role of assimilation in reducing the negative effect of NSW mobility, opportunities exist to deepen our understanding of assimilation. Future research should seek to learn what actions the schools took, what teachers they assign mobile students to, the curricula established, or other malleable factors associated with assimilating mobile students that contribute to the differences in the value added for mobile and stable students. Schools may be able to provide volunteer coaches or create systems to assimilate the student so that the school can better serve their mobile population, potentially lessening the burden for the individual teacher who is receiving the student within the year without information on the student's background, prior mastery of content, or best practices for serving that student. Future analyses can provide more insight into assimilation and its effect on how student mobility affects student achievement.

Further analysis can address some of these limitations with the data on hand. We could leverage knowledge of siblings to remove bias associated with the family's decision to change schools. If we were able to observe those siblings who were moving to different schools, and thus having different assimilation experiences, we would be able to better isolate the school-related factors, rather than the unobserved family motivations, that inform how student mobility affect student achievement. We could then compare across time for the same student in the same family. We could also focus on student mobility from an educator perspective. We know little about how teachers are supported when a new student enters their class in the middle of a year. Research continuously points to the significant role that educators play in improving student academic outcomes, as well as nonacademic outcomes such as attendance or going to college. With further analysis, we could identify which teachers are most likely to experience high levels of NSW mobility with students exiting their classes midyear; or, conversely, which teachers are most effective at mitigating the negative effects of NSW mobility in their classrooms for students who enter midyear. With this information, school leaders could target specific teachers for strategies to engage and support disadvantaged students to reduce mobility.

As we expand our understanding of nonstructural student mobility, future research should understand the causes and ramifications of disproportionality with respect to school structures and structural mobility. Table 12 highlights the fact that Black and Hispanic students are approximately 10 percentage points more likely to engage in a structural move relative to staying in the same school, but economically disadvantaged students and students with disabilities are about 6 percentage points less likely. These differences raise equity concerns about school structure, and a need for future research as to why certain groups across the state are more frequently engaging in structural moves. One possibility is that grade structures in districts with high percentages of Black and Latino students are more likely to have structural moves embedded in the system. While research on K-8 schools has been mixed (Rockoff, 2010; Dove, Pearson, & Hooper, 2010; Clark, Slate, Combs, & Moore, 2013), the benign results of the nonstructural between-year moves in this study suggest that summer moves are not particularly harmful, and should be a future line of inquiry if structural moves follow this pattern.

Finally, this research raises concerns around student mobility and school segregation, but does not fully address the expansion of school choice opportunities. Future research can explore the extent to which school choice policies change parental perceptions around student mobility, and then whether there is an increase in student mobility as a result of expanded school choice. The confluence of mobility and choice may exacerbate concerns around segregated and unequal schooling opportunities, a problem that has been noted in large urban areas (Welsh, Duque, & McEachin, 2016; Welsh, 2016). The intersection of these factors would expand upon recent literature that has demonstrated increased segregation coinciding with increased school choice (Kotok, Frankenberg, Schafft, Mann, & Fuller 2015; Welsh, 2016) and the role that gentrification has played in the expansion of school choice (Pearman & Swain, 2017). Both intradistrict and interdistrict choice systems establish school choice to meet parental demand and increase student performance. Yet we have limited evidence that open-choice systems drastically increase mobility rates; rather, as found in this dissertation, high-achieving students and low-achieving students opt into different sets of schools (Welsh, Dubuque, & McEachin, 2016). With our knowledge that the effect of NSB mobility is accounted for through changes in school quality, attempts to break the pattern of low-performing students enrolling in low-achieving schools should be part of a larger targeted effort at systems improvements.

As a lever for those systematic improvements, public accountability policies aim to equip parents with information to make informed choices so that their children can attend the school that best meets their needs, yet those efforts do not appear to drive changes in how disadvantaged families, at scale, make choices for their families. Other factors such as safety, transportation, school demographics, or even latent characteristics such as parent perceptions, drive those decisions in both disadvantaged and nondisadvantaged families. In other cases, the move may be involuntary due to disciplinary factors. Still, considering the findings of this dissertation, efforts should be made to maintain a continuous enrollment in a single school to finish out the year before transitioning to a school that may be a better fit for the student. We argue this delay because this dissertation finds no evidence that strategic NSB moves hurt academic performance in the subsequent year, but we do find evidence that NSW moves decrease student test scores in the year of the move. Future research should aim to understand how the motivations for nonstructural mobility differ between NSW and NSB mobility and how that information may be used to reduce NSW mobility.

Ultimately, families desire to enroll their children in high-quality, safe, and nurturing schools that best fit the needs of their children. With a growing landscape of charter, magnet, virtual, and traditional school structures for families to choose from, and as these choices are made within an increasingly segregated schooling environment, school mobility will continue to be central to addressing the challenges that face public education. This dissertation highlights the facts that within-year moves are harmful to student achievement, and that research to improve education outcomes for those students, who tend to be the most disadvantaged, should continue to account for the role that mobility plays in their educational experience.

REFERENCES

Alexander, K. L., Entwisle, D. R., & Dauber, S. L. (1996). Children in motion: School transfers and elementary school performance. *Journal of Educational Research*, *90*, 3–12. doi:10.1080/00220671.1996.9944438

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173-1182. doi: https://doi.org/10.1037/0022-3514.51.6.1173

Bradshaw, C. P., Koth, C. W., Bevans, K. B., Ialongo, N., & Leaf, P. J. (2008). The impact of school-wide positive behavioral interventions and supports (PBIS) on the organizational health of elementary schools. *School Psychology Quarterly, 23*(4), 462–473. https://doi.org/10.1037/a0012883

Bradshaw, C. P., Waasdorp, T. E., & Leaf, P. J. (2012). Effects of school-wide positive behavioral interventions and supports on child behavior problems. *Pediatrics: 130* (5), e1136-e1145. doi: https://doi.org/10.1542/peds.2012-0243

Brummet, Q. (2014). The effect of school closings on student achievement. *Journal of Public Economics*, *119*, 108–124. doi:10.1016/j.jpubeco.2014.06.010

Bulkley, K., Henig, J., & Levin, H. (2010). *Politics, governance, and the new portfolio models for urban school reform: Between public and private*.

Burkam, D., Lee, V., & Dwyer, J. (2009, June). School mobility in the early elementary grades: Frequency and impact from nationally-representative data. Paper presented at the National Academies Workshop on the Impact of Mobility and Change on the Lives of

Young Children, Schools, and Neighborhoods, Washington, DC.

de la Torre, M., & Gwynne, J. (2009a). *Changing schools: A look at student mobility trends in Chicago public schools since 1995*. Consortium on Chicago School Research. Retrieved from http://files.eric.ed.gov/fulltext/ED504245.pdf

de la Torre, M., & Gwynne, J. (2009b). *When schools close: Effects on displaced students in Chicago public schools*. Consortium on Chicago School Research. Retrieved from http://files.eric.ed.gov/fulltext/ED510792.pdf

CREDO (2015). *Urban Charter School Study: Report on 41 Regions.* Center for Research on Education Outcomes. Retrieved from http://credo.stanford.edu

Dougherty, S. M., & Weiner, J. M. (2017). The Rhode to turnaround: The impact of waivers of No Child Left Behind on School Performance. *Education Policy*, 1-32. https://doi.org/10.1177/0895904817719520

Engec, N. (2006). Relationship between mobility and student performance and behavior. *Journal of Educational Research*, *99*, 167–178. doi:10.3200/JOER.99.3.167-178

Fantuzzo, J. W., LeBoeuf, W. A., Chen, C.-C., Rouse, H. L., & Culhane, D. P. (2012). The unique and combined effects of homelessness and school mobility on the educational outcomes of young children. *Educational Researcher*, *41*, 393–402. doi:10.3102/0013189X12468210

Fiel, J. E., Haskins, A. R., & Turley, R. N. L. (2013). Reducing school mobility: A randomized trial of a relationship-building intervention. *American Educational Research Journal*, *50*, 1188–1218. doi:10.3102/0002831213499962

Freeman, J., Simonsen, B., McCoach, D. B., Sugai, G., Lombardi, A., & Horner, R. (2016). Relationship between school-wide positive behavior interventions and supports and academic, attendance, and behavior outcomes in high schools. *Journal of Positive Behavior Interventions*, *18*(1), 41–51. https://doi.org/10.1177/1098300715580992

Gottfried, M. A. (2010). Evaluating the relationship between student attendance and achievement in urban elementary and middle schools: An instrumental variables approach. *American Educational Research Journal*, *47*(2), 434–465.

Grigg, J. (2012). School enrollment changes and student achievement growth: A case study in educational disruption and continuity. *Sociology of Education*, *85*, 388–404. doi:10.1177/0038040712441374

Hanushek, E. A., Kain, J. F., & Rivkin, S. G. (2004). Disruption versus Tiebout improvement: The costs and benefits of switching schools. *Journal of Public Economics*, *88*, 1721–1746. doi:10.1016/S0047-2727(03)00063-X

Henry, G. T., Pham, L. D., Kho, A., & Zimmer, R. W. (2020). Peeking into the black box of school turnaround: A formal test of mediators and suppressors. *Education Evaluation and Policy Analysis*, *42*(2), 232-256. https://doi.org/10.3102/0162373720908600

Herbers, J. E., Reynolds, A. J., & Chen, C.-C. (2013). School mobility and developmental outcomes in young adulthood. *Development and Psychopathology*, *25*, 501–515. doi:10.1017/S0954579412001204

Horner, R. H., Sugai, G., Smolkowski, K., Eber, L., Nakasato, J., Todd, A. W., & Esperanza, J. (2009). A randomized, wait-list controlled effectiveness trial assessing school-wide positive behavior support in elementary schools. *Journal of Positive Behavior Interventions*, *11*(3), 133–144. https://doi.org/10.1177/1098300709332067

Imberman, S., Kugler, A., & Sacerdote, B. (2012). Katrina’s children: Evidence on the structure of peer effects from hurricane evacuees. *American Economic Review*, *102*, 2048–2082.

doi:10.1257/aer.102.5.2048

Institute of Medicine and National Research Council. (2010). *Student mobility: Exploring the impact of frequent moves on achievement [Summary of a workshop]* (A. Beatty, Ed.). National Academies Press.

James, A. G., Noltemeyer, A., Ritchie, R., & Palmer, K. (2019). Longitudinal disciplinary and achievement outcomes associated with school-wide PBIS implementation level. *Psychology in the Schools*, *56*, 1512– 1521. https://doi.org/10.1002/pits.22282

K-12 Education Many Challenges Arise in Educating Students Who Change Schools Frequently : Report To Congressional Requesters. (2010). U.S. Government Accountability Office. Retrieved from: http://purl.fdlp.gov/GPO/gpo7105

Kerbow, D. (1996). Patterns of urban student mobility and local school reform. *Journal of Education for Students Placed at Risk*, *1*, 147–169. doi:10.1207/s15327671espr0102_5

Kotok, S., Frankenberg, E., Schafft, K. A., Mann, B. A., & Fuller, E. J. (2017). School choice, racial segregation, and poverty concentration: Evidence from Pennsylvania charter school transfers. *Educational Policy*, *31*(4), 415–447. https://doi.org/10.1177/0895904815604112

Preacher, K. J. (2015). Advances in mediation analysis: A survey and synthesis of new developments. *Annual Review of Psychology*, *66*. https://doi.org/10.1146/annurev-psych-010814-015258

Parke, C., & Kanyongo, G. (2012). Student attendance, mobility, and mathematics achievement in an urban school district. *The Journal of Educational Research*, *105*(3), 161–175. https://doi.org/10.1080/00220671.2010.547231

Pearman, F. A., & Swain, W. A. (2017). School choice, gentrification, and the variable significance of racial stratification in urban neighborhoods. *Sociology of Education*, *90*(3), 213–235. https://doi.org/10.1177/0038040717710494

Raudenbush, S. W., Jean, M., & Art, M. (2011). Year-by-year and cumulative impacts of attending a high-mobility elementary school on children's mathematics achievement in Chicago, 1995 to 2005. In G. J. Duncan & R. Murnane (Eds.), *Whither opportunity? Rising inequality, schools, and children's life chances* (pp. 359–376). New York, NY: Russell Sage Foundation.

Ream, R. K. (2005). Toward understanding how social capital mediates the impact of mobility on Mexican American achievement. *Social Forces*, *84*, 201–224. doi:10.1353/sof.2005.0121

Reynolds, A. J., Chen, C., & Herbers, J. (2009, June). *School mobility and educational success: A research synthesis and evidence on prevention*. Paper presented at the National Academies Workshop on the Impact of Mobility and Change on the Lives of Young Children, Schools, and Neighborhoods, Washington, DC.

Rumberger, R. W. (2002). *Student mobility and academic achievement* (ED466314). Retrieved from http://files.eric.ed.gov/fulltext/ED466314.pdf

Rumberger, R. W. (2003). The causes and consequences of student mobility. *Journal of Negro Education*, *72*, 6–21. doi:10.2307/3211287

Rumberger, R. W. (2015). *Student mobility: Causes, consequences, and solutions*. National Education Policy Center. Retrieved from http://nepc.colorado.edu/publication/student-mobility

Rumberger, R. W., & Larson, K. A. (1998). Student mobility and the increased risk of high school dropout. *American Journal of Education*, *107*, 1–35. doi:10.1086/444201

Rumberger, R. W., Larson, K. A., Ream, R. K., & Palardy, G. J. (1999). *The educational consequences of mobility for California students and schools*. Policy Analysis for California Education. Retrieved from http://files.eric.ed.gov/fulltext/ED441040.pdf

Sanders, W. L., & Rivers, J. C. (1996). Cumulative and residual effects of teachers on future student academic achievement. Retrieved from http://beteronderwijsnederland.net/files/cumulative%20and%20residual%20effects%20of%20teachers.pdf

Schafft, K. A. (2009). Poverty, residential mobility, and student transiency within rural and small town contexts. Paper presented at the Workshop on the Impact of Mobility and Change on the Lives of Young Children, Schools, and Neighborhoods, National Academies, Washington, DC, June 29–30.

Schwartz, A., Stiefel, L., & Cordes, S. (2017). Moving matters: The causal effect of moving schools on student performance. *Education Finance and Policy*, *12*(4), 419–446. https://doi.org/10.1162/edfp_a_00198

Schwartz, A. E., Stiefel, L., & Chalico, L. (2009, November 18) The multiple dimensions of student mobility and implications for academic performance: Evidence from New York city elementary and middle school students. Retrieved from https://ssrn.com/abstract=1508603

South, S., Haynie, D., & Bose, S. (2007). Student mobility and school dropout. *Social Science Research*, *36*(1), 68–94. https://doi.org/10.1016/j.ssresearch.2005.10.001

Swanson, C. B., & Schneider, B. (1999). Students on the move: Residential and educational mobility in America's schools. *Sociology of Education*, *72*, 54–67. doi:10.2307/2673186

Todd, P., & Wolpin, K. (2003). On the specification and estimation of the production function for cognitive achievement. *Economic Journal*, *113*(485), F3–F33. https://doi.org/10.1111/1468-0297.00097

Welsh, R., Dubuque, M., & McEachin, A. (2016). School choice, student mobility, and school quality: Evidence from post-Katrina New Orleans. *Education Finance and Policy*, *11*(2), 150-176. Doi: https://doi.org/10.1162/EDFP_a_00183

Welsh, R. O. (2017). School hopscotch: A comprehensive review of k–12 student mobility in the United States. *Review of Educational Research*, *87*(3), 475–511. https://doi.org/10.3102/0034654316672068

Xu, Z., Hannaway, J., & D'Souza, S. (2009). *Student transience in North Carolina: The effect of mobility on student outcomes using longitudinal data* (Working Paper No. 22). National Center for Analysis of Longitudinal Data in Education Research. Retrieved from http://www.caldercenter.org/sites/default/files/1001256_student_transience.pdf

Zimmer, R. W., & Guarino, C. M. (2013). Is there empirical evidence that charter schools "push out" low-performing students? *Educational Evaluation and Policy Analysis*, *35*, 461–480. doi:10.3102/0162373713498465

Zimmer, R., Henry, G. T., & Kho, A. (2017). The effects of school turnaround in Tennessee's achievement school district and innovation zones. *Educational Evaluation and Policy Analysis*, *39*(4), 670–696. https://doi.org/10.3102/0162373717705729