Mobility in Maine Schools:

Impact on Student Performance and Proficiency

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EXECUTIVE SUMMARY

As part of the AY2018 Maine Education Policy Research Institute (MEPRI) work plan, the Education and Cultural Affairs Committee of the Maine State Legislature commissioned a report examining the nature and impact of student mobility in Maine schools. This report summarizes analyses using state assessment and student demographic data provided by the Maine Department of Education from AY2011 (i.e., the 2010-2011 academic year) through AY2017 (i.e., the 2016-2017 academic year), with a particular focus on data from AY2016 and AY2017. The report focuses specifically on ***non-promotional mobility,*** which occurs when a student transitions out of their current school before graduating from the highest grade in that school. Non-promotional mobility can result from a variety of factors, such as a family relocation due to a change in employment, financial need, or a family seeking services in a new district. The report does not address promotional mobility, which is the normal course of transitioning from the highest grade in one school to a new school – for example, such as transitioning from elementary school to middle school. For this report, non-promotional mobility is measured as the number of years in which a child is impacted by non-promotional mobility. As such, it reflects a year-to-year change in enrollment, and would include a move over the summer, if it reflected a non-promotional move. Note that multiple moves within the same academic year are seen as "one" year impacted by mobility and are not separated or counted as multiple occurrences within the same year.

The report examined non-promotional mobility in several ways over different time periods and outcomes in order to determine whether common themes emerged in how mobility impacted students. The report begins by summarizing the extent and nature of non-promotional mobility at the student-level, before examining the degree and correlates of non-promotional mobility at the school-level. The report then transitions from describing the relationship between mobility and student or school characteristics, to exploring the potential impact of mobility on student academic achievement. This included examining (1) short-term effects of mobility on student performance, (2) the effect of longer, multiyear trends in mobility, and (3) the impact of moving into a higher or lower performing school.

EXTENT OF MOBILITY AMONG STUDENTS AND SCHOOLS

Mobility at the Student Level. Based on student records from AY2011 through AY2017, each year approximately 6.9% of students are impacted by a non-promotional move. For students enrolled throughout this 7-year period, 27.1% experienced at least one year with a non-promotional move. This suggests that over time a relatively large percentage of students have at least one year that is impacted by a non-promotional move.

Not surprisingly, student mobility was found to be related to eligibility for free/reduced lunch (a marker of lower family income). In any given year, approximately 10.1% of students identified

as eligible for free/reduced lunch experienced a non-promotional move each year. This was 2.3 times the rate of students not identified as eligible. Similarly, 9.4% of students enrolled in special education experienced at least one non-promotional move each year, a rate which was 47% greater than students not enrolled in special education. Higher annual rates were also seen for students who were ethnic minority (26.9% higher) and students identified as having limited English proficiency (16.2% higher).

Mobility at the School Level. Analyses examining mobility at the school level found that the average school mobility rate was 7.9%, with considerable variability in these school rates: Ten percent of schools had annual mobility rates of 13% or more, and nearly three percent had annual mobility rates of 20% or more. Understandably, schools with the very highest rates tended to be non-traditional or alternative schools whose mission involved focusing on higher-risk students.

Not surprisingly, schools with higher free/reduced lunch rates and higher special education rates also experienced higher mobility rates, but this increase was largely seen for schools whose free/reduced lunch and special education rates were above the mean – less of a difference was seen in mobility rates for schools whose free/reduced lunch and special education rates were below the mean. Similarly, schools with higher proportions of ethnic minority students and schools with lower overall enrollment numbers also experienced higher mobility rates.

SHORT-TERM IMPACT OF NON-PROMOTIONAL MOBILITY

The impact of non-promotional mobility was examined in three ways: (1) short-term effects of mobility on student performance, (2) the effect of longer, multiyear trends in mobility, and (3) the impact of moving into a higher or lower performing school.

The more short-term impact of mobility was examined using AY2016 and AY2017 math and English language arts (ELA) state assessment data. AY2016 and AY2017 were selected in part because both years used the same assessment instrument (eMPowerME). Analyses were conducted based on 65,035 students enrolled in 3rd through 8th grade for both years so that the change in student relative performance across years could be examined. Mobility patterns for were reviewed and students were coded into four groups:

1) Non-mover (N=57,189)
2) Non-promotional move that ***only*** impacted the prior year, AY2016 (N=3694)
3) Non-promotional move that ***only*** impacted the current year, AY2017 (N=3429)
4) Non-promotional moves that impacted both AY2016 and AY2017 (N=723)

Impact on Student Percentile Scores. Mobility was found to be highly related to students AY2017 percentile scores in both math and ELA. The estimated scores for a student with no moves during the prior two years was at the 50.8 percentile in both math and ELA. Students who were impacted by a move in one of the two years had lower scores in both math and ELA, ranging from the 42.0 to 43.9 percentile. However, on average students with moves in both

years performed the lowest, with scores at the 36.4 percentile in math and 36.8 percentile in ELA.

Not surprisingly given the association between mobility and student characteristics, follow-up analyses suggested that approximately 55.3% of the mobility difference in math percentile scores and 59.1% of the difference in ELA percentile scores was related to other student demographic differences. Therefore, a final pair of analyses examined differences in percentile scores based on these mobility groups, after statistically controlling for student demographic differences and student's test scores from the previous year. This provides a more conservative test of the impact of mobility, because it is predicting the ***difference*** between how a student actually scored and ***what one would have expected*** given their free/reduced lunch status, special education status, race/ethnicity, sex, grade in school, and state testing scores from the previous year.

Even after controlling for all other factors, mobility continued to have a significant impact, particularly on performance in math. A move impacting one year resulted in predicted scores being 1.2 percentile points lower than expected in math and 0.53 to 0.58 percentile points lower in ELA. A move in both years results in predicted scores being 2.3 percentile points lower in math and 1.05 percentile points lower in ELA. For context, the effect associated with free/reduced lunch status was a reduction of 4.29 percentile points in math. In other words, the impact of high-mobility (i.e., moves impacting two years) on math scores, was equivalent to over half (54%) of the effect of free/reduced lunch status – a well-documented indicator of lower income status widely seen as an important effect.

A series of follow-up analyses found that the short-term impact of mobility was greatest for more highly mobile students (i.e., those with moves in both years) who were initially high performing in math or ELA. Specifically, predicted scores for highly mobile students who initially performed at the 80th percentile in AY2016 declined by 5.95 percentile points in math and 4.01 percentile points in ELA – both larger than the corresponding effect of free/reduced lunch.

Impact on Student Proficiency Levels. Analyses also examined whether non-promotional mobility increased risk of being identified as either (a) "well below", or (b) "below" state expectations in math and ELA. Without controlling for any other student characteristics, students with a non-promotional move impacting one of the last two years were at double or more the odds of performing "well below" state expectations in math (increased odds 2.04 to 2.26) and ELA (increased odds 2.07 to 2.20). In cases where non-promotional moves impacted both years, the odds of being well below expectations were 3.91 times greater in math and 3.72 times greater in ELA. When looking at the increased risk for performing "below" (but not "well below") expectations, a non-promotional move impacting one year increased the odds by 62% to 63% for math and 40% to 46% for ELA. The odds increased by 132% in math and 136% in ELA if non-promotional moves impacted both years.

Not surprisingly, odds decreased after controlling for student demographics and prior state testing, with the odds of performing well below expectations increasing 33% to 39% in math and 25% to 28% in ELA if a non-promotional move impacted one year, and 65% in math and 34% in ELA if a non-promotional move impacted both years. For context, this translates to one-fourth to one-half the effect associated with lower-income status for math, and approximately one-third that for ELA.

When focusing on the increased risk of performing "below" expectations, after controlling for student demographics and prior testing, a move impacting one year increased the odds by 14% to 21% in math and only 8% to 9% in ELA. This increased to 27% in math and 31% in ELA if moves impacted both years.

LONG-TERM MOBILITY TRENDS AND IMPACT

A second series of analyses examined the relationship between longer-term mobility and student academic outcomes. This focused on 137,350 students who were (1) enrolled for at least two years between AY2011 and AY2017 and (2) had at least two years of grade 3-8 state assessment data. Mobility was calculated as a ***mobility rate***: The mean number of years in a 5-year period in which a student experienced a non-promotional move. Not surprisingly, 72.8% of students had a mobility rate of zero – they had no non-promotional moves during this time, 11.2% (N=15,311) had a mobility rate equal to or greater than 1.00 (i.e., an average of one out of five years impacted by a non-promotional move), and 2.9% (N=4,033) had a mobility rate of two or more (i.e., an average of two out of five years impacted by a non-promotional move).

Impact on Percentile Scores. When examining simple effects without controlling for any student characteristics, predicted percentile scores for both math and ELA were reduced approximately 7 percentile points for each year (in the equivalent of a five-year period) that a student experienced a non-promotional move. After controlling for student demographic differences and prior testing, this was reduced to approximately a 1.4 percentile point decline in math and ELA for each year that a student experienced a non-promotional move. For context, this is approximately one-quarter the size of the effect for free/reduced lunch status.

Follow-up analyses found that this effect varied based on a number of student characteristics. As was found for short-term mobility, the negative effect was greater for students who were initially higher performing. For example, predicted scores for a student who initially performed at the 80th percentile, but experienced 2 in 5 years impacted by mobility, were reduced by 5.20 percentile points in math, and 3.66 percentile points in ELA. Consistent with this pattern, after controlling for student demographics, the negative effect of mobility was also found to be greater for students ***not*** enrolled in special education and for students ***not*** identified as eligible for free/reduced lunch. The negative effect was also greater for females specifically in regards to ELA.

Impact on Proficiency Levels. When not controlling for any student characteristics, for each year a student experienced a non-promotional move the odds of performing "well below" state expectations increased 83% in math and 82% in ELA and the odds of performing "below" state expectations increased 51% for math and 45% for ELA. These odds were naturally reduced after adjusting for demographic differences and prior testing, to increased odds of 27% in math and 41% in ELA for performing well below expectations, and increased odds of 21% in both math and ELA for performing below expectations (with each year a student experienced a non-promotional move).

A series of follow-up analyses found that the effect of long-term mobility on proficiency continued to be greatest for more highly mobile students (i.e., those with moves multiple years) who were initially high performing in math or ELA. For example, if a student initially performed at the 80th percentile in math, their odds of performing well below expectations increased by 79% if two in five years were impacted by non-promotional mobility.

IMPACT OF MOVEMENT INTO HIGHER OR LOWER PERFORMING SCHOOLS

Given the results have consistently shown that mobility has a negative effect on academic performance, a final question addressed in this report is whether movement into a higher or lower performing school can either offset or further accentuate this effect. In other words, is there an additional effect based on whether a student moves from a school with overall low test scores into a school with overall higher test scores – does movement into a ***higher*** performing school have an additional positive impact? Does moving into a ***lower*** performing school have an additional negative impact? These questions were addressed in a final series of analyses that examined the effect of changes in overall school performance following a non-promotional move. These analyses were addressed using the previously described long-term mobility dataset.

To accomplish this, a new variable – the ***change in school performance*** – was created for each case of non-promotional mobility. This was calculated as the difference between the mean percentile score for the new school minus the mean percentile score for the previous school. Change in school performance was calculated separately for each year for each student, with the value set at zero if a student did not experience a non-promotional move in the corresponding year. Positive scores indicated a student moved into a higher performing school, while negative scores indicated they moved into a lower performing school. Among students with at least one non-promotional move, the average change in school-wide performance was 0.33 percentile points for math (SD=8.59) and 0.44 percentile points for ELA (SD=8.65). This suggests that while students were moving fairly evenly into both higher and lower performing schools, there was nevertheless considerable case-by-case variability in both directions.

Impact on Percentile Scores. After controlling for student demographic differences and prior testing, moving into a higher or lower performing school was related to both math and ELA percentile scores. On one extreme, predicted scores for students who moved into a school with a

mean 16 percentile points ***below*** their prior school, ***decreased*** 2.30 percentile points in math and 2.02 percentile points in ELA. On the other extreme, predicted scores for students who moved into a school with a mean 16 percentile points ***above*** their prior school, ***increased*** 2.30 and 2.02 percentile points, respectively. Follow-up analyses found that for math scores, this effect varied based on a student's initial level of performance, and continued to be greater for higher performing students. For example, the predicted score for students who initially performed at the 80th percentile was reduced 3.11 percentile points if the mean for their new school was 16 percentile points below their prior school, and increased 3.11 percentile points if the mean for the new school was 16 percentile points higher than their prior school.

Impact on Proficiency Levels. After controlling for student characteristics, prior testing, and mobility, moving into either a higher or lower performing school was highly related to proficiency in both math and ELA. If the mean for the new school was 16 percentile points lower than the prior school, the odds of performing well below expectations in math and ELA increased 38% and 28%, respectively; while the odds of performing below expectations increased 19% and 15%, respectively. On the other hand, if the mean for the new school was 16 percentile points higher than the prior school, the odds of performing well below expectations in math and ELA decreased 27% and 22%, respectively; while the odds of performing below expectations decreased 16% and 13%, respectively.

Follow-up analyses found that this effect varied based on a student's initial test score, but was consistent in that the benefit of moving into a higher performing school – and the negative effect of moving into a lower performing school – was greater for students who were themselves higher performing at their initial assessment. For example, if a student initially performed at the 80th percentile, the odds of performing well below expectations ***increased*** 72% if they moved into a school with a mean math score 16 percentile points below their prior school, while the odds ***decreased*** 42% if their new school had a mean 16 percentile points above their prior school. The same was true in regards to odds for performing below expectations in both math and ELA, although the differential effect due to student's initial state assessment score was smaller.

MID-YEAR MOBILITY

An appendix to the report provides additional analysis of the subgroup of students who move during the course of an academic year rather than over the summer, denoted as "mid-year" mobility. The negative effects of mobility are more pronounced for this group, which is also characterized by a higher poverty rate and higher proportion of students identified as having special educational needs.

INTRODUCTION

As part of the AY2018 *Maine Education Policy Research Institute* work plan, the Education and Cultural Affairs Committee of the Maine State Legislature commissioned a report examining student mobility in Maine. Research on student mobility has long documented its negative effect on academic outcomes, as well as it placing students at-risk for not completing high school (e.g., Gruman, Harachi, Abbott, Catalano, & Fleming 2008; Rumberger & Larson 1998; South, Haynie, & Bose 2007). When examining the impact of mobility, studies often broadly categorize it into either (1) ***promotional mobility***, which is the normal course of transitioning from the highest grade in one school to a new school, for example, such as transitioning from elementary school to middle school, and (2) ***non-promotional mobility,*** which occurs when a student transitions out of their current school before graduating from the highest grade in that school. Non-promotional mobility can result from a variety of factors, such as a family relocation due to a change in employment, financial need, or a family seeking services in a new district.

While both non-promotional and promotional mobility typically entail social re-adjustment, given a non-promotional move will include more dramatic changes in peers, classmates, and school environments, it is generally seen as more disruptive than a promotional move. Furthermore, non-promotional moves, particularly those to a new district, can lead to the loss of important student information, especially information not contained in a formal record. In contrast, promotional moves are more likely to have well-established systems in place to ensure that academic information and services continue smoothly. When well-implemented, this can help prevent any disruption in educational planning or support services a child may require.

The main report focuses on all ***non-promotional mobility***, and examines non-promotional mobility over time in order to assess the impact it has on students, and particularly highly-mobile students, across Maine. Non-promotional mobility is measured as the number of years in which a child is impacted by a non-promotional move. As such, it reflects a year-to-year change in enrollment, and would include non-promotional moves over the summer[1]. An appendix examines the impacts of the subset of student mobility that occurred within a recent school year.

The findings are based on Maine state assessment and student demographic data provided by the Maine Department of Education from AY2011 (i.e., the 2010-2011 academic year) through AY2017 (i.e., the 2016-2017 academic year), with particular attention to data from AY2016 and AY2017. Analyses describe both the overall impact of non-promotional moves on student

[1] Note that multiple moves within the same academic year are seen as "one" year impacted by mobility and are not separated or counted as multiple moves within the same year.

achievement, as well as assess the degree to which those effects vary based on key student demographic differences, such as free or reduced lunch status or race/ethnicity.

The report begins by summarizing the extent of non-promotional mobility for both students and schools. It then transitions from describing the relationship between mobility and student or school characteristics, to exploring the potential impact of mobility on student academic achievement. This included examining (1) short-term effects of mobility on student performance, (2) the effect of longer, multiyear trends in mobility, and (3) the impact of moving into a higher or lower performing school.

METHODS

The study used several different statistical approaches based on the specific data and time frame of each analysis. The intent was to examine non-promotional mobility in different ways in order to determine whether common themes emerged within the findings. As described later in the report, these included multi-level modeling, multinomial regression, and traditional multiple regression analyses.

VARIABLES USED IN ANALYSES

Outcomes: Four different academic achievement measures were used:

- Percentile scores on state standardized testing in grades 3-8 mathematics
- Percentile scores on state standardized testing in grades 3-8 English language arts (ELA)
- Mathematics proficiency levels
- ELA proficiency levels

Mobility: Student mobility was measured as a year-to-year non-promotional change in the school in which a student was enrolled based on annual census counts. Mobility was measured annually for each student, providing both a measure for a specific year, as well as an aggregate of mobility over multiple years. Note that when creating mobility scores for individual students, mobility is calculated as the number of year-to-year non-promotional moves: If a student had two non-promotional moves within a single year, their score for that year would be one, not two. Furthermore, in order to avoid unnecessary wordiness, the terms "mobility" and "non-promotional mobility" will be used interchangeably. ***But unless otherwise noted (e.g., a statement specifically using the term "promotional mobility"), all findings and discussion focus strictly on non-promotional mobility and should be interpreted as pertaining to non-promotional mobility***.

Student Characteristics: The following student characteristics were also included in analyses, in order to control for possible confounding effects with mobility (e.g., lower income families

were expected to have higher mobility rates), as well as to determine whether the mobility had a larger effect on any related subgroups:

- Student gender
- Race/ethnicity (generally coded as either ethnic minority or white/non-Hispanic)
- Special education status
- Free/reduced lunch status
- Grade level in school

Given that special education status and free/reduced lunch status may change over time, analyses reported here used a student's initial value for each. It should be noted that analyses not included in this report examined both as time-varying factors in which their values could change from year-to-year. Results for those analyses were consistent with those included in this report.

Prior Testing. A student's previous scores on state mathematics and ELA tests were also included as a possible covariate in order to examine the impact of mobility after controlling for a student's prior performance level.

FINDINGS

The report first summarizes the extent and nature of non-promotional mobility at the student-level, before examining the degree and correlates of non-promotional mobility at the school-level. The report reviews the impact of mobility on student academic achievement in three ways: (1) short-term effects of mobility on student performance, (2) the effect of longer, multiyear trends in mobility, and (3) the impact of moving into a higher or lower performing school.

EXTENT OF STUDENT MOBILITY

MOBILITY AMONG STUDENTS

Analyses first sought to assess the degree to which students in Maine experienced mobility[2]. Using data provided by the Maine Department of Education, a total of 300,008 students enrolled at any time from AY2011 (2010-2011) through AY2017 (2016-2017) were identified. During this time period, these students were enrolled in a Maine school from one to seven years (e.g., a 12th grade student in AY2011 and a kindergarten student in AY2017 would only have one year of enrollment possible). As described previously, for the purpose of these analyses, mobility was defined as a student changing schools from one year to the next when the grade in which they were enrolled in the new school was a grade that continued to be served by their previous school.

[2] Again, we are referring specifically to ***non-promotional mobility***, not promotional mobility.

Not surprisingly, the number of non-promotional moves students experienced increased with additional years of enrollment (see Figure 1). Given classification of a move required data from two years (i.e., enrollment in one school the first year and a different school in the second), students with only a single year of data could not classified as experiencing a non-promotional move. However, among those students with 7 years of data, 27.1% experienced at least one year with a non-promotional move. When summarized across years – and excluding data from cases where a year-to-year move was not possible given the available data (i.e., AY2011 and all students enrolled in kindergarten), this translates to on average of 6.9% of students experiencing a non-promotional move each year[3].

Figure 1. Number of years in which students experience non-promotional moves, based on their years of enrollment (AY2011 – AY2017).

Years Enrolled		Number of Years with Non-Promotional Move						
		0	1	2	3	4	5+	
1	n	45924	0	0	0	0	0	45924
	%	100.0%						
2	n	34731	4338	0	0	0	0	39069
	%	88.9%	11.1%					
3	n	29145	5236	863	0	0	0	35244
	%	82.7%	14.9%	2.4%				
4	n	26636	5655	1435	215	0	0	33941
	%	78.5%	16.7%	4.2%	0.6%			
5	n	22710	6113	1623	420	48	0	30914
	%	73.5%	19.8%	5.3%	1.4%	0.2%		
6	n	21774	6006	1940	571	122	13	30426
	%	71.6%	19.7%	6.4%	1.9%	0.4%	0.0%	
7	n	61626	16457	4667	1310	352	78	84490
	%	72.9%	19.5%	5.5%	1.6%	0.4%	0.1%	
Total		242546	43805	10528	2516	522	91	300008
		80.8%	14.6%	3.5%	0.8%	0.2%	0.0%	

Additional analysis of 2016-17 data as detailed in Appendix A demonstrates that about 2% of students experienced a mid-year move during the year. Since an average of 6.9% of all students have a non-promotional move each year, by extension we estimate that about one-third of non-promotional moves occur within the school year and two-thirds occur between school years.

[3] As noted previously, this does not factor in multiple non-promotional moves within a single year. Specifically, a single student who moved twice during the same year would be counted as "1" year-to-year non-promotional move.
[4] In contrast, a student's perspective would view this as one child with three moves.

Student Gender. As expected, student gender had no meaningful association with mobility: On average, 6.9% of female students and 6.8% of male students experienced a non-promotional move in any given year ($\chi^2(1, N=994{,}668)=3.831$, $p>.05$).

Race/Ethnicity. Mobility rates were slightly higher among ethnic minority students. Specifically, 6.7% of students who were white/non-Hispanic and 8.5% of students who were identified as ethnic minority had non-promotional moves in any given year. This corresponds to ethnic minority students being 26.9% more likely to experience a non-promotional move than their white/non-Hispanic peers ($\chi^2(1, N=994{,}668)=438.5$, $p<.001$).

Limited English Proficiency (LEP) Status. While the number of LEP students in Maine is relatively small, analyses examined the degree to which LEP status was related to mobility. Mobility rates for LEP students were slightly higher than non-LEP students (7.8% versus 6.8%, respectively), reflecting a 16.2% greater likelihood of a non-promotional move for an LEP student ($\chi^2(1, N=994{,}668)=51.2$, $p<.001$).

Mobility in Schools

Analyses then examined the degree to which schools varied in mobility. To do this, the student mobility data from AY2012 through AY2017 was aggregated at the school-level. Thirty-four schools with less than 50 records in the student-level data were excluded due to their small numbers. In addition, 22 schools that were started after AY2012 were excluded because (1) they understandably had a spike in non-promotional mobility in their first year, and (2) the issues associated with moving into a newly established school – that may include the same cohort of students and teachers if the school is in the same district – are fundamentally different than moving into an existing school. The result was a sample of 601 schools for these analyses.

Overall, the mean school-rate for non-promotional mobility was 7.9%, with a median of 6.7%. As illustrated in Figure 2, there was considerable variability in school mobility rates. Ten percent of schools had annual mobility rates of 13% or more, and nearly three percent had annual mobility rates of 20% or more. Understandably, schools with the very highest rates tended to be non-traditional or alternative schools whose mission involved focusing on higher-risk students.

Analyses then examined differences between schools based on their mobility rate.

School Free/Reduced Lunch Rate. Overall, schools had a mean free/reduced lunch rate of 47.9% (SD=19.0). Schools with higher free/reduced lunch rates also experienced higher mobility rates (b=0.083, $t(599)=6.700$, $p<.001$); however there was a curvilinearity to this trend (b=0.004, $t(598)=7.853$, $p<.001$). When the free/reduced lunch rate was below the mean, the estimated mobility rate was fairly flat and unrelated to a school's free/reduced lunch rate (see top-left panel of Figure 3). However, as a school's free/reduced lunch rate increased above the mean, the school's mobility rate also increased. This suggests that non-promotional mobility is a greater issue for those schools with a higher proportion of students from lower-income families.

School Special Education Rate. A similar, but less distinct pattern was seen in the relationship between school rates of special education and mobility. Overall, the mean special education rate for a school was 17.1% (SD=6.43). As the rate of students enrolled in special education increased, the school non-promotional mobility rate also increased (b=0.228, $t(599)=6.211$, $p<.001$), with a similar curvilinear effect (b=0.006, $t(598)=6.383$, $p<.001$). The estimated mobility rate was effectively flat and unrelated to a school's special education rate when the special education rate was below the mean. However, estimated mobility rates steadily increase once the rate of special education enrollment exceeds the mean (see the top-right panel of Figure 3). In sum, this suggests that non-promotional mobility is a greater issue for those schools with higher proportions of students enrolled in special education.

School Ethnic/Racial Distribution. A different, but statistically significant pattern was observed in the relationship between mobility and the percentage of the student population identified as ethnic minority. Overall, the mean percentage of students in a school who were ethnic minority was 8.2% (SD=10.1). As this increased, the school mobility rate also showed a modest increase (b=0.059, $t(599)=2.447$, $p=.015$; see the bottom left panel of Figure 3). What is not obviously apparent in that figure is that there was an additional curvilinear effect (b=-0.003, $t(598)=-3.390$, $p<.001$) that leads to the estimated mobility rate leveling-off around 11.5% for schools with particularly high levels of ethnic minority enrollment. In sum, this suggests that non-promotional mobility may be a greater issue for schools with higher rates of ethnic minority enrollment.

Figure 2. Mean year-to-year mobility rates for individual schools 2012-2017

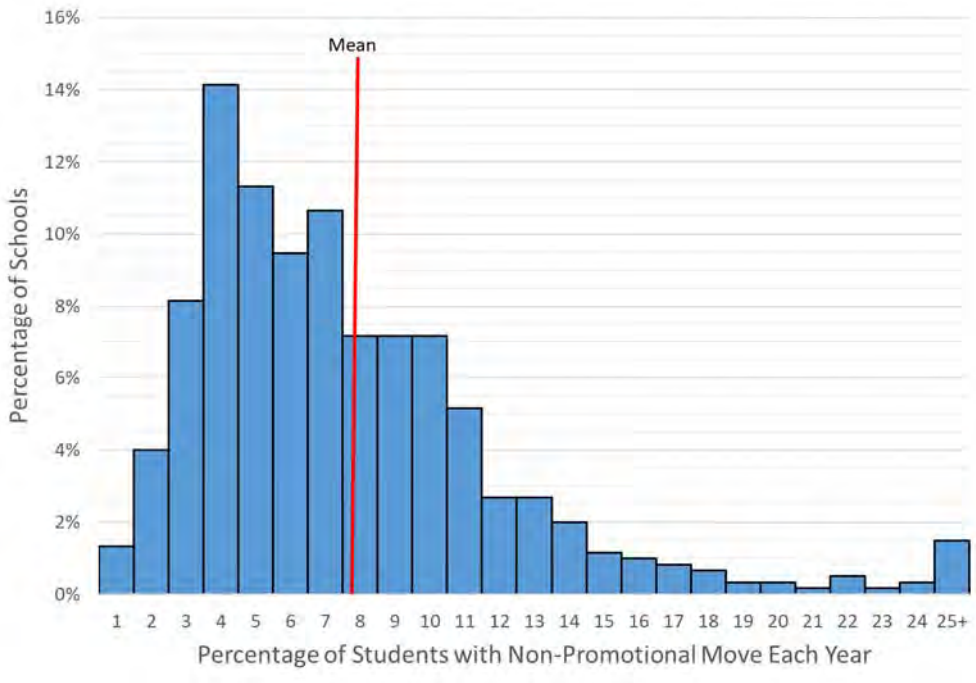
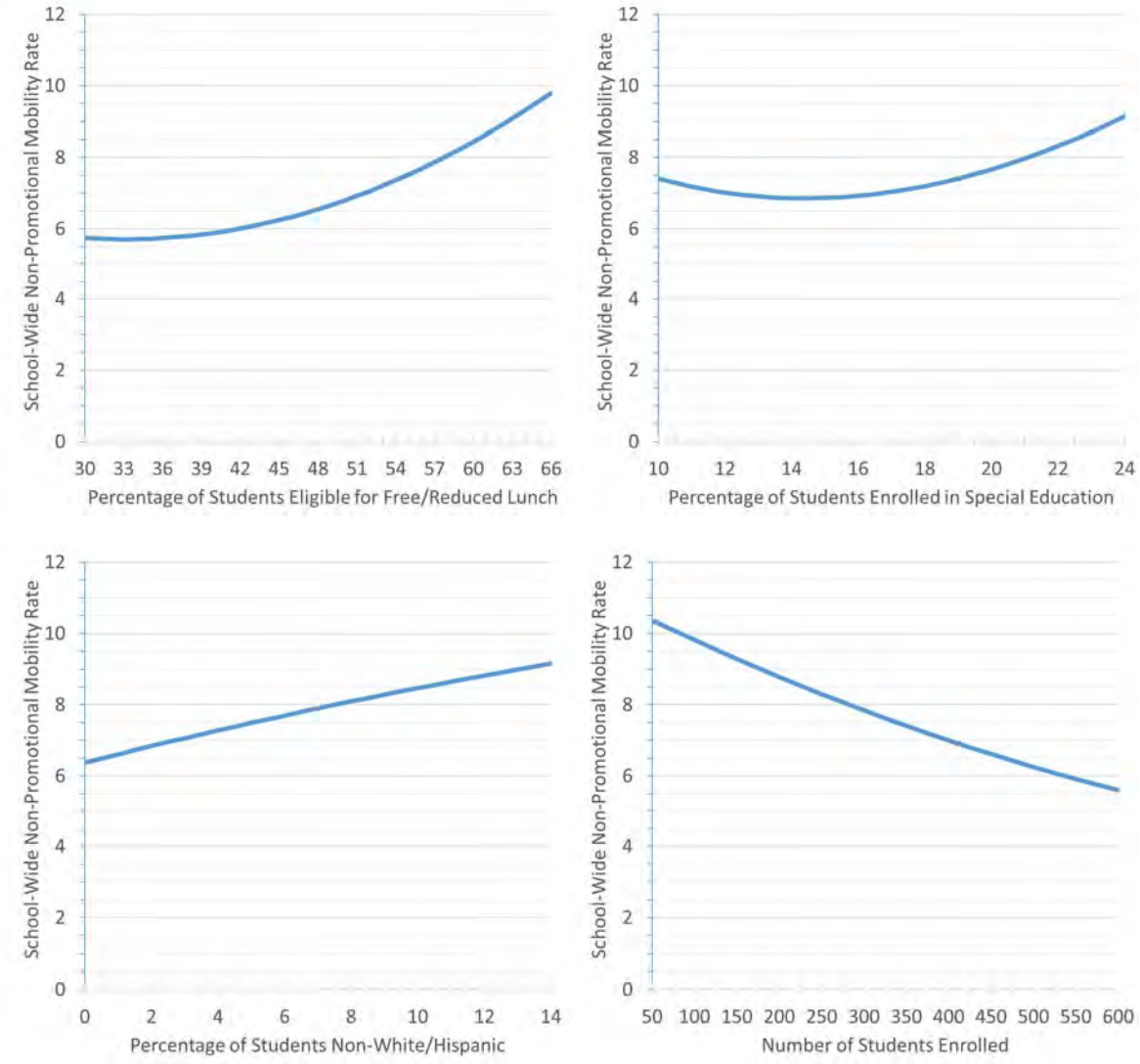


Figure 3. Estimated school-wide mobility rates based on school rates of free/reduced lunch, special education, ethnic minority status, and school enrollment size.



Total School Enrollment. A third type of pattern was seen in the relationship between school size – measured in total enrollment – and mobility. Overall, the mean school enrollment was 335.9 students (SD=268.2). In this case, as the enrollment size increased, the mobility rate decreased[5] (b=-0.626, $t(599)=7.149$, $p<.001$; see the bottom left panel of Figure 3), with an additional curvilinear effect (b=0.049, $t(598)=2.702$, $p=.007$). In sum, this suggests that mobility may be a relatively greater issue in smaller schools.

[5] For ease of interpretation of the analyses, enrollment was measured in units of 100 students – e.g., an enrollment of 335 students was converted to 3.35.

Analyses then transitioned from describing the relationship between mobility and student or school characteristics, to examining the potential impact of mobility on student academic achievement. Given inherent features of this data – for example, the use of three different instruments over the last four years – several different approaches were used. Analyses first examined more immediate, short-term effects of mobility on student AY2017 math and English language arts (ELA) percentile scores. This was followed by analyses examining similar short-term effects on student AY2017 math and ELA proficiency levels. The impact of longer, multiyear trends in mobility were then examined in connection to both percentile scores and proficiency levels. Finally, analyses examined the impact of moving into a higher or lower performing school on both percentile scores and student proficiency levels.

IMPACT OF SHORT-TERM MOBILITY ON AY2017 PERCENTILE SCORES

The first set of analyses focused on AY2016 and AY2017 math and English language arts (ELA) percentile scores, in part given that both are based on the same state assessment instrument (eMPowerME). Data consisted of Maine students enrolled in 3rd through 8th grade for both AY2016 and AY2017. Students were required to be enrolled in both years so that the change in their relative performance across years could be examined. Note that this requirement meant the students who were in 3rd grade in AY2017 and in 8th grade in AY2016 were excluded. The result was a sample of 65,035 students. Mobility patterns in AY2016 and AY2017 for these students were then reviewed and students were categorized into four groups:

5) Non-mover (N=57,189)
6) Non-promotional move that ***only*** impacted the prior year, AY2016 (N=3694)
7) Non-promotional move that ***only*** impacted the current year, AY2017 (N=3429)
8) Non-promotional moves that impacted both AY2016 and AY2017 (N=723)

Analyses used multilevel/hierarchical linear modeling in order to address student nesting within schools[6]. The outcome variables were 2017 percentile rank scores in mathematics and ELA.

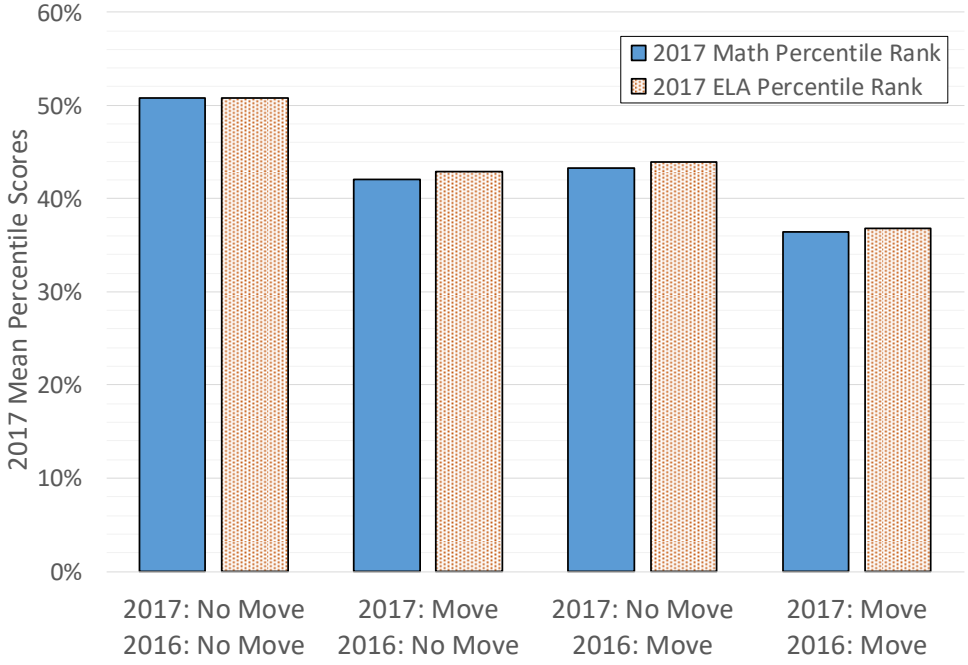
UNADJUSTED EFFECTS OF MOBILITY ON PERCENTILE SCORES

An initial model examined 2017 percentile scores based on the 4 mobility groups, but did not adjust for demographic differences or prior testing. Mobility was found to be highly related to 2017 performance in both math and ELA (math: $F(3, 62301.9)=208.572$; ELA: $F(3, 62264.7)=176.622$, $p<.001$). The estimated performance in math for a student with no moves[7] during the prior two years was at the 50.8 percentile (see Figure 4). The estimated score for students with a move impacting one year were lower, whether it impacted the current (42.0 percentile) or prior year (43.3 percentile). Scores were lowest for students with moves impacting both years (36.4

[6] All analyses were based on random intercept, fixed-slope models.
[7] Again, this specifically refers to year-to-year non-promotional moves.

percentile). Nearly identical patterns were seen in ELA performance: Students with no moves had predicted scores at the 50.8 percentile. The estimated ELA score for students with a move impacting one year was at the 42.9 percentile if it impacted the current year, and the 43.9 percentile if it impacted the prior year. The estimated ELA score for students with moves impacting both years was at the 36.8 percentile.

Figure 4. Mean mathematics and English language arts (ELA) 2017 percentile rank performance based on non-promotional moves during prior two years.



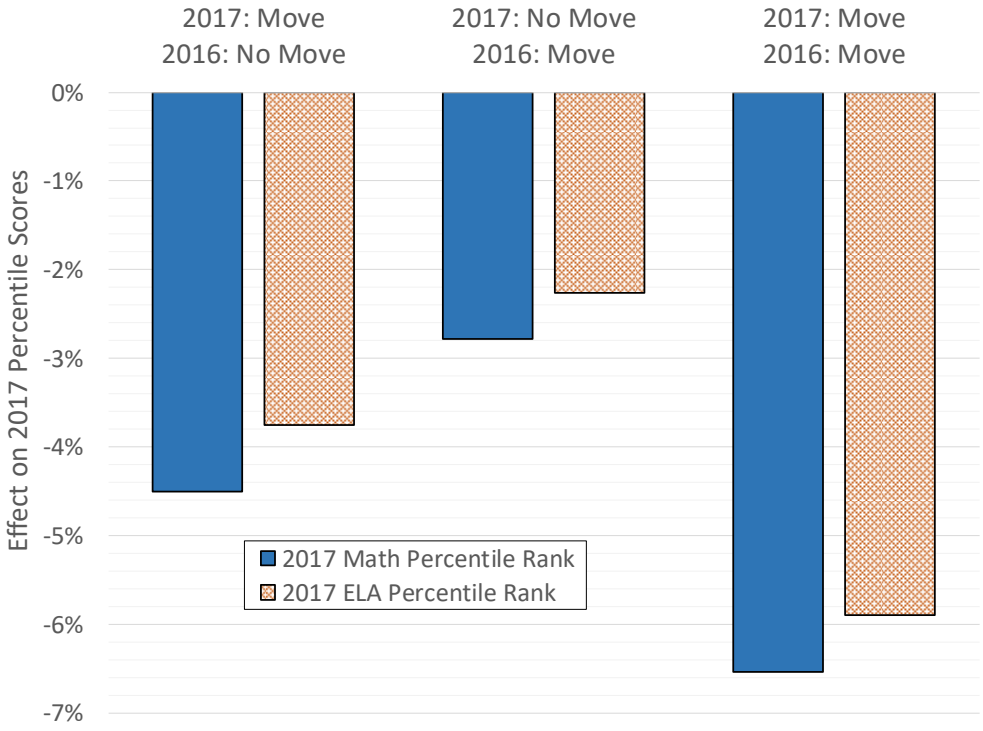
While this clearly illustrates how mobility is related to lower performance on state standardized tests, these same students were also more likely to have characteristics that are also associated with lower state assessment scores. This confound raises the question of the degree to which these differences are due to mobility or are in fact simply spurious effects due to a third factor, such as higher rates of free or reduced lunch eligibility or enrollment in special education.

ADJUSTED EFFECTS OF MOBILITY ON PERCENTILE SCORES.

Adjusted for Student Demographic Characteristics. Therefore, additional analyses estimated the impact of student mobility on state assessment performance after statistically controlling for free/reduced lunch status, special education status, race/ethnicity, gender, and grade in school. The result of these analyses suggested that approximately 55.3% of the mobility difference in math percentile scores and 59.1% of the difference in ELA percentile scores was related to these other student demographic differences. The estimated mobility effect after controlling for these student variables is illustrated in Figure 5, which shows the degree to which predicted 2017

percentile scores were lowered based on mobility during the previous two years. As seen in Figure 5, the smallest declines (2.8 percentile points for math, 2.3 percentile points for ELA) were seen when the move impacted the prior year, greater when the move impacted the current year (4.5 percentile points for math, 3.8 percentile points for ELA), and largest when moves impacted both years (6.5 percentile points for math, 5.9 percentile points for ELA).

Figure 5. Reduction in predicted math and ELA 2017 percentile scores based on non-promotional moves during prior two years, controlling for free/reduced lunch status, special education status, race/ethnicity, gender, and grade in school.



Adjusted for Prior Performance. A final set of analyses also controlled for prior testing using AY2016 percentile scores as an additional predictor of AY2017 performance. In effect, this changes the model from simply predicting AY2017 scores, to predicting the ***difference*** between how a student actually scored and ***what one would have expected*** given their performance in the previous year[8].

Mobility continued to have a significant impact on math performance, even after controlling for demographic differences and prior testing. A move in either of the previous two years resulted in predicted scores being 1.2 percentile points lower than expected (AY2016: $t(61263.0)=-3.636$,

[8] Also referred to as residualized change scores.

p<.001; AY2017: t(59508.0)=-3.388, p<.001). The reduction was nearly double this amount, 2.3 percentile points, if a student experienced moves in both years (t(61478.8)=-3.244, p=.001).

For context, the effect associated with free/reduced lunch status was a reduction of 4.29 percentile points (t(61103.0)=26.742, p<.001). In essence, the impact of high-mobility (i.e., moves impacting two years), was equivalent to over half (54%) of the effect of free/reduced lunch status – a well-documented indicator of lower income status widely seen as an important effect. Also, it is worth remembering that AY2017 math scores were adjusted for AY2016 scores. Consequently, the fact that a move impacting AY2016 continued to have a negative effect suggests that the impact of a non-promotional move may continue for at least one additional year after the move itself.

The same pattern was seen for ELA performance, although the actual size of the effect was slightly less than half of that seen for math (F(3,60346.8)=2.913, p=.033). Adjusting for student demographic differences and prior performance, a move that impacted AY2016 led to predicted scores being 0.53 percentile points lower (t(60961.8)=-1.868, p=.062), while a move that impacted AY2017 led to a 0.58 percentile point reduction (t(58236.2)=-1.885, p=.059). Once again, the reduction in predicted scores nearly doubled (1.05 percentile points), when a student experienced moves in both years (t(61423.8)=-1.653, p=.098). Note that while the overall effect of mobility was statistically significant, the individual effects of each mobility group were only marginally significant, making this interpretation more tentative.

VARIATION BASED ON STUDENT CHARACTERISTICS

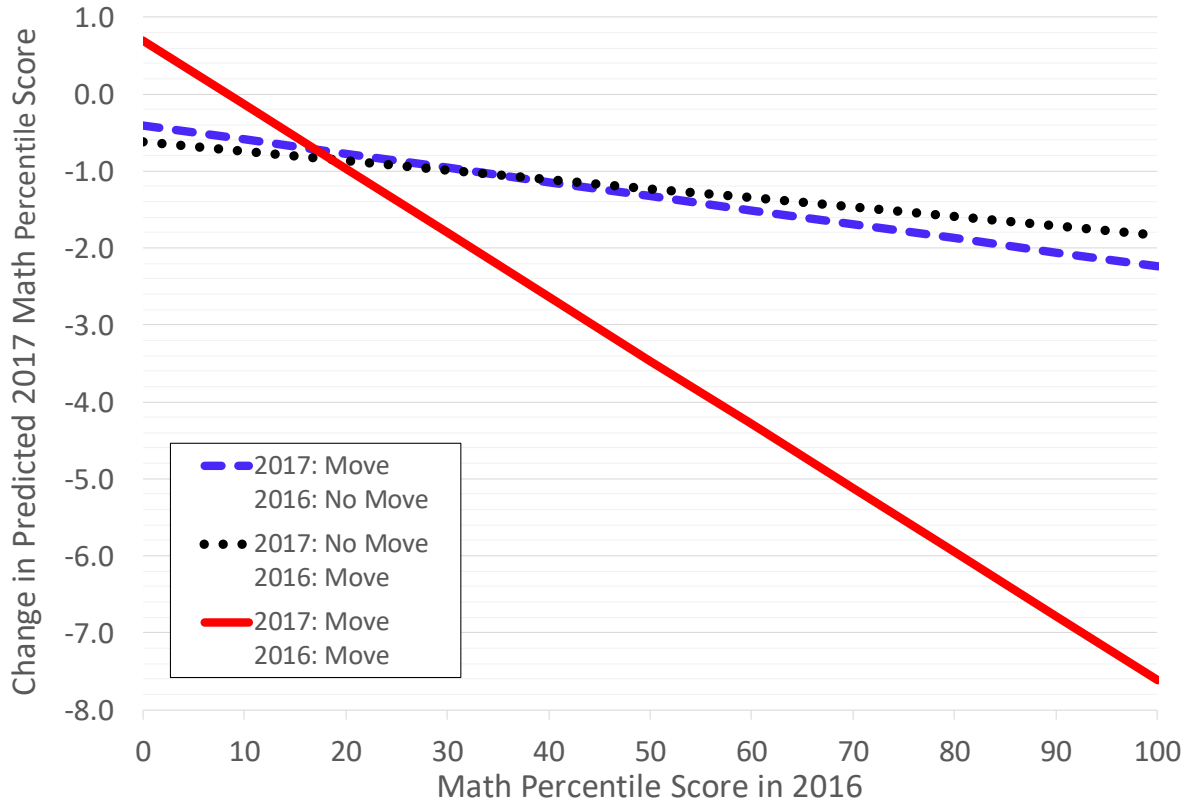
A final set of analyses examining the impact of short-term mobility on percentile scores tested possible interactions[9] between mobility and the various student characteristics, in order to see whether the effect of mobility varied for different subgroups of students. For example, does mobility have a larger (or smaller) effect on students from lower income families? All interaction analyses also controlled for student characteristics and AY2016 test scores.

Prior (AY2016) State Testing. First, after controlling for testing and student characteristics, a significant interaction was found between mobility and AY2016 scores when predicting AY2017 percentile scores in math (F(3, 61,380.6)=4.141, p=0.006). Figure 6 shows the degree to which mobility impacted AY2017 scores, relative to child who had no non-promotional moves during that time period. The horizontal x-axis covers the range of possible AY2016 student percentile scores. The vertical y-axis shows the predicted impact of different types of mobility on AY2017 percentile scores. A value of zero on the y-axis indicates that mobility had no effect on a student's predicted AY2017 performance, while a negative value indicates that mobility led to a ***reduction*** in predicted percentile scores and a positive value indicates that it led to an ***increase*** in predicted percentile scores. For example, in order to see the estimated impact for a student who

[9] Also referred to as moderator effects.

(a) performed at the 80th percentile in AY2016, and (b) had moves in both AY2016 and AY2017, one would first go to "80" on the x-axis and then move up to find the correspond point on the red line for students who moved in both years. Scrolling across to the y-axis, one can then see that the estimated score would decline by nearly six percentile points.

Figure 6. Predicted change in AY2017 math percentile scores based on non-promotional moves during prior two years and prior math performance.



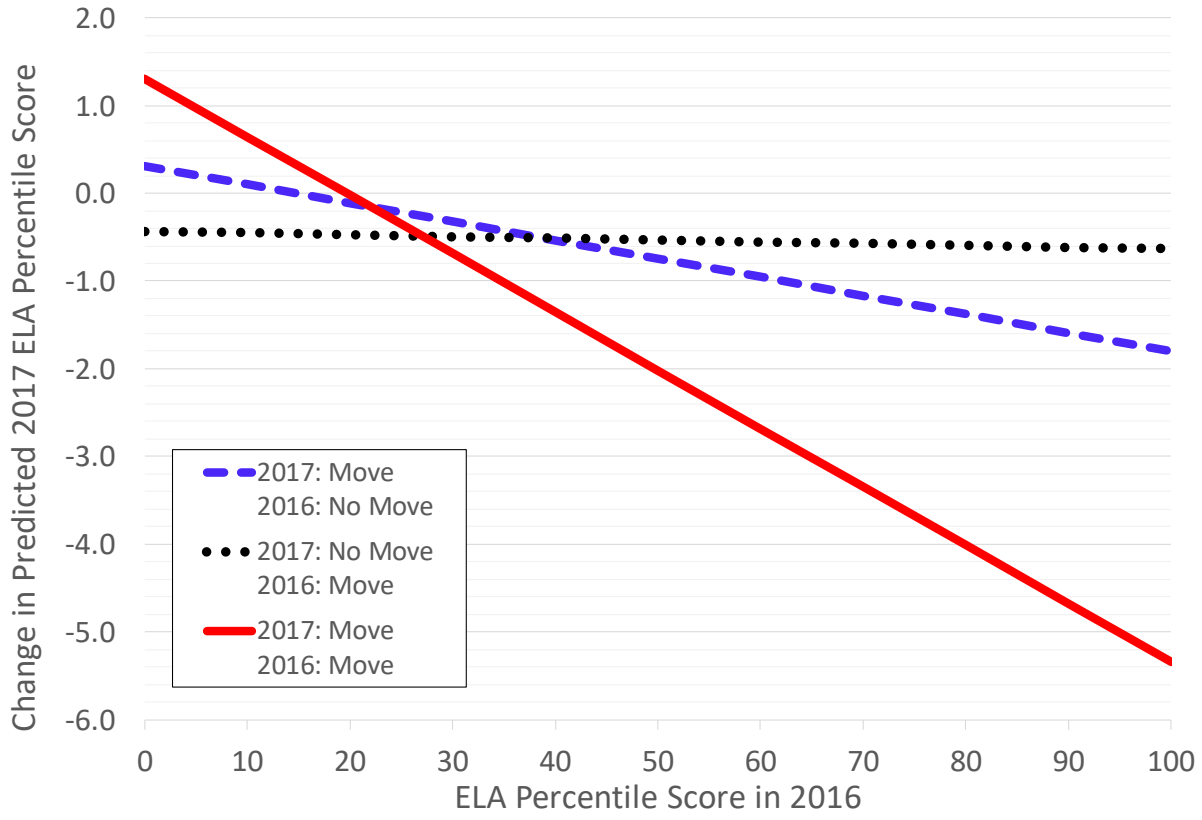
As we see in Figure 6, the pattern for a move impacting one year was similar whether that move impacted AY2016 or AY2017. While mobility had a negative effect in both cases, the effect did not vary based on students' AY2016 scores (AY2016: b=-0.012, t(61,391.1)=-1.082, p=0.279; AY2017: b=-0.018, t(61,375.4)=-1.554, p=0.120). In other words, the previously described negative effect associated with a move impacting one year was fairly consistent for both lower- and higher-performing students. This was not the case for students who experienced moves in both AY2016 and AY2017. For the more highly mobile students, the negative effect of moving increased dramatically in higher performing students (b=-0.083, t(61,375.4)=-3.058, p=0.002). For example, consider a student who performed at the 50th percentile in AY2016. If that student experienced a non-promotional move impacting both years, their predicted score in AY2017 was

reduced by 3.46 points. If they had performed at the 80th percentile in AY2016, their predicted score in AY2017 declined by 5.95 points. For context, the free/reduced lunch effect was a reduction of 4.284 points ($t(61{,}098.5)=-26.703$, $p<.001$). In essence, the reduction associated with high mobility was on par or larger than the reduction associated with lower income status for students who were previously in the top half of their cohort.

A somewhat similar pattern was observed when predicting AY2017 ELA test scores ($F(3, 61{,}325.3)=3.922$, $p=0.008$). Figure 7 shows the degree to which mobility impacted AY2017 ELA scores, relative to child who had no non-promotional moves during AY2016 and AY2017. Analyses continued to control for AY2016 scores and student demographic differences.

As we see in Figure 7, a non-promotional move impacting the AY2016 had relatively minimal effect on AY2017 performance, which was consistently small regardless of a student's AY2016 test score ($b=-0.002$, $t(61{,}355.7)=-0.203$, $p=0.840$). In contrast, a more recent move impacting AY2017 had a slightly more negative effect on higher performing students ($b=-0.021$,

Figure 7. Predicted change in AY2017 ELA percentile scores based on non-promotional moves during prior two years and prior ELA performance.



t(61,308.0)=-2.051, p=0.040). In essence, higher performing students experienced more of a negative impact from a recent non-promotional move than did lower performing students.

The latter trend was more pronounced for youth with moves years (b=-0.067, t(61,309.8)=-2.796, p=0.005). For example, predicted scores for students with moves in both years declined 4.01 percentile points for those who performed at the 80th percentile in AY2016, and 2.02 percentile points for those who performed at the 50th percentile in AY2016. For context, the effect of free/reduced lunch was 2.944 point decline (t(60,691.0)=-20.569, p<.001), making the effect of high mobility on par with the reduction associated with lower income status for students who were previously in the top half of ELA scores.

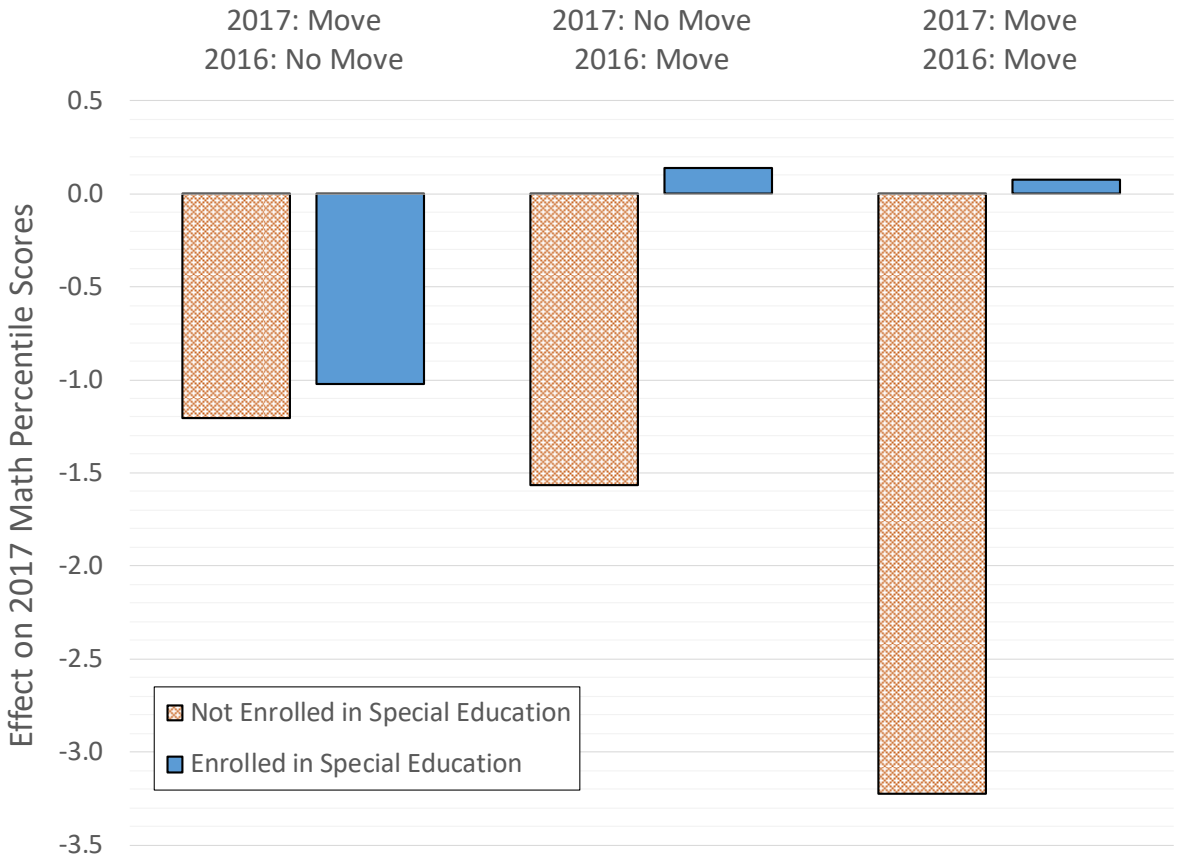
Special Education Status. In addition, after controlling for prior testing and student characteristics, analyses found a significant interaction between mobility and special education status when predicting AY2017 math percentile scores (F(3, 61322.8)=3.154, p=0.024). In essence, while mobility had significant negative effects for children not enrolled in special education, the effect of mobility for children enrolled in special education was relatively suppressed (see Figure 8) – the exception being those with a move that only impacted AY2017.

In contrast, no difference was found in the relationship between mobility and special education status as predictors of AY2017 ELA percentile scores (F(3, 61274.7)=0.596, p=0.618). In other words, unlike math scores, the negative effect of mobility on ELA performance was similar for both students enrolled in special education and students not enrolled in special education.

Grade in School. After controlling for prior performance and student demographic differences, analyses found no difference in the relationship between mobility and grade in school (F(3, 60626.8)=2.286, p=0.077) as predictors of AY2017 math scores. When predicting AY2017 ELA scores, a relatively minor difference (F(3, 60056.8)=2.709, p=0.043) suggested that the effect of mobility in the immediate prior year may be larger for students in earlier grades.

Other Student Characteristics. No other statistically significant interaction effects were found between mobility and student characteristics when predicting either AY2017 math or ELA scores. These included interactions between mobility and free/reduced lunch status (math: F(3, 61394.2)=1.076, p=0.358; ELA: F(3, 61344.8)=0.440, p=0.724), student sex (math: F(3, 61378.8)=0.461, p=0.709; ELA: F(3, 61220.3)=2.335, p=0.072), and ethnic minority status (math: F(3, 61378.8)=0.461, p=0.709; ELA: F(3, 61328.1)=0.832, p=0.476). In essence, the lack of interactions suggest that the negative effect of mobility is approximately the same for students across socio-economic status, as well as for males and females and ethnic minority and white/non-Hispanic youth.

Figure 8. Predicted change in AY2017 ELA percentile scores based on non-promotional moves during prior two years and special education status.



IMPACT OF SHORT-TERM MOBILITY ON PROFICIENCY LEVELS

In addition to student test scores, proficiency in math and ELA provides an alternative way of examining the impact of mobility on academic achievement. Therefore, a series of multinomial regressions were conducted that used student demographic characteristics, prior testing, and mobility patterns as predictors of AY2017 proficiency in math and ELA.

For these analyses, proficiency was coded into three categorical values:

(1) Well below state expectations
(2) Below state expectations
(3) At or above state expectations

These multinomial regressions assessed the increase in odds that a student who experienced non-promotional mobility performed either (a) "well below", or (b) "below" state expectations. Analyses first examined simple effects without controlling for any other variables, before controlling for prior testing and student demographic differences.

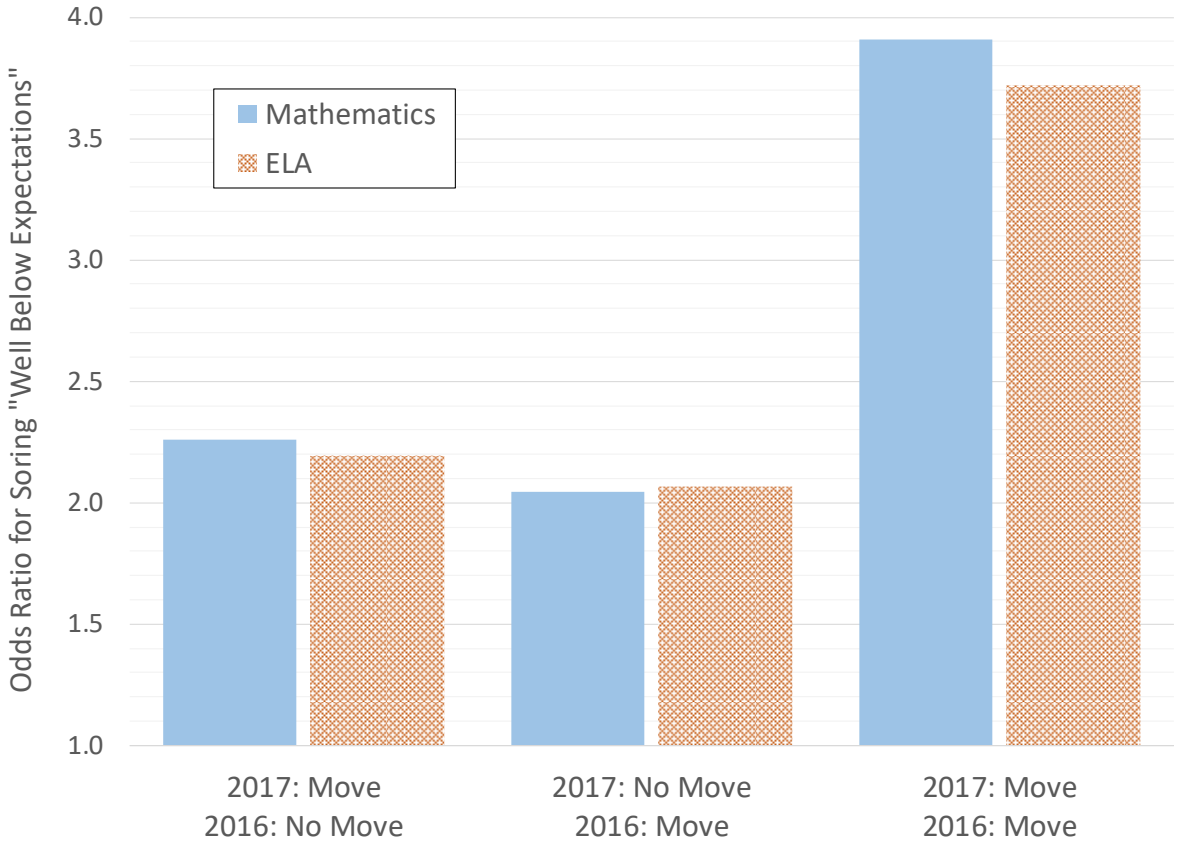
UNADJUSTED EFFECTS OF MOBILITY ON PROFICIENCY LEVELS

In a simple model that did not control for prior testing or student demographic differences, non-promotional mobility was found to be highly related to AY2017 student proficiency in math and ELA (math: $\chi^2(6)=683.2$, p<.001; ELA: $\chi^2(6)=684.2$, $p<.001$).

Risk of Performing Well Below Expectations. Mobility was found to be highly related to an increased risk of performing well below state expectations in both math and ELA.

Well Below Expectations in Math. Analyses found that students with a move in one of the last two years were at double or more the odds of performing "well below" state expectations in math. This was true whether the move impacted AY2017 or AY2016 (AY2017: b=0.815, $\chi^2(1)=291.5$, $p<.001$, OR=2.26; AY2016: b=0.714, $\chi^2(1)=244.0$, $p<.001$, OR=2.04). In cases where moves impacted both years, the odds of being well below expectations in math were nearly four times greater (b=1.363, $\chi^2(1)=149.1$, $p<.001$, OR=3.91). The increased odds of performing "well below" expectations in math are presented in the solid blue bars in Figure 9.

Figure 9. Unadjusted odds-ratios for performing "well below" state expectations on AY2017 math and ELA assessments based on non-promotional moves during prior two years.

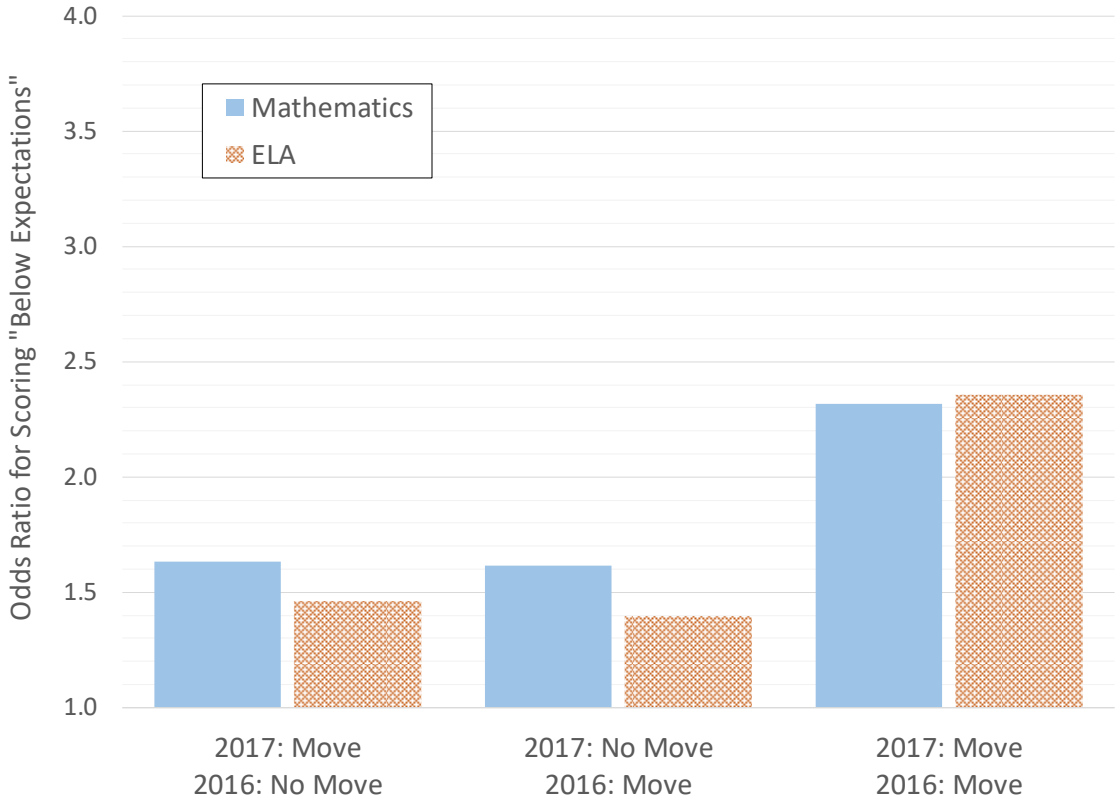


Well Below Expectations in ELA. The same pattern was observed for the risk of performing well below expectations in ELA. Students with a move in one of the last two years were at double or more the odds of performing well below expectations, whether the move impacted AY2017 or AY2016 (AY2017: b=0.786, $\chi^2(1)=295.0$, $p<.001$, OR=2.20; AY2016: b=0.727, $\chi^2(1)=275.8$, $p<.001$, OR=2.07). Moves impacting both years increased the odds of scoring well below expectations by 3.72 times (b=1.314, $\chi^2(1)=169.4$, $p<.001$, OR=3.72). The increased odds for performing well below ELA expectations are shown in the checkered orange bars in Figure 9.

Risk of Performing Below Expectations. The same general pattern, but less extreme, was observed with the increased odds of performing "below" state expectations[10] in math and ELA.

Below State Expectations in Math. As illustrated in the solid blue bars in Figure 10, the odds of being identified as below expectations in math increased by 62% if a move impacted AY2016 (b=0.479, $\chi^2(1)=123.2$, $p<.001$, OR=1.62), increased 63% if a move impacted AY2017 (b=0.491,

Figure 10. Unadjusted odds-ratios for performing "below state expectations" on AY2017 mathematics and ELA assessment based on non-promotional moves during prior two years.



[10] Reflecting state terminology, we will refer to this category as "below" expectations; however, it must be remembered that this does not include students identified as "well below" expectations. Any reference to students "below" expectations refers only to this group, and does not include students performing "well below" expectations.

$\chi^2(1)=114.1$, $p<.001$, OR=1.63), and increased 132% if non-promotional moves impacted both years (b=0.84, $\chi^2(1)=56.1$, $p<.001$, OR=2.32).

Below State Expectations in ELA. Similarly, **t**he odds of performing below expectations in ELA increased by 40% if the move impacted AY2016 (b=0.335, $\chi^2(1)=66.0$, $p<.001$, OR=1.40), increased by 46% if the move impacted AY2017 (b=0.381, $\chi^2(1)=76.9$, $p<.001$, OR=1.46), and increased 136% if both years were impacted by non-promotional moves (b=0.858, $\chi^2(1)=75.9$, $p<.001$, OR=2.36) (see the checkered orange bars in Figure 10).

ADJUSTED EFFECTS OF MOBILITY ON PROFICIENCY LEVELS

Not surprisingly, the size of mobility effects on mathematics and ELA proficiency decreased significantly after statistically controlling for student demographic characteristics (i.e., free/reduced lunch status, special education status, race/ethnicity, student sex, grade in school, and prior state mathematics performance). Nevertheless, mobility continued to be highly related to AY2017 proficiency in both math and ELA (math: $\chi^2(6)=51.3$, $p<.001$; ELA: $\chi^2(6)=26.5$, $p<.001$).

Risk of Performing Well Below Expectations

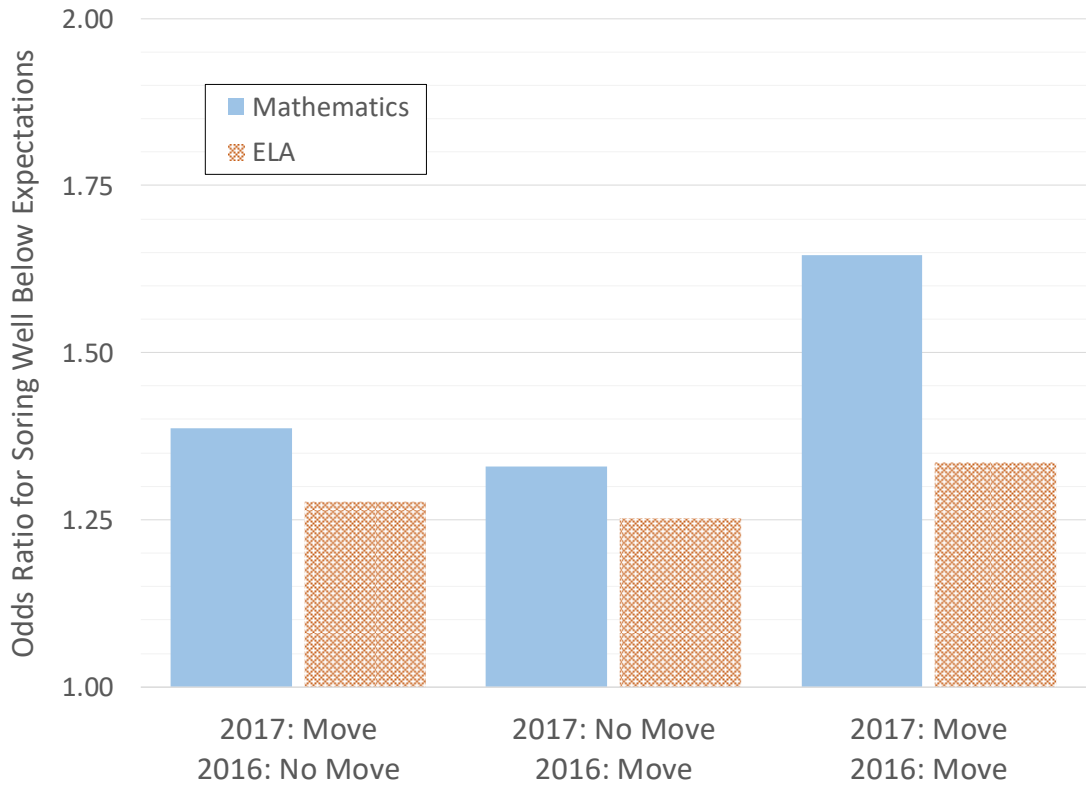
Well Below Expectations in Math. After controlling for student characteristics and prior testing, mobility impacting either AY2016 or AY2017 was associated with a 33% or 39%, respectively, increase in the odds that a student would be identified as well below expectations in math (AY2016: b=0.285, $\chi^2(1)=19.0$, $p<.001$, OR=1.33; AY2017: b=0.327, $\chi^2(1)=22.9$, $p<.001$, OR=1.39). This increased to 65% for students with non-promotional moves impacting both years (b=0.499, $\chi^2(1)=10.4$, $p=0.001$, OR=1.65). These increased odds are illustrated in the solid blue bars in Figure 11.

For context, it should be noted that being identified as eligible for free/reduced lunch increased the odds that a student would perform well below expectations by 131% (b=0.838, $\chi^2(1)=705.1$, $p<.001$, OR=2.31). In essence, after controlling for free/reduced lunch status, special education status, race/ethnicity, sex, grade in school, and testing performance, the effect of mobility was approximately one-fourth to one-half the effect associated lower-income status.

Well Below Expectations in ELA. The pattern for ELA proficiency differed somewhat from mathematics proficiency. After controlling for student characteristics and prior testing, mobility impacting either AY2016 or AY2017 was associated with a 25% or 28%, respectively, increase in the odds that a student would be identified as well below expectations in ELA (AY2016: b=0.225, $\chi^2(1)=10.7$, $p=0.001$, OR=1.25; AY2017: b=0.244, $\chi^2(1)=11.7$, $p=0.001$, OR=1.28). This increased to 34% if both years were impacted (b=0.289, $\chi^2(1)=3.6$, $p=0.058$, OR=1.34) – an increase, but less of a relative increase than was observed for proficiency in math. These increased odds are illustrated in the checkered orange bars in Figure 11.

For context, after controlling for all other variables, eligibility for free/reduced lunch increased the odds a student would be identified as performing well below ELA expectations by 87% (b=0.628, $\chi^2(1)=319.4$, $p<.001$, OR=1.87). In other words, after controlling for all other variables and prior state testing, the effect of mobility was approximately one-third that of lower-income status.

Figure 11. Adjusted odds-ratios for performing "well below" expectations in math and ELA in AY2017 based on non-promotional moves.



Risk of Performing Below Expectations.

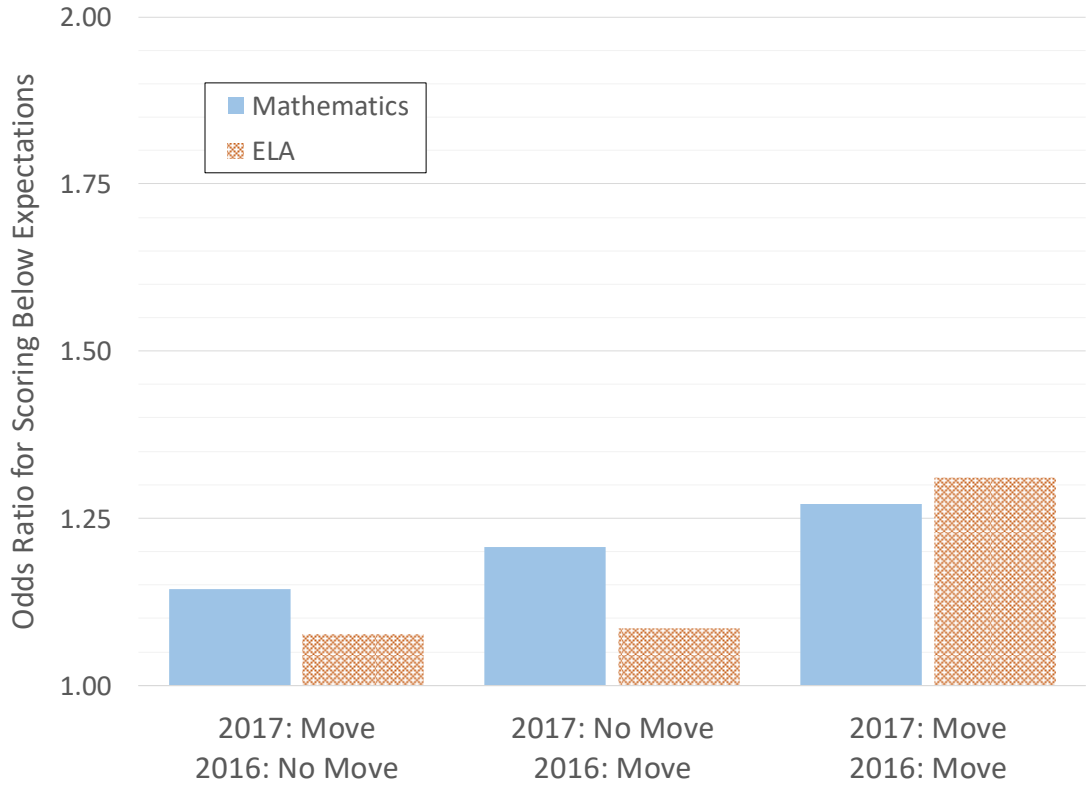
Below Expectations in Math. The relationship between mobility and performance "below" state expectations in math also showed smaller effects after controlling for student characteristics and prior testing. The odds of performing below expectations in math increased by 21% if the move impacted AY2016 (b=0.188, $\chi^2(1)=12.7$, $p<.001$, OR=1.21), 14% if the move impacted AY2017 (b=0.135, $\chi^2(1)=5.7$, $p=0.017$, OR=1.14), and 27% if the move impacted both years (b=0.239, $\chi^2(1)=3.1$, $p=0.077$, OR=1.27). This is illustrated in the solid blue bars in Figure 12.

For context, eligibility for free/reduced lunch was associated with a 53% increase in odds (b=0.424, $\chi^2(1)=312.2$, $p<.001$, OR=1.53), giving mobility approximately one-quarter to one-half the effect of lower income status.

Below Expectations in ELA. The relationship between mobility and performance "below expectations" in ELA continued to differ somewhat from that for math proficiency (see orange checkered bars in Figure 12).

The odds of performing below expectations in ELA increased by 9% if the move impacted AY2016 (b=0.082, $\chi^2(1)=2.46$, $p=0.117$, OR=1.09) and increased by 8% if the move impacted AY2017 (b=0.073, $\chi^2(1)=1.72$, $p=0.190$, OR=1.08). In neither case was this statistically significant. However, if both years were impacted by non-promotional moves, the odds of performing below expectations increased 31% (b=0.27, $\chi^2(1)=4.66$, $p=0.031$, OR=1.31), which, for context, was similar to the effect of free/reduced lunch status (b=0.344, $\chi^2(1)=196.6$, p<.001, OR=1.41).

Figure 12. Adjusted odds-ratios for performing "below" expectations in math and ELA in AY2017 based on non-promotional moves.



VARIATION BASED ON STUDENT CHARACTERISTICS

A series of analyses examined possible interactions between student characteristics and non-promotional mobility as predictors of either AY2017 mathematics or ELA proficiency. Only one analysis found a significant interaction. Given the number of statistical tests performed, it was concluded that there was a reasonable chance this was a spurious random finding, and so is not interpreted here. In sum, the lack of interactions suggests that the previously reported relationships between mobility and student proficiency appear to be fairly consistent, regardless of a student's free/reduced lunch status, special education status, race/ethnicity, or sex.

IMPACT OF LONG-TERM MOBILITY ON PERCENTILE SCORES

For methodological reasons, the previous analyses focused specifically on a two-year period (AY2016 and AY2017) in which students used the same state assessment instrument. The consistent finding that non-promotional mobility had a negative impact on student percentile scores and proficiency levels naturally leads to the question of long-term trends and outcomes across several years. Therefore, an additional series of analyses examined the relationship between longer-term mobility and student academic outcomes. Analyses first examined the impact of long-term mobility on percentile scores, before testing the impact on proficiency levels.

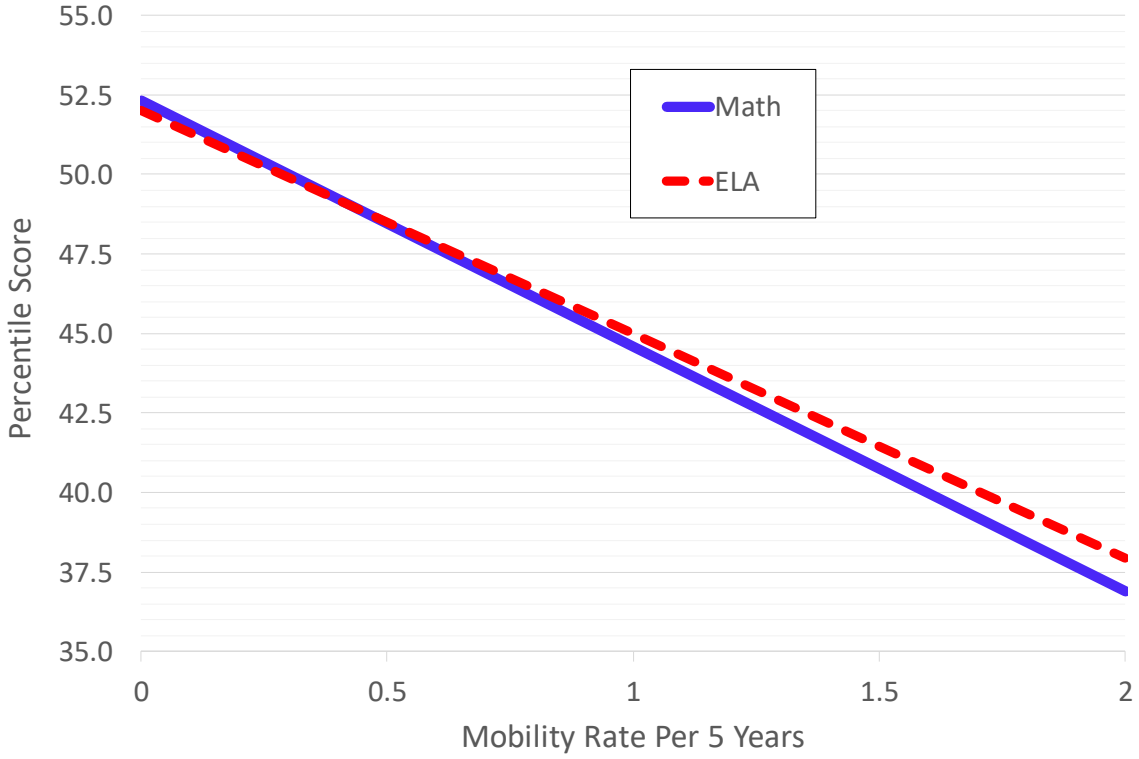
The first step in this process was to create an analysis file containing long-term mobility and testing data. This began by considering all students enrolled at any time between AY2011 and AY2017. Students enrolled for only a single year were excluded as it would be impossible to examine mobility while controlling for prior performance. Given the goal was to examine changes in state assessment scores, the sample was further restricted to students with at least 2 years of state assessment data – in other words, for a student to be included at least two years of enrollment had to be in grades 3 through 8. This resulted in a final sample of 137,350 students for the long-term mobility analyses.

Variables included a student's initial status for free/reduced lunch, special education, and grade-level, as well as their sex and race/ethnicity. Results from a student's first state assessment served as an additional control variable, with the outcome variable based on a student's final or most recent math or ELA assessment. Note that different students were enrolled for different periods of time and so mobility was calculated as a ***mobility rate***: The mean number of years in a 5-year period in which a student experienced a non-promotional move. Not surprisingly, 72.8% of students had a mobility rate of zero – they had no non-promotional moves during this time. The remaining students (N=37,258) had mobility rates greater than zero. A total of 11.2% of all students (N=15,311) had a mobility rate equal to or greater than 1.00 (i.e., an average of one out of five years impacted by a non-promotional move), while 2.9% (N=4,033) had a mobility rate of two or more (i.e., an average of two out of five years impacted by a non-promotional move).

UNADJUSTED EFFECTS OF LONG-MOBILITY ON PERCENTILE SCORES

An initial pair of analyses examined the relationship between mobility rates and math and ELA percentile scores from a student's final or most recent assessment. Note that given this covered the time period of AY2011 through AY2017, students were assessed using one of three different instruments. Mobility was found to be highly related to performance in both mathematics (b=-7.699, $t(137172)=-57.380$, $p<.001$) and ELA (b=-7.035, $t(137137)=-52.278$, $p<.001$). As illustrated in Figure 13, the trend was very similar for both: equivalent to approximately a seven percentile point reduction for each year with a non-promotional move in a five-year period.

Figure 13. Predicted math and ELA percentile scores based mobility rate.



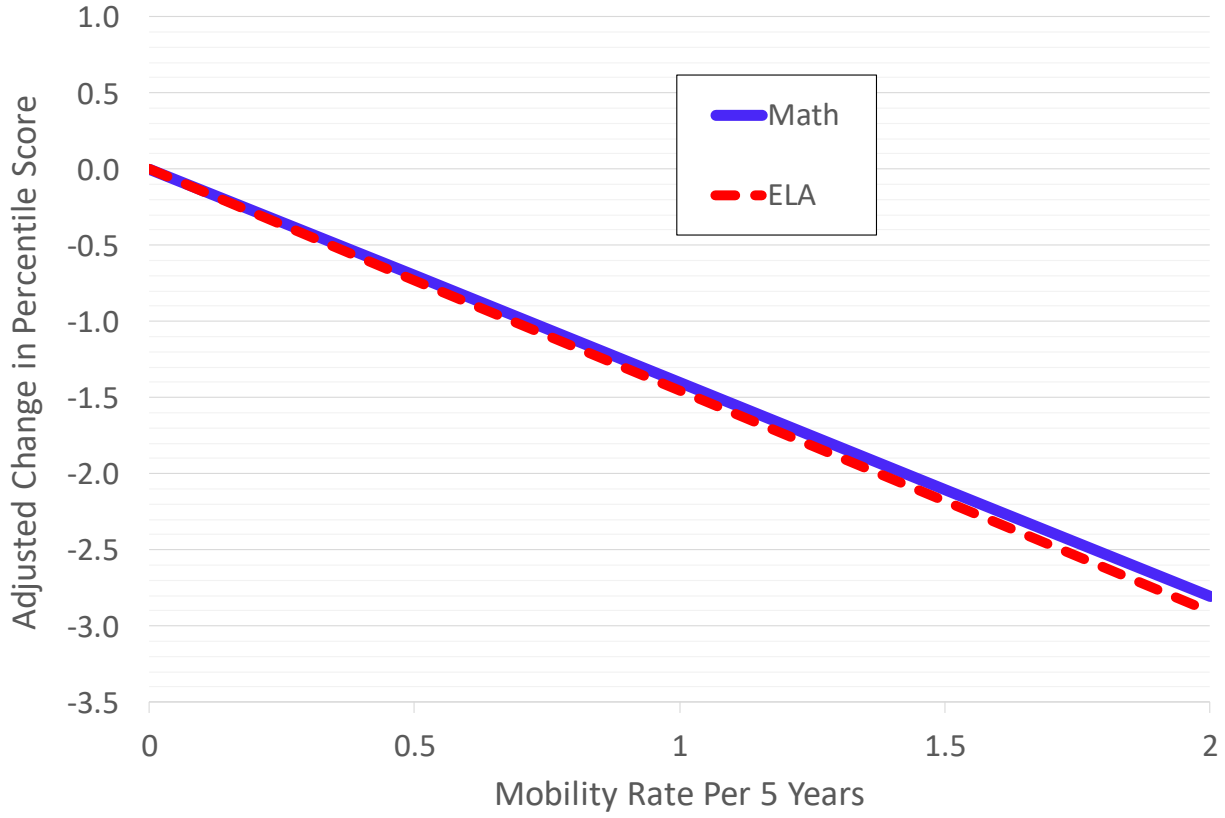
ADJUSTED EFFECTS OF LONG-TERM MOBILITY ON PERCENTILE SCORES

A second series of analyses examined the effect of mobility after controlling for student demographic differences, including free/reduced lunch status, special education status, race/ethnicity, sex, and grade in school. These analyses also controlled for a student's score on their first or initial state assessment. Note that this assessment was not necessarily tied to a student's first appearance in the data – for example, a student may have had enrollment and mobility data available for 2nd grade, but would not have had assessment data available until 3rd

grade. Also note that the instrument used for a student's initial assessment was often not the same instrument used at their final assessment.

These more conservative analyses continued to find mobility highly related to performance in both math and ELA (math: b=-1.402, $t(137166)=-15.608$, $p<.001$; ELA: b=-1.454, $t(137131)=-15.345$, $p<.001$), with approximately a 1.4 percentile point decline in scores for each year (based on a 5-year mobility rate) a student experienced a non-promotional move, even after controlling for student characteristics and prior testing scores. For context, this is approximately one-quarter the size of the effect for free/reduced lunch status (b=-5.439 for math, b=-5.698 for ELA). The additional impact of mobility after controlling for student characteristics and prior testing is presented in Figure 14.

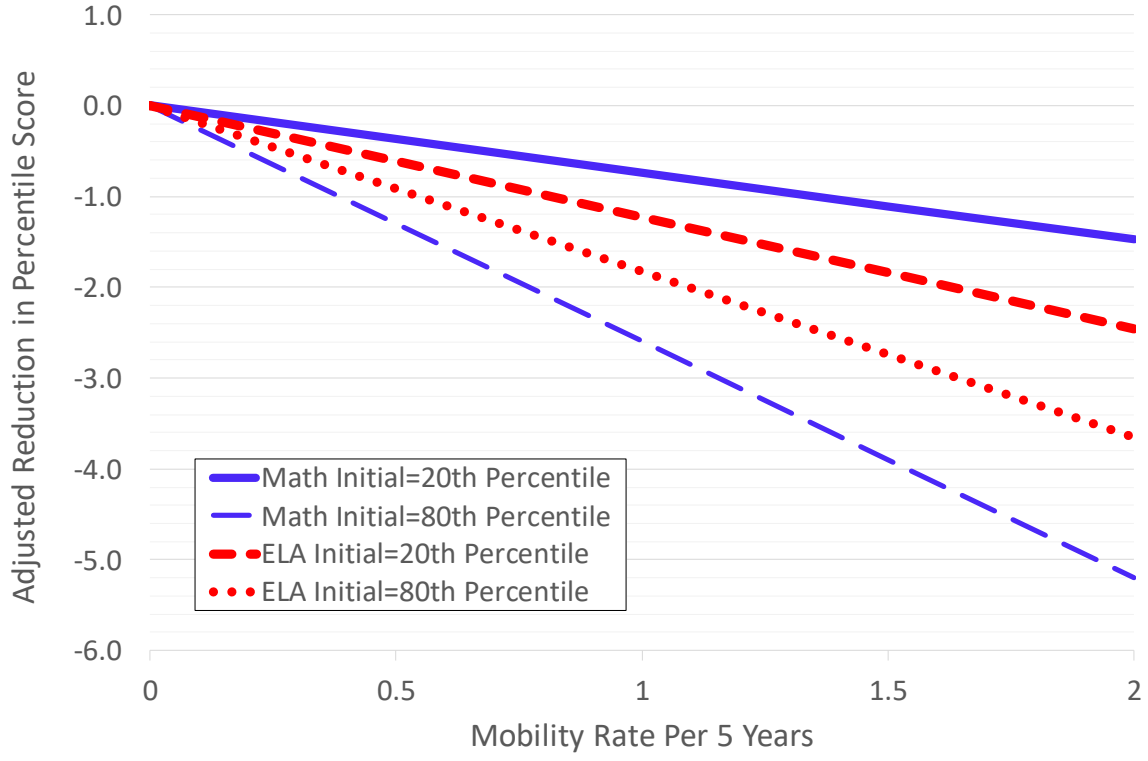
Figure 14. Change in percentile scores based on mobility rate, adjusted for student characteristics and prior testing.



VARIATION BASED ON STUDENT CHARACTERISTICS

Prior (2016) State Testing. The effect of long-term mobility varied based on a student's score at their initial assessment when predicting either math (b=-0.031, t(137165)=-10.075, p<.001) or ELA percentile scores (b=-0.010, t(137130)=-3.123, p=.002). As illustrated in Figure 15, the negative effect of non-promotional moves increased with higher initial test performance, with the greater variation in the effect observed in math. For example, if a student's mobility rate was 2 non-promotional moves per 5 years, the predicted reduction in math scores was 1.48 percentile points if they initially performed at the 20th percentile (solid blue line in Figure 15), but 5.20 percentile points if they originally performed at the 80th percentile (long-dashed blue line). The same pattern was seen for ELA performance, although more attenuated: The predicted reduction for a student with non-promotional moves in two out of five years is 2.46 points if they initially performed at the 20th percentile (short-dashed red line), but 3.66 percentile points if they originally performed at the 80th percentile (dotted red line). For context, the effect of being identified as eligible for free/reduced lunch was a reduction of 5.41 percentile points for math, and 5.69 percentile points for ELA.

Figure 15. Change in predicted percentile scores based on a student's initial testing performance and mobility rate.



Special Education Status. Controlling for prior testing and student characteristics, mobility rates were found to interact with special education status when predicting both math and ELA percentile scores (math: b=0.830, $t(137165)=3.469$, $p=.001$; ELA: b=0.559, $t(137139)= 2.212$, $p=.027$). As illustrated in Figure 16, the negative impact of mobility for students ***not*** in special education is almost identical for both math and ELA. For example, the predicted reduction given a mobility rate of 2 moves per 5 years was 3.07 percentile points in math (solid blue line) and 3.08 percentile points in ELA (short-dashed red line). The effect was smaller for students enrolled in special education, with predicted reductions of 1.41 percentile points in math (long-dashed blue line) and 1.95 percentile points in ELA (dotted red line) for the same mobility rate.

Student Sex. After controlling for prior test performance and student characteristics, analyses found no interaction between student sex and mobility rates for math. However, a significant interaction was found when predicting ELA percentile scores (b=0.573, $t(137130)=3.145$, $p=.002$). As illustrated in Figure 17, the negative impact of mobility on ELA percentile scores was greater for female students (dashed red line) than male students (solid blue line), with the predicted impact given a rate of 2 non-promotional moves per 5 years being a reduction of 3.49 percentile points in ELA for females, and 2.35 percentile points for males.

Figure 16. Change in predicted percentile scores based on special education status and mobility rate.

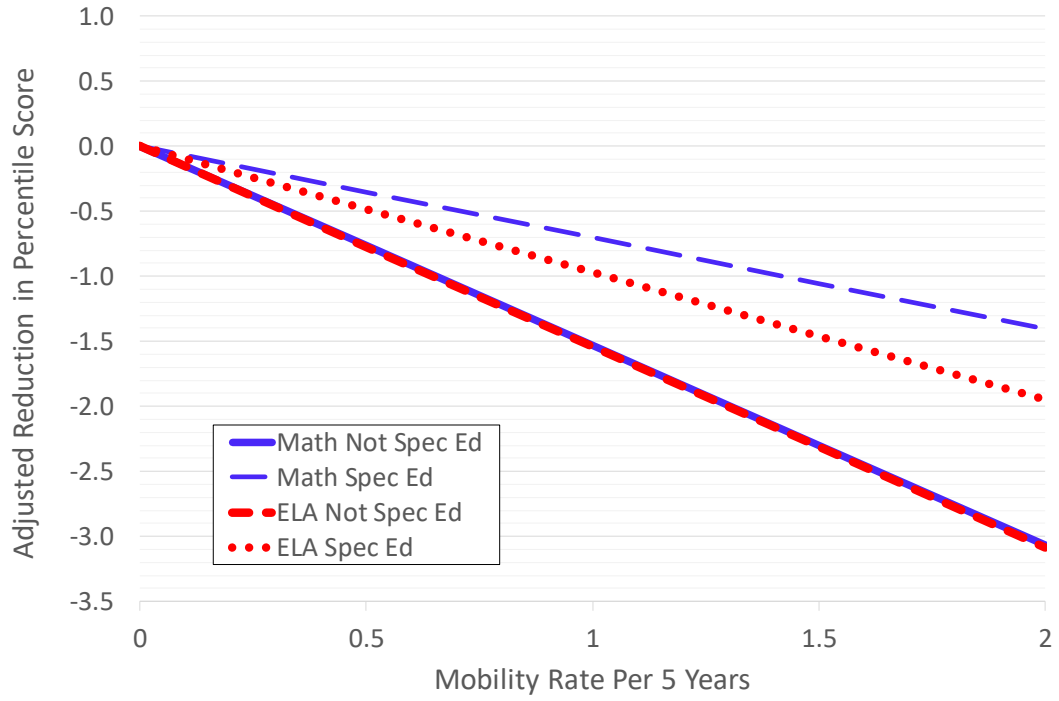
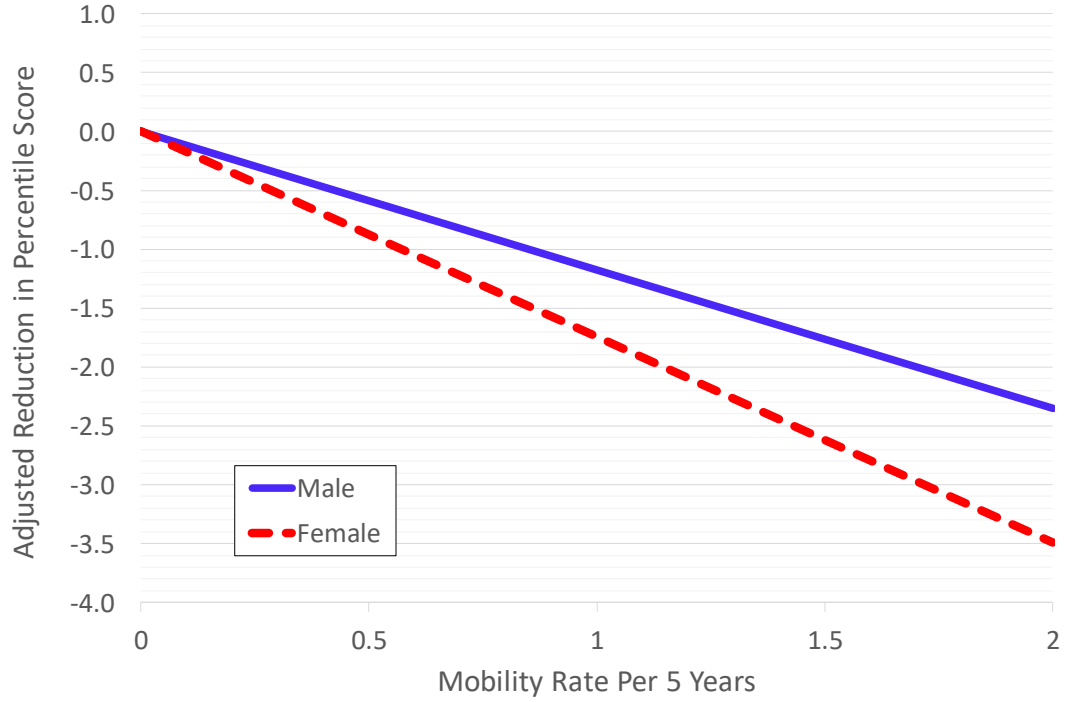


Figure 17. Change in predicted ELA percentile scores based on sex and mobility rate.

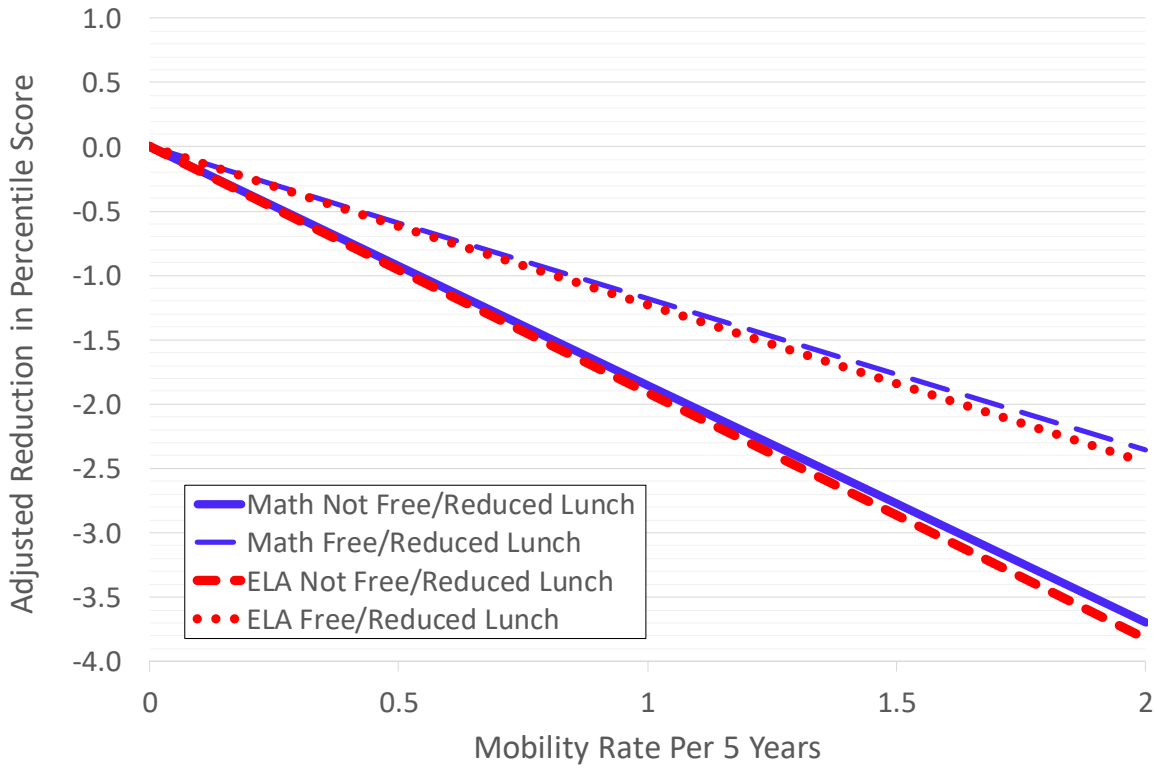


Free/Reduced Lunch. After controlling for student demographics and prior testing, a significant interaction between mobility and free/reduced lunch status was observed for both math and ELA percentile scores (math: b=0.670, $t(137165)=3.566$, $p<.001$; ELA: b=0.684, $t(137130)=3.452$, $p=.001$). In this case, the effect of mobility was almost identical for both outcomes. As illustrated in Figure 18, the impact of mobility was more negative for students who were ***not*** identified as eligible for free/reduced lunch. For example, if a student was not identified as eligible for free/reduced lunch, the predicted impact given a rate of 2 non-promotional moves per 5 years was a reduction of 3.70 percentile points in math (solid blue line) and 3.82 percentile points in ELA (short-dashed red line). In contrast, for students eligible for free/reduced lunch, the predicted reduction given the same mobility rate was 2.36 percentile points in math (long-dashed blue line) and 2.45 percentile points in ELA (dotted red-line).

For context, the effect of free/reduced lunch status for a student with no non-promotional moves was a reduction of 5.62 percentile points in math and 5.89 points in ELA. In other words, the effect of a high-level of mobility (i.e., 2 non-promotional moves per 5 years) was equal to two-thirds of the core effect of lower-income status on non-mobile students.

Other Student Characteristics. Finally, it should be noted that no statistically significant interactions were found between mobility and grade in school (math: $t(137165)=-1.437$, $p=0.151$; ELA: $t(137130)=1.015$, $p=0.310$), or mobility and ethnic minority status (math: $t(137165)=0.324$, $p=0. 746$; ELA: $t(137130)=1.028$, $p=0.304$). In essence, the negative effect of non-promotional mobility was approximately the same for students across grade levels, as well as for ethnic minority and white/non-Hispanic students.

Figure 18. Change in predicted percentile scores based on special education status and mobility rate.



IMPACT OF LONG-TERM MOBILITY ON PROFICIENCY LEVELS

The impact of long-term mobility was also examined in relation to proficiency-levels in mathematics and ELA. Analyses examined the increase in the odds that a student performed (a) well below state expectations, or (b) below state expectations in math and ELA, based on their rate of non-promotional moves over a 5-year period. Analyses first examined simple effects without controlling for other variables, before controlling for prior testing and student demographic differences.

UNADJUSTED EFFECTS OF LONG-TERM MOBILITY ON PROFICIENCY LEVELS

In a simple model that did not control for prior testing or student characteristics, mobility was found to be highly related to proficiency in both math and EL (math: $\chi^2(2)=2780.8$, $p<.001$; ELA: $\chi^2(2)=2675.1$, $p<.001$). For each year a student experienced a non-promotional move, based on a 5-year rate, the odds of performing "well below" state expectations increased 83% in math and 82% in ELA (math: b=0.607, $\chi^2(1)=2529.2$, $p<.001$, OR=1.83; ELA: b=0.600, $\chi^2(1)=2428.1$, $p<.001$, OR=1.82). The increased odds of performing in the "below" state expectations category increased 51% for math and 45% for ELA with each year a student experienced a non-promotional move (math: b=0.414, $\chi^2(1)=1150.0$, $p<.001$, OR=1.51; ELA: b=0.375, $\chi^2(1)=1115.1$, $p<.001$, OR=1.45). This pattern is illustrated in Figure 19.

ADJUSTED EFFECTS OF LONG-TERM MOBILITY ON PROFICIENCY LEVELS

After adjusting for demographic differences and prior testing, mobility continued to be highly related student proficiency in math and ELA (math: $\chi^2(2)=247.9$, $p<.001$; ELA: $\chi^2(2)=485.7$, $p<.001$). For each year a student experienced a non-promotional move, the odds of performing "well below" state expectations increased 27% in math and 41% in ELA (math: b=0.239, $\chi^2(1)=218.0$, $p<.001$, OR=1.27; ELA: b=0.341, $\chi^2(1)=471.3$, $p<.001$, OR=1.41), and the odds of performing "below" expectations increased 21% for both math and ELA (math: b=0.192, $\chi^2(1)=185.3$, $p<.001$, OR=1.21; ELA: b=0.193, $\chi^2(1)=223.1$, $p<.001$, OR=1.21). As illustrated in Figure 20, these trends suggest that after controlling for student demographic differences and prior testing, long-term mobility trends have a relatively stronger negative impact on ELA proficiency and on the odds that a child will perform well below state proficiency expectations.

Figure 19. Factor by which the odds of performing "well below" or "below" state expectations increased based on mobility rate (unadjusted).

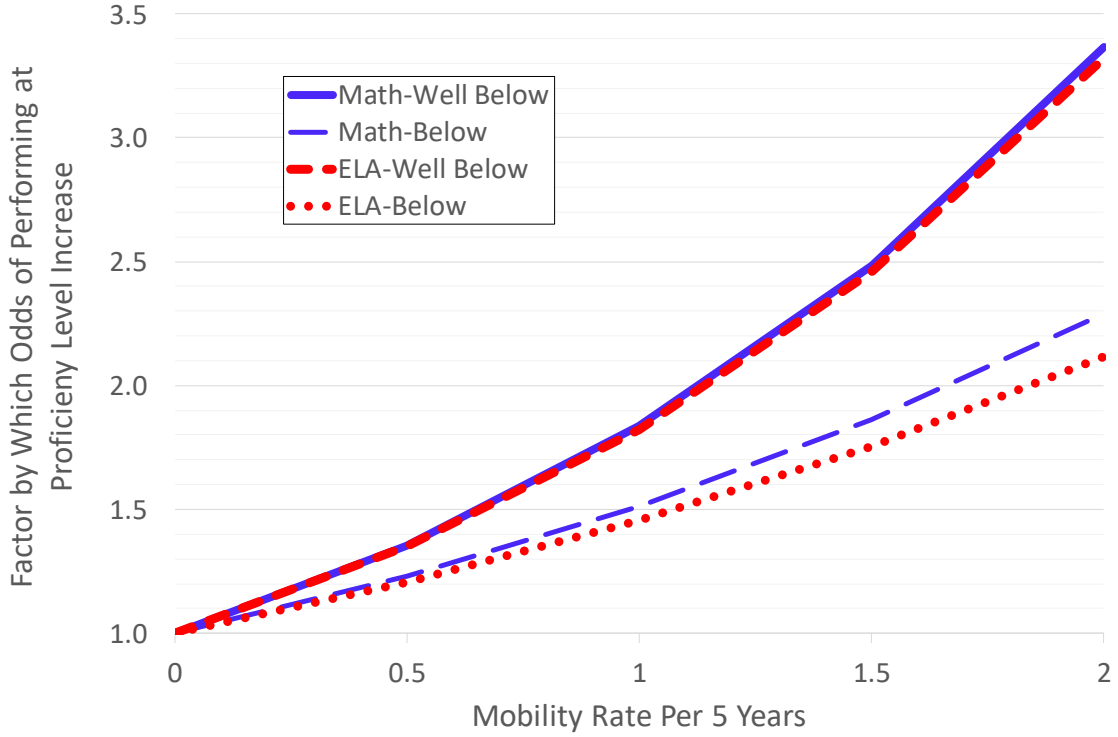
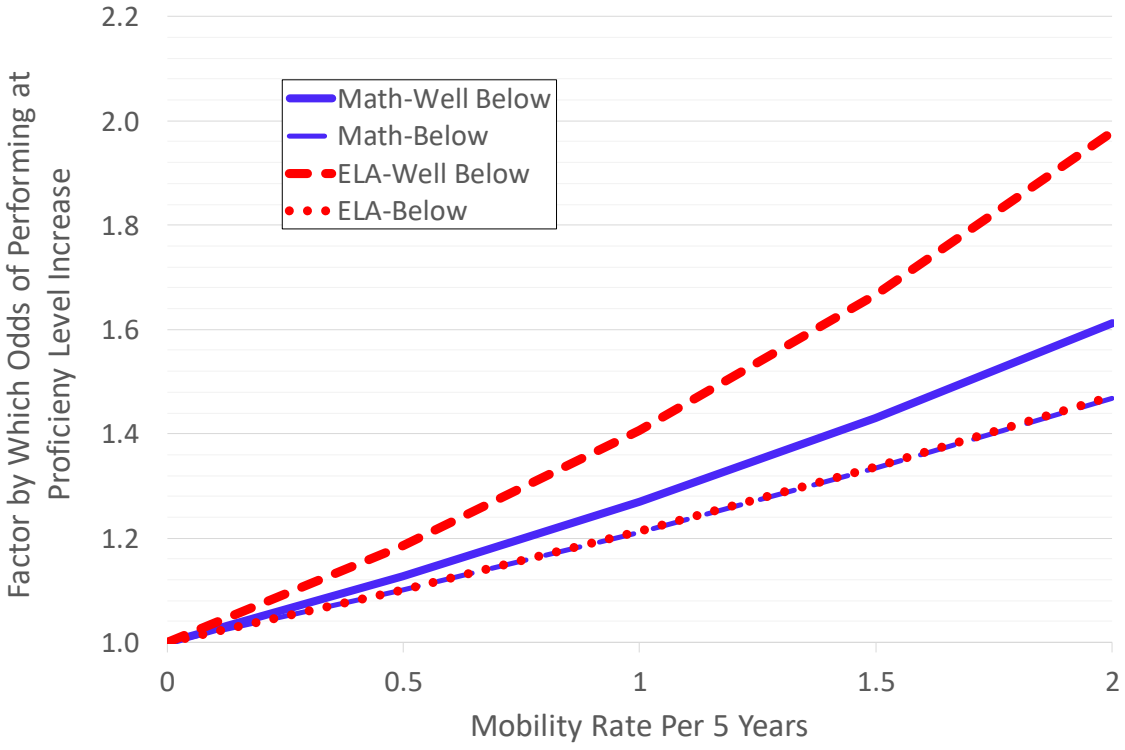


Figure 20. Factor by which the odds of performing "well below"or"below" expectations increase based on mobility rate, adjusted for student characteristics and prior testing.



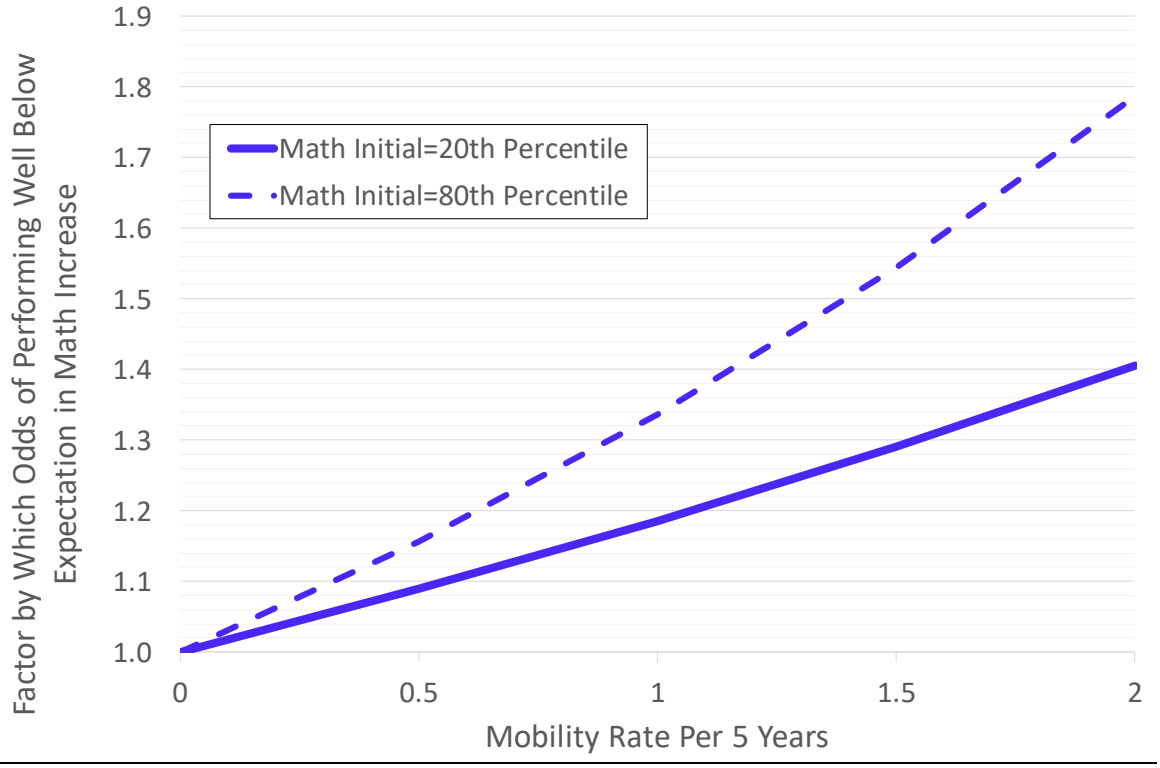
VARIATION BASED ON STUDENT INITIAL PERFORMANCE

Analyses then examined whether the impact of long-term mobility on proficiency varied based on student characteristics. These analyses found that the effect of mobility on both math and ELA proficiency levels varied based on students' initial performance at the time of their first test (math: $\chi^2(2)=14.60$, $p=.001$; ELA: $\chi^2(2)=15.31$, $p<.001$).

Risk of Performing Well Below Expectations. When specifically focusing on the risk of performing "well below" expectations in ELA, these same analyses found that prior performance did not interact with a student's mobility rate (b=-0.001, $\chi^2(1)=0.338$, $p=.533$). In other words, the negative effect of mobility was the same regardless of whether a student was initially low or high performing.

When specifically focusing on the risk of performing "well below" expectations in math, prior test scores were found to significantly interact with long-term mobility rates (b=0.002, $\chi^2(1)=5.775$, $p<.001$). As illustrated in Figure 21, the effect of mobility was greater for students who initially performed ***higher*** in mathematics. For example, if a student initially performed at the 20th percentile in math, a mobility rate of one in five years increased the odds of scoring below expectations by 19%. Those odds increased to 40% for high mobility youth (i.e., a mobility rate of two in five years). However, if a student initially performed at the 80th

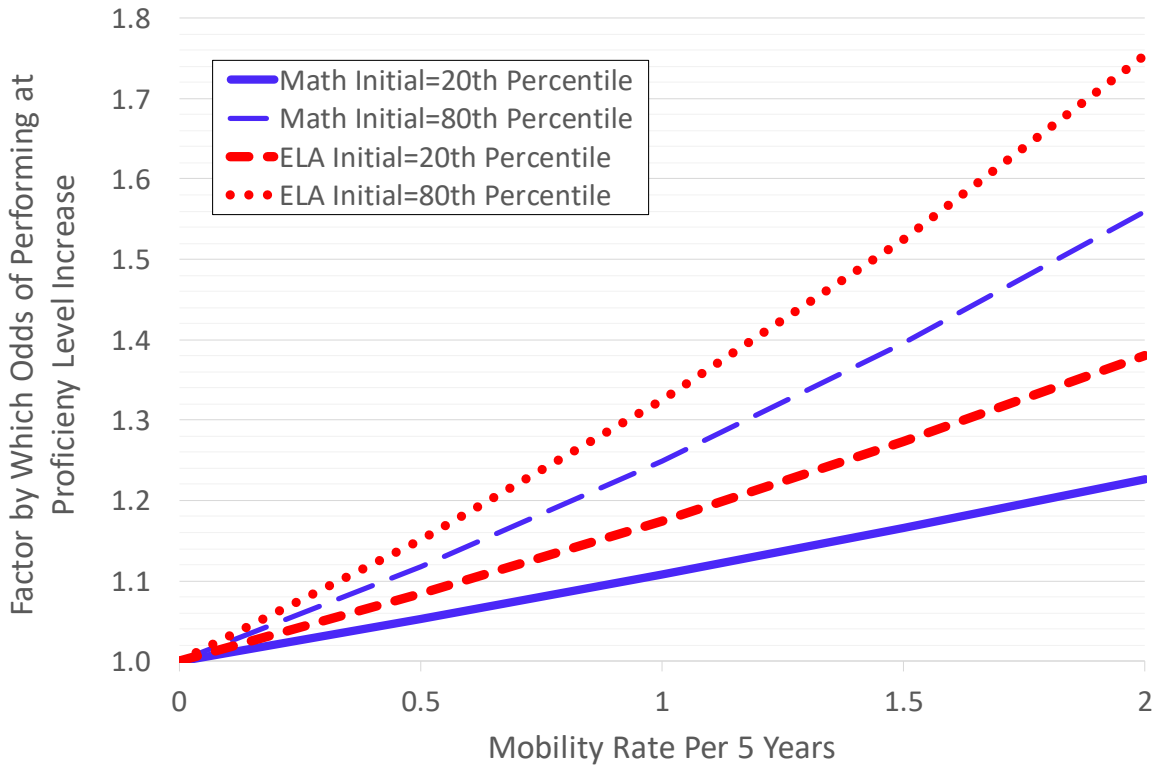
Figure 21. Factor by which the odds of performing "well below" expectations in math increase based on mobility rate and initial performance, adjusted for student demographics



percentile in math, their risk for performing well below expectations increased by 34% and 79%, respectively.

When focusing on the risk for scoring "below" expectations, prior performance was found to influence the mobility effect for both math and ELA (math: b=0.002, $\chi^2(1)=14.869$, $p<.001$; ELA: b=0.002, $\chi^2(1)=9.892$, $p=.002$). As illustrated in Figure 22, the negative effect of mobility was again greater for higher performing students. For example, if a student initially performed at the 20th percentile, a mobility rate of one of five years increased the odds they would perform below expectations 11% in math and 17% in ELA. This increased to 23% and 38%, respectively, for students with a mobility rate of two in five years. However, if a student initially performed at the 80th percentile, a mobility rate of one in five years increased the odds of scoring below expectations by 25% in math and 32% in ELA, increasing to 56% and 75%, respectively, for students with a mobility rate of two in five years.

Figure 22. Factor by which the odds of performing "below" state expectations increase based on mobility rate and initial testing, adjusted for student characteristics.



Other Student Characteristics. A series of additional analyses examined possible interactions between other student characteristics and non-promotional mobility as predictors of either mathematics or ELA proficiency level. Only one of these produced a statistically significant result. It was suspected to be a statistically spurious effect due to the large number of analyses performed, and is not interpreted here.

In essence, the lack of interactions suggests that – other than mobility having a relatively larger impact on initially higher performing students – after controlling for student characteristics and prior testing performance, the negative impact of mobility on proficiency levels appears to be fairly consistent regardless of a student sex, race/ethnicity, free/reduced lunch status, or special education status.

IMPACT OF MOVING INTO A HIGHER OR LOWER PERFORMING SCHOOL

Given the results have consistently shown that mobility has a negative effect on academic performance, a final question addressed in this report is whether movement into a higher or lower performing school can potentially offset or further accentuate that effect. In other words, is there an additional effect based on whether a student moves from school with overall low test scores to a school with overall higher test scores – does movement into a higher performing school have an additional positive effect? Does moving into a lower performing school have an additional negative effect? These questions were addressed in a final series of analyses that examined the impact of changes in overall school performance following a non-promotional move.

To accomplish this, a new variable – the change in school performance – was created for each case of non-promotional mobility. This was calculated as the difference between the mean percentile score for the new school minus the mean percentile score for the previous school. Change in school performance was calculated separately for each year for each student, with the value set at zero if a student did not experience a non-promotional move in a given year. Positive scores indicated a student moved into a higher performing school, while negative scores indicated they moved into a lower performing school. Among students with at least one non-promotional move, the average change in school-wide performance was 0.33 percentile points for math (SD=8.59) and 0.44 percentile points for ELA (SD=8.65). This suggests that while students were moving fairly evenly into both higher and lower performing schools, there was nevertheless considerable case-by-case variability in both directions.

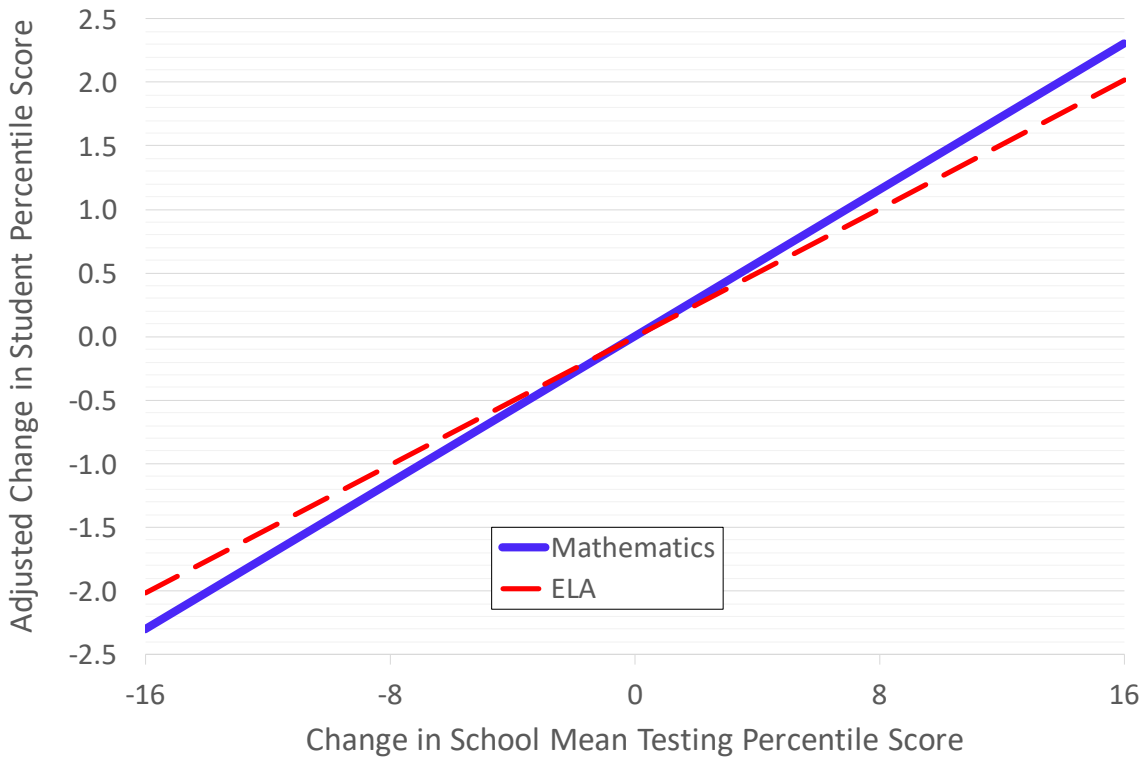
It was anticipated that the impact of moving into a higher or lower performing school would be reflected in more long-term outcomes for a mobile student, and so analyses focused on the previously described long-term mobility data set.

IMPACT OF CHANGES IN SCHOOL MEAN SCORES ON STUDENT PERCENTILE SCORES

Analyses first examined the impact of changes in school-wide performance as a predictor of student percentile scores. All analyses controlled for student demographic characteristics (free/reduced lunch status, special education status, sex, race/ethnicity, and grade), as well as the student's initial testing score and mobility rate.

Adjusted Effect of Changes in School Mean Scores. Results suggested that even after controlling for student demographic differences, prior testing, and mobility rates, moving into a higher or lower performing school was related to both math and ELA percentile scores (math: b=0.144, $t(137165)=11.479$, $p<.001$; ELA: b=0.126, $t(137130)=9.601$, $p<.001$). As illustrated in Figure 23, the overall pattern for both outcomes was similar. On one extreme, predicted scores for students who moved into a school with a mean 16 percentile points ***below*** their prior school, ***decreased*** 2.30 percentile points in math and 2.02 percentile points in ELA. On the other extreme, predicted scores for students who moved into a school with a mean 16 percentile points ***above*** their prior school, ***increased*** 2.30 and 2.02 percentile points, respectively. It should be noted that this was after controlling for student demographic differences and prior testing, and is an additional effect beyond whatever impact mobility itself had on predicted scores.

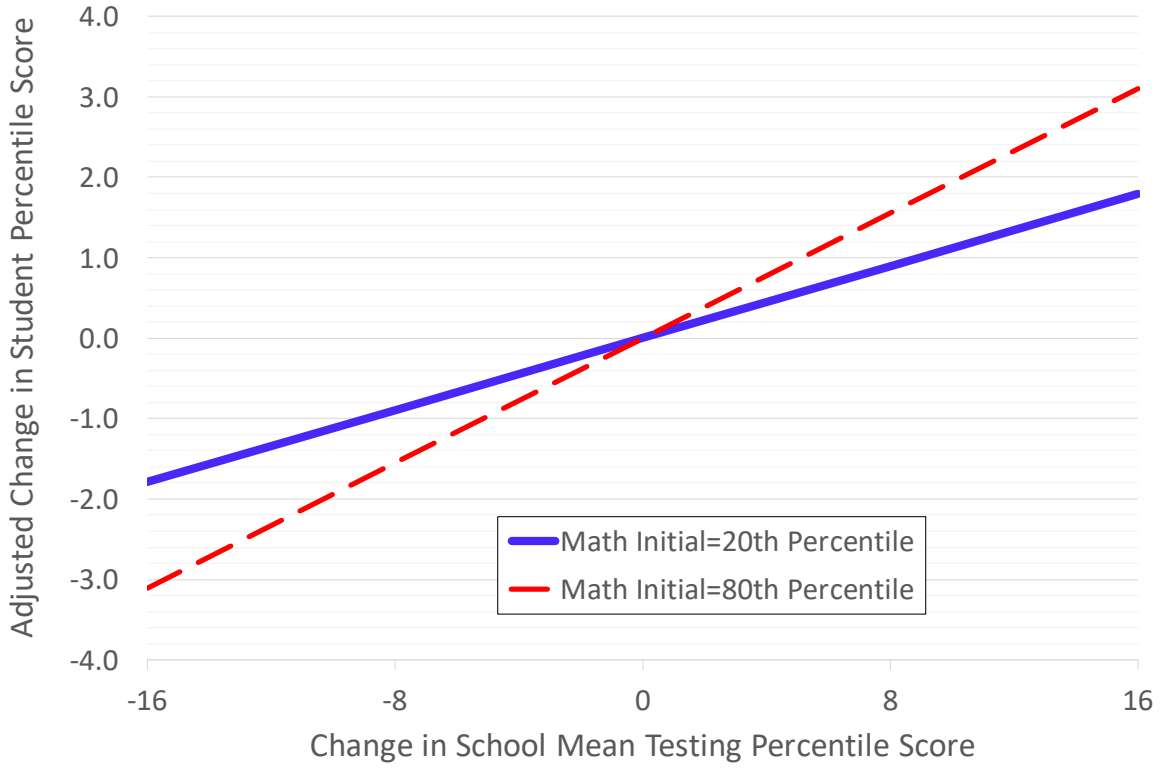
Figure 23. Change in student percentile scores based on the difference in school mean performance, adjusted for student characteristics, prior testing, and mobility.



Variation in Risk Based on Student Characteristics. Follow-up analyses examined whether this effect varied based on a student's initial performance (i.e., did moving into a higher or lower performing school have a larger impact on students who were themselves initially higher or lower performing) and student mobility rates (i.e., did additional moves continue to have a negative impact if they resulted in attending a higher performing school).

Prior Performance. When predicting math percentile scores, the effect of moving into a higher or lower performing school varied based on a student's initial math score (b=.00137, $t(137164)=3.139$, $p=.002$). As illustrated in Figure 24, the benefit of moving into a higher performing school – and the negative effect of moving into a lower performing school – was greater for higher performing students. For example, after controlling for student characteristics, prior testing, and mobility rates, the predicted score for students who initially performed at the 80th percentile was reduced 3.11 percentile points if the mean for their new school was 16 percentile points below their prior school, and increased 3.11 percentile points if the mean for the new school was 16 percentile points higher than their prior school. However, predicted scores for students who initially performed at the 20th percentile were only reduced 1.79 percentile points if a student moved into a school with a mean 16 percentile points below their prior school, and only increased 1.79 percentile points if their new school mean was 16 percentile points higher than their prior school.

Figure 24. Change in math scores based on the difference in school means and student initial math performance, adjusted for student characteristics, prior testing, and mobility.



When predicting ELA percentile scores, the effect of moving into a higher or lower performing school did not vary based on a student's initial ELA score (b=0.000672, $t(137129)=1.480$, $p=.139$), suggesting it is similar whether a student was initially high or low performing in ELA.

Mobility Rate. Changes in school mean assessment scores did not interact with student mobility rates when predicting either math or ELA percentile scores (math: b=.013, $t(137164)=0.475$, $p=.635$; ELA: b=0.018, $t(137129)=0.639$, $p=.523$). In essence, the effect of moving into a school with a higher or lower mean scores was consistent regardless of the number of non-promotional moves an individual student experienced.

IMPACT OF CHANGES IN SCHOOL MEAN SCORES ON STUDENT PROFICIENCY

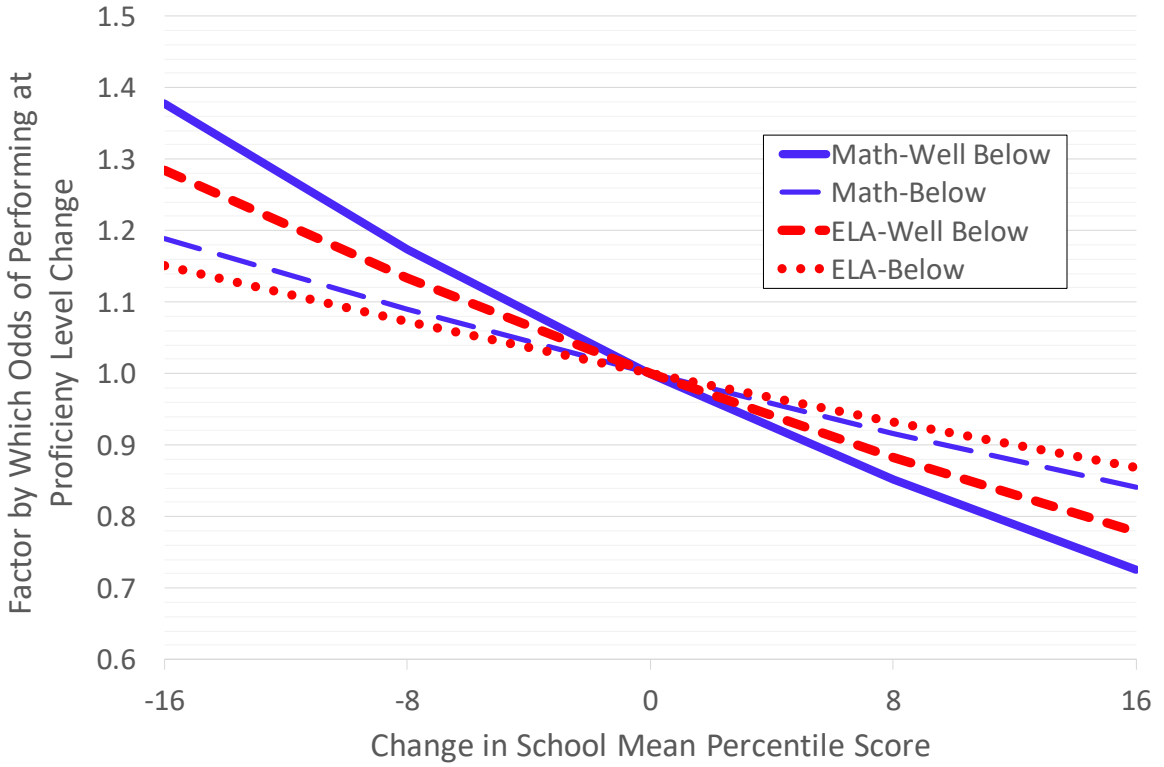
The impact of moving into a higher or lower performing schools was also examined in relation to a student math and ELA proficiency-levels using a series of multinomial regressions. Proficiency was coded into three categories: Well below state expectations, below state expectations, and at or above state expectations. These analyses examined the increased risk that a student will perform either (a) well below, or (b) below state expectations based on the difference in the mean performance at their new and old school following a non-promotional move. All models controlled for student characteristics, prior testing, and mobility rates.

Adjusted Effect of Changes in School Mean Scores. After adjusting for student characteristics, prior testing, and mobility, differences in school mean test scores were highly related to proficiency in both math and ELA (math: $\chi^2(2)=77.088$, $p<.001$; ELA: ($\chi^2(2)=50.681$, $p<.001$).

Risk of Performing Well Below Expectations. For each percentile point that the new school mean was ***higher*** than the previous school mean, the odds that a student would perform "well below" state expectations ***decreased*** by a factor of .980 or 2.0% in math and a factor of .984 or 1.6% in ELA (math: b=-0.020, $\chi^2(1)=76.878$, $p<.001$, OR=0.980; ELA: b=-0.016, $\chi^2(1)=48.589$, $p<.001$, OR=0.984).

This pattern is illustrated in the solid blue and short-dashed red lines in Figure 25. For students moving into a lower performing school (i.e., negative values on the horizontal x-axis) the odds of scoring well below expectations in both math and ELA increase (i.e., values on the y-axis are greater than one). For example, a predicted score of 1.30 on the "Math-well below" line would indicate that the odds of a student performing well below expectations in math ***increased*** 30%. In contrast, for students moving into a higher performing school (i.e., positive values on the horizontal x-axis) the odds of scoring well below expectations in both math and ELA decrease (i.e., values on the y-axis are less than one). For example, a predicted score of 0.80 on the "Math-well below" line would indicate that the odds of a student performing well below expectations in math ***decreased*** by 20%.

Figure 25. Change in odds of performing well below and below expectations, based on the difference in school mean scores, adjusted for student characteristics, prior testing, and mobility.



As seen in Figure 25, if the mean for the new school was 16 percentile points lower than the prior school, the odds of performing well below expectations in math and ELA increased 38% and 28%, respectively. On the other hand, if the mean for the new school was 16 percentile points higher than the prior school, the odds of performing well below expectations in math and ELA decreased 27% and 22%, respectively.

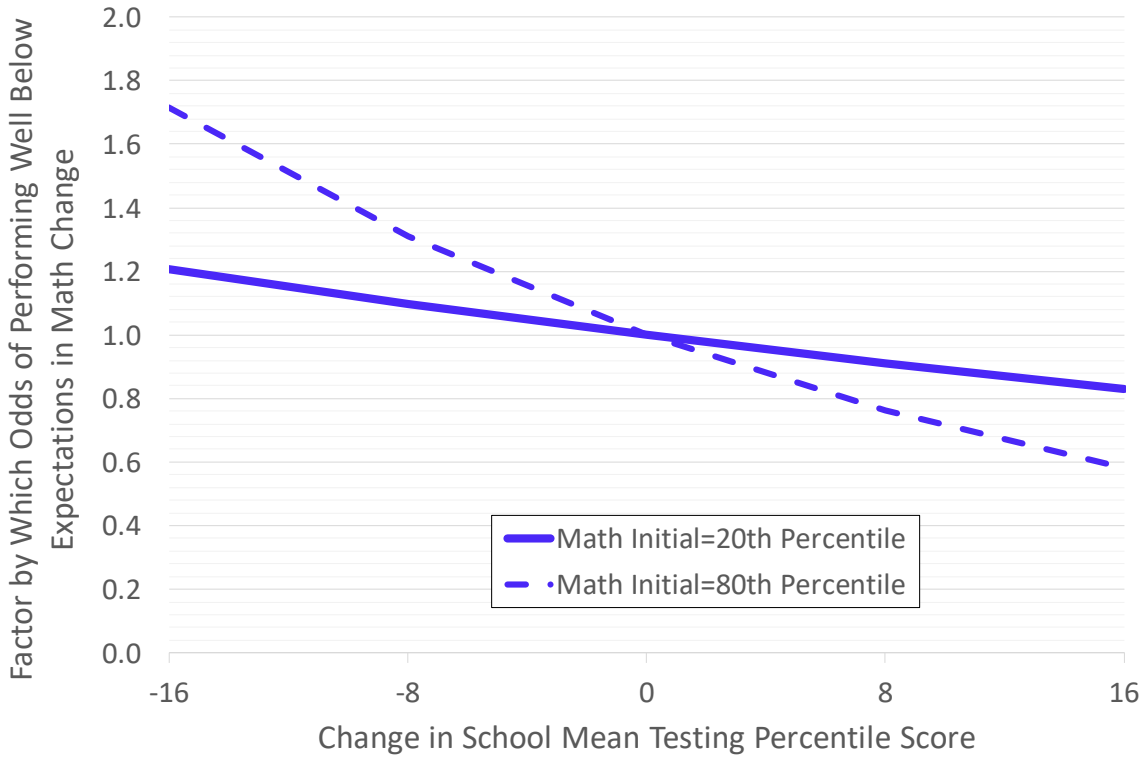
Risk of Performing Below Expectations. The same patterns were observed when predicting the odds that a student would be classified as performing "below" expectations in math (blue long-dashed line in Figure 25) and ELA (red dotted line). For each percentile point that the new school mean was higher than the previous school mean, the odds that a student would perform "below" expectations decreased by a factor of .989 or 1.1% in math and a factor of .991 or 0.9% in ELA (math: b=-0.011, $\chi^2(1)=30.688$, $p<.001$, OR=0.989; ELA: b=-0.009, $\chi^2(1)=23.774$, $p<.001$, OR=0.991). In essence, if the mean for the new school was 16 percentile points lower than the prior school, the odds of performing below expectations increased 19% in math and 15% in ELA. On the other hand, if the mean for the new school was 16 percentile points higher than the prior school, the odds of performing below expectations decreased 16% and 13%, respectively.

A closer examination of Figure 25 highlights three points worth noting. First, the odds of a student performing below or well below expectations in both math and ELA decrease in schools with higher overall mean performance. Moving into higher performing schools helps students. Second, the positive effect of higher-performing schools – and the negative impact of lower performing schools – is greater in terms of math outcomes. Third, this trend is also greater in terms of a student's risk for performing "well below" expectations.

Variation in Risk Based on Initial Performance. Follow-up analyses examined whether this effect varied based on a student's initial performance. These analyses also controlled for student characteristics, prior testing, and student mobility rates.

Risk of Performing Well Below Expectations. Analyses first examined the risk of a student being classified as performing well below expectations in math. Results found that the effect of moving into a higher or lower performing school did vary based on a student's initial math score (b=-0.000368, $\chi^2(1)=10.511$, $p=.001$), with the benefit of moving into a higher performing school – and the negative effect of moving into a lower performing school – greater for students who were themselves higher performing at their initial assessment. As illustrated in Figure 26, for students who initially performed at the 80th percentile (blue dashed line), the odds of performing

Figure 26. Change in odds of performing well below expectations in math based on the difference in school mean performance and student's own initial math performance, adjusted for student characteristics, prior testing, and mobility.



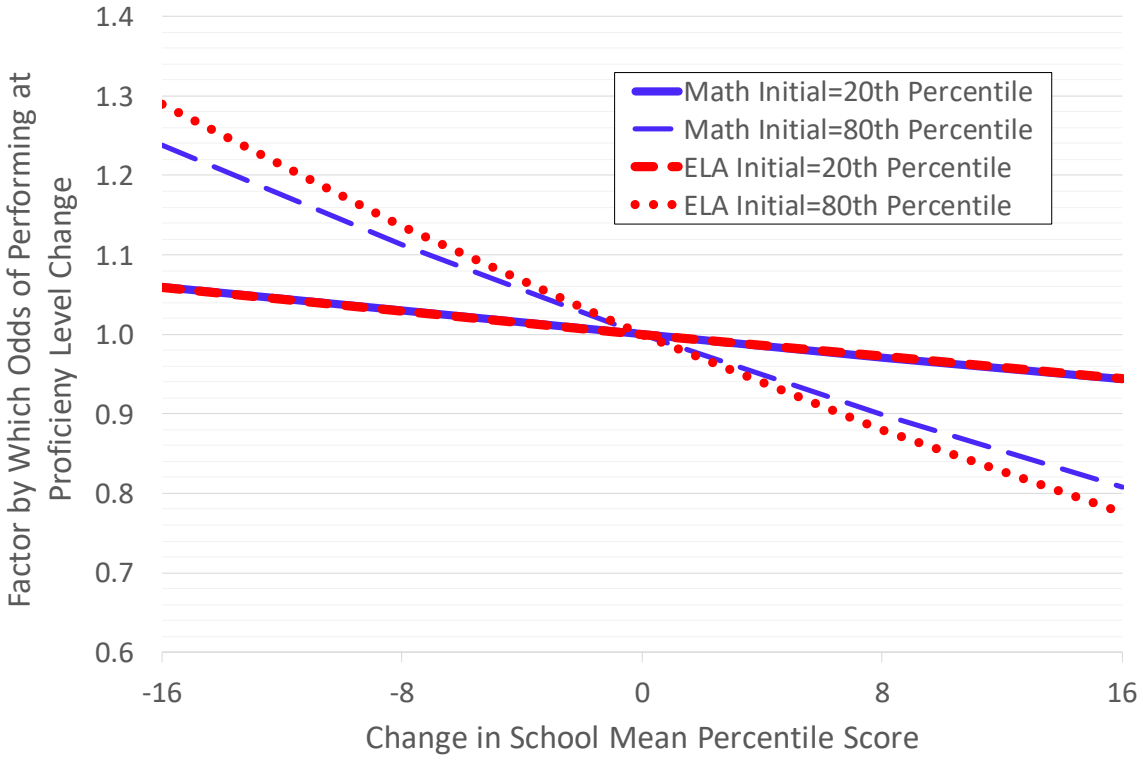
well below expectations ***increased*** 72% if they moved into a school with a mean math score 16 percentile points below their prior school, while the odds ***decreased*** 42% if their new school had a mean 16 percentile points above their prior school. In contrast, for students who initially performed at the 20th percentile (solid blue line), the odds of performing well below expectations increased 21% if they moved into a school with a mean 16 percentile points below their prior school, and decreased 17% if the new school had a mean 16 percentile points above their prior school.

Analyses found no interaction between changes in school mean scores and a student's initial ELA score when predicting the odds of performing well below expectations in ELA (b=-.000161, $\chi^2(1)=1.815$, $p=.178$).

Risk of Performing Below Expectations. In terms of performing "below" expectations in math, the effect of moving into a higher or lower performing school was found to vary based on student's initial scores in both math and ELA (math: b= -0.000174, $\chi^2(1)=3.984$, $p=.046$; ELA: b= -0.000174, $\chi^2(1)=3.984$, $p=.046$). The benefit of moving into a higher performing school – and the negative effect of moving into a lower performing school – continued to be greater for students who were higher performing at their initial assessment, although the overall effect was muted. As illustrated in Figure 27, for students who initially performed at the 80th percentile, the odds of being categorized as below expectations increased 24% in math (long-dashed blue line) and 29% in ELA (dotted red line) if the moved into a new school with a mean 16 percentile points below their prior school. In contrast, the odds decreased 19% and 22%, respectively, if the new school mean was 16 percentile points higher than their prior school. However, for students who initially performed at the 20th percentile in either math (solid blue line) or ELA (short-dashed red line), the odds of performing below expectations increased 6% if the mean for their new school was 16 percentile points below their prior school, and decreased 6% if they moved into a school with a mean 16 percentile points higher than their prior school.

Variation in Risk Based on Mobility Rate. Analyses testing for possible interactions between changes in school mean scores and individual student mobility found no statistically significant interaction for either math or ELA (math: $\chi^2(2)=0.144$, $p=.931$; ELA: $\chi^2(2)=7.35$, $p=.693$). This suggests that, in regards to student proficiency levels, the overall effect associated with moving into a higher or lower performing school was relatively consistent regardless of the number of moves experienced by individual students.

Figure 27. Change in odds of performing below expectations based on the difference in school mean performance and student's own initial performance, adjusted for student characteristics, prior testing, and mobility.



CONCLUSIONS AND IMPLICATIONS FOR POLICY

While this report examined the impact of non-promotional mobility in different ways, based on different time frames, using different measures of student achievement, several core findings consistently emerged.

A relatively large subset of the student population experience at least some non-promotional mobility. Based on student records from AY2011 through AY2017, each year approximately 6.9% of students are impacted by a non-promotional move. For students enrolled throughout this 7-year period, 27.1% experienced at least one year with a non-promotional move. These students were disproportionately from demographic groups that are generally seen as at greater risk of experiencing academic challenges: Students identified as eligible for free/reduced lunch were 2.3 times more likely to experience a non-promotional move, while students enrolled in special education were 47% more likely, those identified as an ethnic minority were 27% more likely, and those identified as having limited English Proficiency were 16% more likely.

This complicates the question of how large of an impact non-promotional mobility has on students, as part of any effect is likely due to other, more fundamental factors, such as family financial stress that may be leading to a relocation.

Mobility has a disproportionate impact on a smaller subset of schools in Maine. Analyses examining mobility at the school level found that the average school mobility rate was 7.9%, with considerable variability in these school rates: Ten percent of schools had annual mobility rates of 13% or more, and nearly three percent had annual mobility rates of 20% or more. Understandably, schools with the very highest rates tended to be non-traditional or alternative schools whose mission involved focusing on higher-risk students. Not surprisingly, schools with higher free/reduced lunch rates and higher special education rates also experienced higher mobility rates, while schools with higher proportions of ethnic minority students and schools with lower overall enrollment numbers also experienced higher mobility rates.

From a policy perspective, this potentially leads to the challenge of identifying strategies that efficiently and effectively help school systems address the added needs of mobile students, particularly when these same schools may already be overstretched due to these other related issues.

When examined as simple rates without adjusting for other student and family factors, the impact of non-promotional mobility on state assessment scores is relatively large. Based on AY2016 and AY2017 data, estimated math and ELA performance decreased from the 50.8 percentile for a student with no non-promotional moves, to approximately the 36th percentile for students experiencing promotional moves impacting both years. In terms of student proficiency, the odds that a student would be found to be "well below" expectations in math and ELA more

than doubled if one of those two years involved a non-promotional move, and nearly quadrupled if both years were impacted.

A large proportion of the impact of mobility may in fact be due to other student and family factors. However, upon closer analysis, after controlling for various student characteristics, including free/reduced lunch and special education status, 55.3% of the mobility difference in math and 59.1% of the difference in ELA was related to other student demographic differences. While it's not surprising that mobility would be highly related to these other factors, non-promotional mobility nevertheless continued to have a significant unique impact on student test scores and proficiency levels that was unrelated these demographic differences.

After controlling for student demographic differences, the impact of non-promotional mobility on math and ELA test scores and proficiency levels was typically one-quarter to one-half that of free/reduced lunch status. A comparison to the effect observed for free/reduced lunch status – widely seen as a marker for lower family income – provides a measure of the "real world" practical impact of the mobility negative effect. It should be noted that this pattern was generally seen after statistically controlling for student free/reduced lunch eligibility, special education enrollment, race/ethnicity, sex, grade in school, and prior testing. It was also generally seen whether analyses examined short or long-term mobility trends and impacts, or whether analyses predicted test scores or student proficiency levels.

The negative impact of mobility was generally higher – at times much higher – for a smaller number of students who were (a) had higher levels of non-promotional mobility, and/or (b) scored relatively high on their initial state assessment for math and ELA. For students with non-promotional moves across multiple years, and for students who scored relatively high on their initial state math or ELA assessment, the effect of non-promotional mobility was often larger, at times much larger – approaching or exceeding the effect of free/reduced lunch status. However, this involved smaller number of students, particularly students with multiple moves.

Moving to a school with higher mean performance on state assessments tends to lead to higher performance in students. Finally, and not surprisingly, students individually benefited from moving into a school that had a higher overall mean level of performance than their previous school. At the same time, subsequent predicted scores were reduced after moving into a school that had a lower overall mean level of performance than their previous school.

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APPENDIX A: MID-YEAR MOBILITY

This supplemental analysis to the overall mobility report focuses specifically on mobility within an academic year (i.e., does a student change schools during the course of the academic year). For clarity, this will be referred to as ***mid-year*** mobility and is a subset of the total non-promotional moves described in the main report.

Mid-year mobility was measured as a change in school between the Oct and April school census during AY2017. Analyses did not examine the impact of mid-year mobility in AY2016 because the central analytic models statistically controlled for prior-year testing performance. For AY2016 the prior-year testing was conducted using the *Smarter Balanced* assessment, which (1) had a lower participation rate, and (2) reflected a fundamentally different assessment tool. Note that mid-year mobility was scored as a dichotomous variable: "0" indicating the student did not move during the academic year, and "1" indicating that the student did move. It was not possible to determine if students moved multiple times during the school year, and so these would have also been coded as "1".

FINDINGS

PRELIMINARY ANALYSES

MID-YEAR MOBILITY RATE

Data consisted of Maine students enrolled in 3rd through 8th grade for both AY2016 and AY2017. Students were required to be enrolled in both years so that the change in their relative performance across years could be examined. Note that this requirement meant the students who were in 3rd grade in AY2017 and in 8th grade in AY2016 were excluded. The result was a sample of 65,035 students, of whom 1,324 (2.0%) experienced a move during the 2016-2017 academic year.

STUDENT FACTORS RELATED TO MOBILITY

A series of analyses first examined the degree to which various student characteristics were related to mid-year mobility.

Free/Reduced Lunch. On average, 44.4% of students who did move during the academic year were identified as being eligible for free/reduced lunch (a marker for lower-income status). In contrast, 81.9% of students who moved during the school year were also identified as eligible for free/reduced lunch. From a different perspective, students eligible for free/reduced lunch were 5.49 times more likely to experience a mid-year move than those who were not identified as eligible ($\chi^2(1, N=62511)=769.8$, $p<.001$).

Special Education. Similarly, 17.2% of students who did move during the school year were enrolled in special education, while 31.9% of students who moved were enrolled in special education. This translates to students enrolled in education being 2.20 times more likely to experience a mid-year move than those not enrolled ($\chi^2(1, N=62511)=201.9$, $p<.001$).

Student Sex. Not surprisingly, student sex had no statistically significant association with mid-year mobility ($\chi^2(1, N=62511)=0.632$, $p=.427$).

Race/Ethnicity. Students who moved during the school year were also more likely to have an ethnic minority background (14.1%) than non-movers (9.6%), making ethnic minority students 52% more likely to experience a non-promotional move than their white/non-Hispanic peers ($\chi^2(1, N=62511)=30.4$, $p<.001$).

Grade in School. Analyses also found that students in earlier grades appeared to be more likely to experience moves during the school year, than were children in higher grades ($\chi^2(5, N=62511)=27.8$, $p<.001$). For example, approximately 2.6% of students in third[11] through fifth grade experienced a move during the school year, while only 2.1% of sixth grade students moved, and 1.9% of students enrolled in seventh and eighth grade moved.

IMPACT OF MID-YEAR MOBILITY ON PERCENTILE SCORES

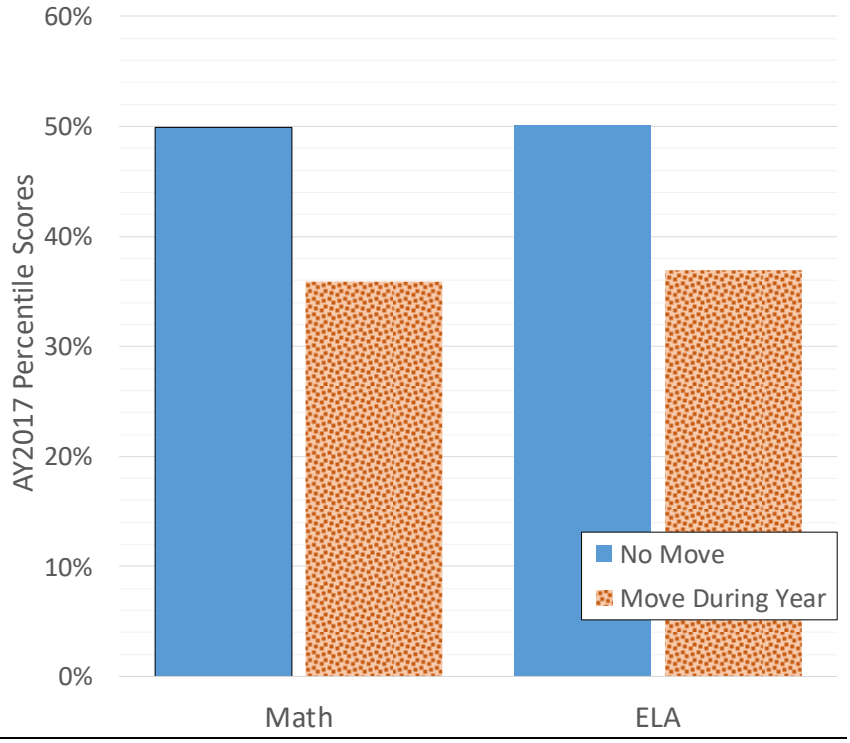
Analyses used multilevel/hierarchical linear modeling in order to address student nesting within schools[12]. The outcome variables were 2017 percentile scores on the mathematics and ELA eMPowerME assessment.

UNADJUSTED EFFECTS OF MOBILITY ON PERCENTILE SCORES

An initial model examined 2017 percentile scores based on mid-year mobility, but did not adjust for demographic differences or prior testing. Mobility during the academic year was found to be highly related to performance in both math and ELA (math: $F(1, 62179.9)=351.940$, $p<.001$; ELA: $F(1, 62198.4)=301.913$, $p<.001$). The estimated percentile score in math for a student who did not move during the academic year was 49.9, while the estimated score for a student with a move during the year was at the 35.9 percentile (see Figure A1). Nearly identical patterns were seen in ELA performance: Students who did not move during the academic year had predicted scores at the 50.0 percentile, while those who did move performed at the 36.9 percentile.

[11] To fully examine this trend, the rate of mid-year mobility for 3rd grade students was also examined, even those these students were not used in subsequent analyses in which prior-year testing was included as a covariate.
[12] All analyses were based on random intercept, fixed-slope models.

Figure A1. Unadjusted AY2017 percentile scores in math and ELA based on 2016-2017 mid-year mobility.



While this clearly illustrates how mobility is related to lower performance on state standardized tests, as reported previously, these same students were also more likely to have characteristics that are also associated with lower state assessment scores. This confound raises the question of the degree to which these differences are due to mid-year mobility or are in fact simply spurious effects due to a third factor, such as higher rates of free or reduced lunch eligibility or enrollment in special education.

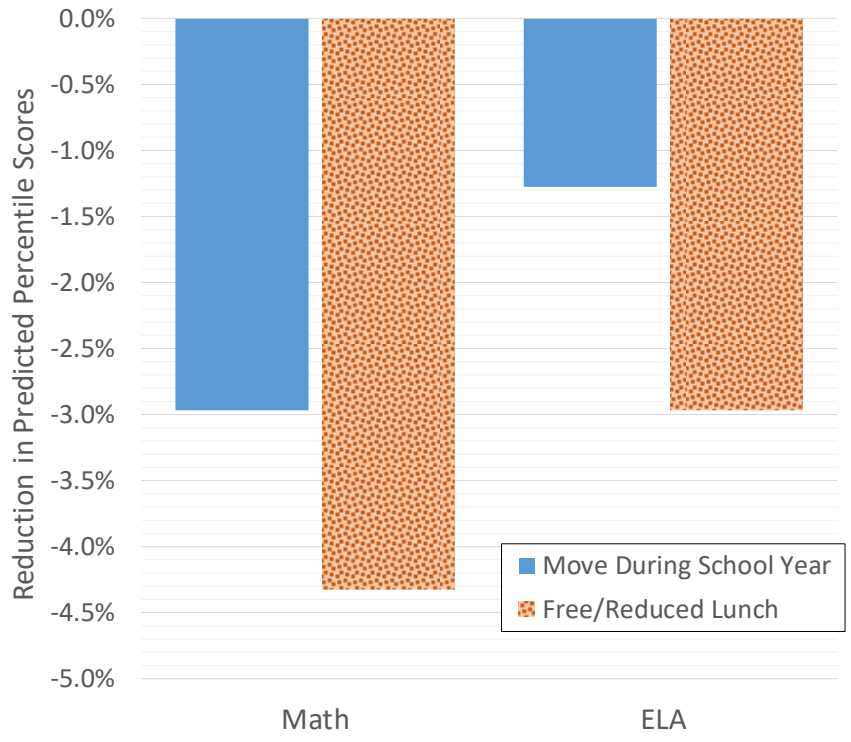
ADJUSTED EFFECTS OF MOBILITY ON PERCENTILE SCORES.

Adjusted for Student Demographic Characteristics. Therefore, additional analyses estimated the impact of student mobility on state assessment performance after statistically controlling for free/reduced lunch status, special education status, race/ethnicity, gender, and grade in school. The result of these analyses suggested that approximately 54.3% of the mobility difference in math percentile scores and 58.1% of the difference in ELA percentile scores was related to these other student demographic differences. After controlling for other student demographic characteristics, predicted scores for a student who experienced a move during the school year declined 6.4 percentile points in math and 5.5 percentile points in ELA (math: $t(61302.7)=-9.508$, $p<.001$; ELA: $t(61250.2)=-8.210$, $p<.001$).

Additional Adjustment for Prior Performance. A final set of analyses also controlled for prior testing using AY2016 percentile scores as an additional predictor of AY2017 performance. In effect, this changes the model from simply predicting AY2017 scores, to predicting the ***difference*** between how a student actually scored and ***what one would have expected*** given their performance in the previous year[13].

Mobility continued to have a significant impact on math performance, even after controlling for demographic differences and prior testing. A move during the school year was associated with a 2.97 percentile point reduction in predicted math scores – even after controlling for prior performance ($t(61353.8)=-5.999$, $p<.001$). For context, the effect associated with free/reduced lunch status was a reduction of 4.32 percentile points ($t(61089.7)=27.041$, $p<.001$). In essence, the impact of mid-year mobility was equivalent over two-thirds (69%) of the effect of free/reduced lunch status – a well-documented indicator of lower income widely seen as an important effect. These are illustrated in Figure A2.

Figure A2. Reduction in predicted math and ELA percentile scores, adjusted for prior testing and student demographics, with the effect of free/reduced lunch status also illustrated for context.



[13] Also referred to as residualized change scores.

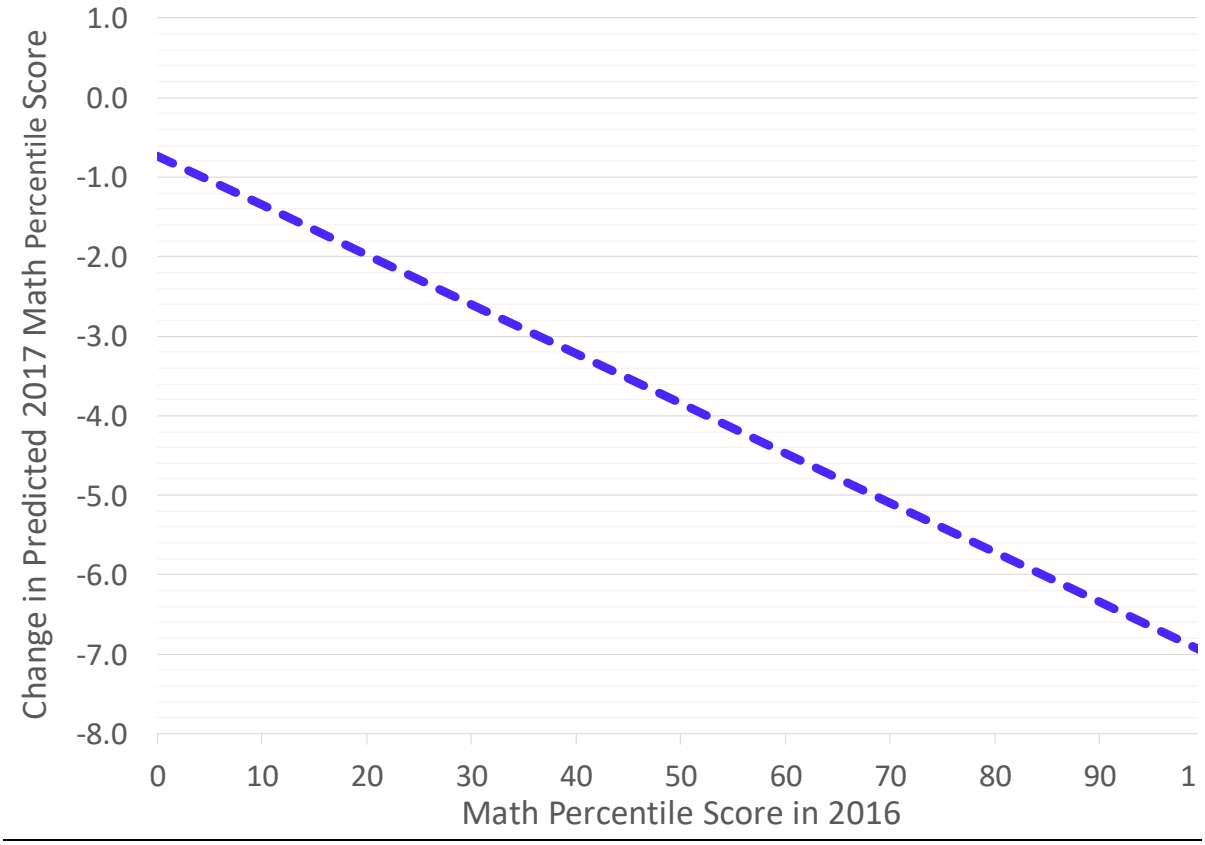
The same pattern was seen for ELA performance, although the size of the effect was slightly less than half of that seen for math. Adjusting for student demographic differences and prior performance, a move during the school year led to predicted ELA scores being 1.27 percentile points lower (t(61311.7)=-2.882, p=.004). Again, for context, the effect associated with free/reduced lunch status was a reduction of 2.97 percentile points (t(60661.9)=-20.817, p<.001), making the impact of mobility equal to 43% of that seen for this marker of lower family income.

VARIATION BASED ON STUDENT CHARACTERISTICS

A final set of analyses examining the impact of mid-year mobility on percentile scores tested possible interactions or moderator effects between mobility and various student characteristics in order to see whether the effect of mobility varied for different subgroups of students. For example, does mobility have a larger (or smaller) effect on students from lower income families? All interaction analyses also controlled for student characteristics and AY2016 test scores.

Prior (FY2016) State Testing. After controlling for testing and student characteristics, a significant interaction was found between mid-year mobility and AY2016 scores when predicting AY2017 percentile scores in math (t(61272.8)=-3.359, p=0.001). Figure A3 shows the

Figure A3. Predicted change in math percentile scores for students experiencing a move during the AY2017 academic year, based on prior-year math performance.



degree to which mobility impacted AY2017 scores, relative to child who did not move during the academic year. The horizontal x-axis covers the range of possible AY2016 student percentile scores. The vertical y-axis shows the predicted impact on AY2017 percentile scores. A value of zero on the y-axis would indicate that mobility had no effect on a student's predicted AY2017 performance, while a negative value indicates that mobility led to a ***reduction*** in predicted percentile scores and a positive value would indicate that it led to an ***increase*** in predicted percentile scores. For example, the predicted reduction for a student who moved in AY2017 was 1.98 percentile points if they previously performed at the 20th percentile rank, and 5.72 percentile points if they previously performed at the 80th percentile rank.

In contrast, no significant interaction was found between mid-year mobility and prior performance when predicting ELA scores (t(61238.7)=-1.464, p=0.143), suggesting that the effect of mid-year mobility on ELA performance was consistent for students regardless of their prior testing.

Other Student Characteristics. No other statistically significant interaction effects were found between mid-year mobility and student characteristics when predicting either AY2017 math or ELA scores. These included possible interactions between mobility and special education status (math: t(61299.7)=0.548, p=.584; ELA: t(61252.8)=-1.213, p=.225), free/reduced lunch status (math: t(61362.1)=-0.669, p=.503; ELA: t(61314.3)=-0.236, p=.813), student sex (math: t(61294.2)=-0.852, p=.394; ELA: t(61241.9)=0.217, p=.829), race/ethnicity (math: F(6, 61424.1)=1.362, p=0.226; ELA: F(6, 61363.2)=1.824, p=0.090), or grade in school (math: t(61350.2)=-0.148, p=.882; ELA: t(61314.3)=-0.468. p=.640).

IMPACT OF MID-YEAR MOBILITY ON PROFICIENCY LEVELS

In addition to student test scores, proficiency in math and ELA provides an alternative way of examining the impact of mobility on academic achievement. Therefore, a series of multinomial regressions were conducted that used student demographic characteristics, prior testing, and mobility patterns as predictors of AY2017 proficiency in math and ELA.

For these analyses, proficiency was coded into three categorical values:

(1) Well below state expectations
(2) Below state expectations
(3) At or above state expectations

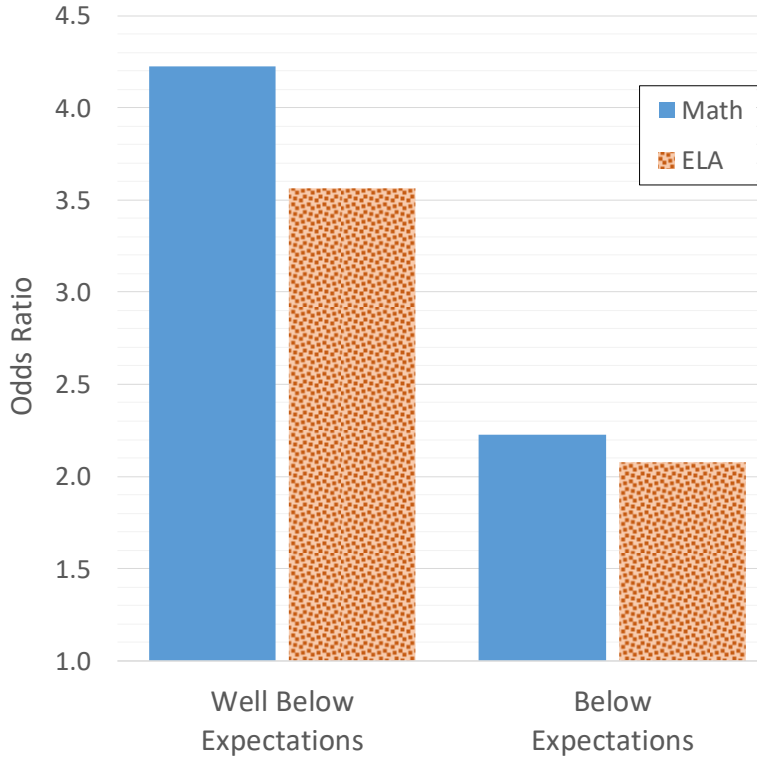
These multinomial regressions assessed the increase in odds that a student who experienced non-promotional mobility performed either (a) "well below", or (b) "below" state expectations. Analyses first examined simple effects without controlling for any other variables, before controlling for prior testing and student demographic differences.

UNADJUSTED EFFECTS OF MOBILITY ON PROFICIENCY LEVELS

In a simple model that did not control for prior testing or student demographic differences, mobility during the AY2017 academic year was found to be highly related to AY2017 student proficiency in both math and ELA (math: $\chi^2(2)=389.4$, p<.001; ELA: $\chi^2(2)=345.4$, $p<.001$).

Risk of Performing "Well Below" or "Below" Expectations. Mobility was found to be highly related to an increased risk of performing "well below" state expectations in both math and ELA. If a student experienced a move during AY2017, their odds of subsequently performing well below expectations in math increased by 423% (b=1.441, $\chi^2(1)=340.1$, $p<.001$, OR=4.23), while their odds of performing "below" expectations in math (but not "well below") increased by 223% (b=0.801, $\chi^2(1)=100.1$, $p<.001$, OR=2.23). Similarly, mid-year mobility was associated with a 357% increase in the odds of performing "well below" expectations in ELA (b=1.271, $\chi^2(1)=338.2$, $p<.001$, OR=3.57) and an increase of 208% in the odds of performing "below" (but not "well below") ELA expectations (b=0.731, $\chi^2(1)=111.4$, $p<.001$, OR=2.08). The increased odds of failing to meet expectations in math and ELA are presented in Figure A4.

Figure A4. Unadjusted odds-ratios for performing "well below" or "below" state expectations in math and ELA based on mobility during the 2016-2017 academic year.



ADJUSTED EFFECTS OF MOBILITY ON PROFICIENCY LEVELS

Not surprisingly, the size of mobility effects on mathematics and ELA proficiency decreased significantly after statistically controlling for prior testing and other student demographic characteristics (i.e., free/reduced lunch status, special education status, race/ethnicity, student

sex, grade in school). Nevertheless, mobility continued to be highly related to AY2017 proficiency in both math and ELA (math: $\chi^2(2)=39.098$, $p<.001$; ELA: $\chi^2(2)=8.296$, $p=.016$).

Performance in Mathematics

After controlling for student characteristics and prior testing, students who moved during the academic year experienced an 89% increase in the odds of performing well below expectations in math (b=0.637, $\chi^2(1)=34.1$, $p<.001$, OR=1.89) and a 35% increase in the odds of performing below expectations in math (b=0.298, $\chi^2(1)=9.618$, $p=.002$, OR=1.35). This is illustrated in Figure A5.

For context, it should be noted that being identified as eligible for free/reduced lunch increased the odds that a student would perform well below expectations by 134% (b=0.849, $\chi^2(1)=731.3$, $p<.001$, OR=2.34) and increased the odds that a student would perform below expectations by 54% (b=0.430, $\chi^2(1)=324.7$, $p<.001$, OR=1.54). In essence, after controlling for prior test scores, free/reduced lunch status, special education status, race/ethnicity, sex, and grade in school, the effect of mobility was approximately two-thirds the effect associated lower-income status.

Performance in ELA

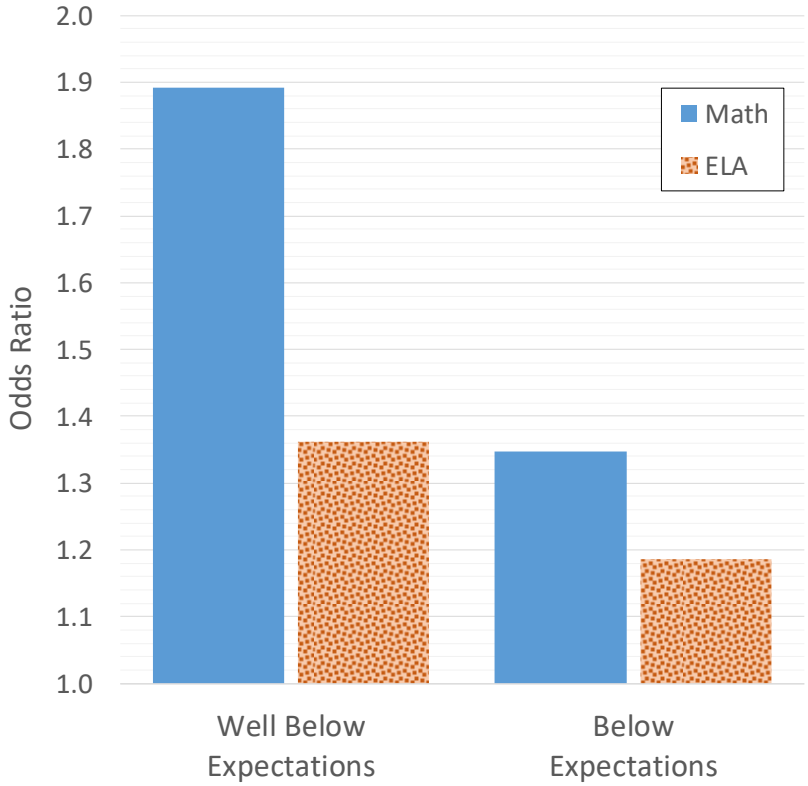
The pattern for ELA proficiency differed somewhat from mathematics proficiency. After controlling for prior testing and student characteristics, mobility during the school year was associated with a 36% increase in the odds of performing "well below" ELA expectations (b=0.309, $\chi^2(1)=8.234$, $p=0.004$, OR=1.36), and a marginally significant 19% increase in the odds of performing "below" ELA expectations (b=0.171, $\chi^2(1)=3.68$, $p=0.055$, OR=1.19).

For context, free/reduced lunch status was associated with a 90% increase in the odds of performing well below ELA expectations (b=0.642, $\chi^2(1)=337.3$, $p<.001$, OR=1.90) and a 42% increase in the odds of performing below ELA expectations (b=0.349, $\chi^2(1)=204.1$, $p<.001$, OR=1.42). In other words, after controlling for prior testing, free/reduced lunch status, special education status, race/ethnicity, sex, and grade in school, the effect of mobility was approximately 40% to 45% of the effect of lower-income status. This is also illustrated in Figure A5.

VARIATION BASED ON STUDENT CHARACTERISTICS

A series of analyses examined possible interactions between student characteristics and mid-year mobility as predictors of proficiency in mathematics or ELA. Only one analysis found a marginally significant interaction. It was concluded that there was a reasonable chance this was a spurious random finding, and so is not interpreted here. In sum, the lack of interactions suggests that the previously reported relationships between mid-year mobility and student proficiency appear to be fairly consistent, regardless of a student's free/reduced lunch status, special education status, race/ethnicity, sex, or grade in school.

Figure A5. Odds-ratios for performing "well below" or "below" state expectations in math and ELA based on mobility during the 2016-2017 academic year, adjusted for prior testing and student demographic characteristics.



CONCLUSION

In conclusion, mid-year mobility has a significant, negative effect on those students who experience a move during the school year. Academically, its negative impact is in the range of 40% to 69% of the size of the effect seen with free/reduced lunch eligibility – a marker of lower-income status that is widely seen as reflecting an important and meaningful effect. While the negative impact of mid-year mobility was fairly consistent across all students who experienced it, two subtleties to this pattern are worth noting for practice and policy planning. First, the fact that students who were identified as being eligible for free/reduced lunch were nearly five and a half times more likely to experience a mid-year move suggests that this may often reflect difficult economic realities that lead families to move during an academic year, rather than strategically time a move over the summer. Changing schools places further stress on these already stressed children and families. Second, follow-up analyses suggested that in terms of math, the negative impact of a mid-year move may be greater on students who were previously higher performing. In that sense, even academically successful students may face challenges following a mid-year move and require additional support and attention.

AUTHOR INFORMATION

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