Student Mobility and Violent Crime Exposure at Baltimore City Public Elementary Schools

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August 2019

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*Acknowledgements:
This research was made possible by a grant from the 21st Century Cities Initiative at Johns Hopkins University and indirect support from the Baltimore Education Research Consortium. Curt Cronister provided invaluable technical support. We are grateful for feedback and assistance from the Baltimore City and Baltimore County Public Schools. All errors and opinions are our own.

Abstract

High levels of school mobility are a problem in many urban districts. Many of these same districts are also dealing with high rates of violent crime. In this study, we use six years (2010-11 to 2015-16) of administrative data from Baltimore City public elementary school students and crime data from the Baltimore Police Department to examine whether changes in violent crime at schools are associated with the likelihood of school exit. Using school fixed-effects models to adjust for constant differences between schools, we find that students are more likely to leave following years with higher levels of violent crime at the school. These associations are strongest for students ineligible for free or reduced price meals and from safer neighborhoods.

Introduction

Turnover and student mobility are a challenge facing many large districts in urban (and increasingly suburban) areas (Miller & Sadowski, 2017; Rumberger, 2016; Welsh 2017). Research on student mobility documents that more disadvantaged students change schools very frequently and often move to schools that are relatively close (geographically and demographically) to their old school (Kerbow, 1996; Sirer et al., 2015; Welsh, 2016). In St. Louis, the mobility rate reached 40% in the 2011-12 school year, meaning that nearly half of the student body turned over during the course of the year (Metzger, Fowler, & Swanstrom, 2018). Similarly high rates of student churn have been documented in cities throughout the country, including the cities of Baltimore (Alexander, Entwisle, & Dauber, 1996), Chicago (De La Torre & Gwynne, 2009; Raudenbush, Jean, & Art, 2011), New Orleans (Welsh, Duque, & McEachin, 2016), New York (Schwartz, Stiefel, & Chalico, 2009), and Philadelphia (Fantuzzo et al., 2012). Student mobility is increasingly impacting broader metro areas as well, including those in Arizona (Fong, Bae, & Huang, 2010), California (Rumberger et al., 1999), North Carolina (Xu, Hannaway, & D'Souza, 2009), Oregon (Porter & Edwards, 2014), Tennessee (Grigg, 2012), Texas (Hanushek, Kain, & Rivkin, 2004), and Virginia (Miller & Sadowski, 2017).

Shifting student populations pose an instructional and organizational problem for schools. When students do not come to class with the same background it can be difficult to properly sequence material (Beatty, 2010; Beck, 1997; Hartman, 2002). Stability in enrollment and staffing is also necessary for building the trusting and supporting environment necessary for learning (Fiel, Haskins, & Turley, 2013; Grigg, 2012). As a result, high turnover rates negatively impact both mobile and non-mobile students (Raudenbush, Jean & Art, 2011; Whitesell, Stiefel, & Schwartz, 2016).

Many of the same districts that experience high student mobility are also are plagued by high levels of violent crime (Casella, 2001; Krivo et al., 2018; Papachristos, Brazil, & Cheng 2018). To date, higher rates of residential and school instability among populations exposed to high levels of violent crime have been noted, but not examined in detail (Alexander, Entwisle, & Dauber, 1996; Burdick-Will, 2016; Chen, 2008; Kerbow, 1996). In this study, we argue that these two phenomena are related in that parental concerns about student safety at school lead to strategic school transfers. Specifically, we test whether changes in the violent crime rate at a school are associated with an increase in the likelihood of school mobility, thereby adding a new dimension to the influences on student mobility described in the literature (e.g. Rumberger, 2015; Welsh, 2017). To do so, we draw on six years (2010-11 to 2015-16) of administrative enrollment data from Baltimore City Public Schools (BCPS) and incident level crime data from the Baltimore Police Department (BPD). Using multilevel logistic regression with school fixed-effects that adjust for constant differences between schools, we find that students are more likely to transfer following an increase in violent crime at the school. These associations are strongest for students who are ineligible for free and reduced-price meals (FARM) and students from safer neighborhoods. These findings have implications not only for our understanding of the mechanisms linking exposure to violence and academic outcomes, but for the sources of school instability and churning in many urban districts.

Background

Existing research on student mobility tends to focus on either who moves or the consequences of school transfers, rather than the sources of student instability. Minority and low-income students in urban districts are the most likely to change schools and to do so relatively frequently (Welsh, 2017). For these students, school transfer represents an additional form of

disadvantage and is associated with a range of negative outcomes due to interruptions in curricula and tracking, changes in peer support, lack of communication between families and new schools, and family stress related to moving residences (Beck, 1997; Welsh, 2017). For example, school transfer is associated with lower achievement scores in math and language arts (Temple & Reynolds, 2000), increased likelihood of high school dropout (Gasper, DeLuca, & Estacion, 2012; Rumberger and Larson, 1998), and loss of social capital through network reduction (South and Haynie, 2004; Ream, 2003). Negative consequences of mobility are particularly well demonstrated for students who move frequently (Temple & Reynolds, 2000).

Furthermore, student mobility can negatively impact academic outcomes not only at the student-level, but also at the classroom and school levels (Raudenbush, Jean, & Art, 2011; Hanushek, Kain, & Rivkin, 2004; South, Haynie, & Bose 2007). High mobility rates within classrooms may lead teachers to repeat curriculum and spend less time on long-term lesson planning (Lash & Kirkpatrick, 1990, Whitesell, Stiefel, & Schwartz, 2016). In these schools, researchers have theorized that high rates of mobility pose an additional problem of reducing the efficacy of long-term school-based reforms seeking to improve the achievement of transient student populations (Kerbow, 1996).

The consequences of mobility, however, may depend on why students change schools. Some research on the consequences of student mobility attempts to distinguish between "strategic" and "reactive" moves (Rumberger, 2003; Welsh, 2017). Strategic moves refer to moves made purposefully by students and parents to attain a preferred school placement. The presumed increase in academic quality and fit with student needs may be why some moves actually result in improvements academic outcomes after some school transfers (Hanushek, Kain, & Rivkin, 2004). On the other hand, reactive moves are thought to be made in reaction to

some (often unmeasured) stressor that is unrelated to school quality or preference, such as an eviction, job loss, or family structure change (e.g. Desmond, 2016). For example, Pribesh and Downey (1999) argue the co-occurrence of stressful events affecting children's home and family environments accounts for much of the negative effect of school mobility on academic outcomes. In this study, we argue that this distinction is perhaps too cut and dry. Students who change schools due to safety concerns are both "reacting" to their experience at the school and "strategically" avoiding perceived danger, but not necessarily making a move that will improve their academic experience.

Evidence of these strategic reactions can be seen in the fact that students are less likely to attend school after being victims of violence (Swahn & Bossarte, 2006; Benbenishty & Astor, 2005; Dake, Price, & Telljohann, 2003) or witnessing victimization of peers (Akiba, 2008). Though much of this literature has focused on victimization, students do not necessarily need to experience victimization personally to feel the effects of increased violence near the school. Burdick-Will (2013) argues that high levels of violent crime in a school can disrupt instruction; thus, school violence can have an impact on all students, regardless of victimization status. Indeed, students who feel unsafe in their classrooms consistently have lower test scores (Lacoe, 2016) and student absenteeism and dropout are also more likely in schools that students perceive as violent and unsafe (Kearney, 2008; Brookmeyer, Fanti, & Henrich, 2006). Together, these studies suggest a potential association between student mobility and exposure to violent crime at school.

The literature on school choice also provides more concrete evidence of the importance of school safety in mobility decisions. In interviews, parents express a strong desire to limit children's exposure to violence in their school environment (Condliffe, Boyd & DeLuca, 2015;

Lindle, 2008). Especially in urban school districts, families report that safety is an important factor they consider in their school enrollment decisions (Goldring & Hausman, 1999; Kleitz et al., 2000). Based on interviews with parents of students enrolling in high school, Bulman (2004) finds that families emphasize the importance of safety and are more likely to identify schools as "good" schools when they perceive them as less violent. Given that perceptions of school safety play a significant role in the school choice process, we would expect them to also play a role in student mobility. While student mobility can be an indicator of an unstable academic trajectory, it can also be a mechanism by which families engage in school choice (Hanushek, Kain, & Rivkin, 2004).

Together, the literature on exposure to violence, student mobility, and parental preferences suggests that parents attend to safety in and around their children's school and that increases in violent crime are likely to be a driver of school exits. Therefore, we expect that increases in violent crime in the area immediately surrounding the school will predict increased likelihood of students transferring to another school for the following school year.

Data

Data for this analysis comes from the city of Baltimore. BCPS has had a high student mobility rate for decades (Alexander, Entwisle, & Dauber, 1996). Student mobility rates at the elementary, middle, and high school levels were between 20 and 25 percent for the 2015-16 school year with significant variation in student mobility across schools and neighborhoods in Baltimore City (MSDE, 2017). There is also significant variation in rates of violent crime across city neighborhoods (see Morgan & Pally, 2016).

Student-level data for this study come from de-identified BCPS administrative records from the 2010-11 through 2015-16 school years that are stored at the Baltimore Education

Research Consortium. The records include gender, race/ethnicity, grade level, free and reduced-price meal status (FARM), special education status, and English language learner status (ELL) for every child enrolled in the district at any point in time. We use the residential addresses recorded by the district at the end of each school year to connect students to neighborhoods and to create an indicator of students' residential mobility.

Most importantly for the purposes of this study, the records include the date of enrollment and withdrawal for each school attended. We limit our analysis to the 2011-12 through 2014-15 school years, and we use the first and last years of the dataset (2010-11 and 2015-16 school years) to calculate change in enrollment before and after each school year. Our outcome of interest is whether a student changed schools during the summer after the completion of the school year. We use only summer moves for two reasons. First, by restricting our mobility measure to the summer months we ensure that the timing of the move necessarily comes after the measurement of violent crime during the school year. If we were to count moves that took place earlier in the school year, we might mistakenly attribute the mobility to crimes that had not yet taken place.[1] Second, throughout the literature on student mobility, summer moves are considered to be, on average, more strategic and intentional than moves that occur during the school year (Welsh, 2017). Disrupting a student's academic year can be detrimental to their studies and social life and parents who are not just reacting to external circumstances, such as eviction, job loss, or discipline problems are more likely to keep their child enrolled for the entire academic year before making a change. By limiting our analysis to these strategic moves, we are

[1] More than 70 percent of all mid-year mobility takes place during the fall semester making the issue of timing especially difficult for mid-year moves. Spring mobility is too rare to predict with any confidence using fall violent crime exposure.

more likely to capture parental reactions to something that happened at school rather than reactions to other not-school-related changes in home or family life.

We limit our analysis to students enrolled in kindergarten through fifth grade. There is substantially more mobility in these lower grades and although there are generally lower levels of violent crime in the area around elementary schools than around high schools, there is also substantial variation in student exposure. We exclude middle and high school students because the open enrollment choice process makes changing schools more difficult. There are not always seats available at desirable schools and it is often difficult to move to a better school after the initial lottery assignment has been made. In contrast, residential mobility provides direct access to any elementary school with a catchment zone, and many Baltimore elementary schools are under-enrolled and accept students from out of zone to fill their seats (BCPS, 2018). There is also substantially less curricular differentiation between elementary schools and there are no selective enrollment or vocational schools at the elementary level that provide a unique experience and would therefore be likely to retain students regardless of local safety concerns.

The school mobility literature distinguishes between promotional and non-promotional school moves (Welsh, 2017). Promotional moves are made by students who change schools because they have reached the highest grade available at their current school. These moves are not voluntary and therefore do not represent an active decision to move on the part of the family. While this is relatively rare in grades K-5, some schools do close or have limited grade offerings. Observations in which students' only option at the end of the year is to change schools are not included in the analysis.

We limit our analytic sample to observations in which students are stably enrolled in a single school for the whole year in order to ensure that all students in a school were exposed to

the same violent crime rate. Midyear mobile students contribute to school-level measures, but their individual observations are not included in the analysis.

Additional school-level data is collected from the National Center for Education Statistics (NCES) Common Core of Data (NCES, 2017) and the MSDE School Report Cards (MSDE, 2017). We use the geocoded school addresses reported in the NCES data to identify the city block in which the school is located. We use annual standardized test score proficiency rates reported by MSDE to create a rough measure of school quality. In 2014-15 Maryland adopted the Common Core-aligned test (the Partnership for Assessment of Readiness for College and Careers [PARCC]) and pass rates on standardized tests were lower than in previous years. To account for this discrepancy, we measure school-level achievement by ranking schools by percentile within years according to their average test scores rather than comparing raw test score data. Relative differences in test performance across schools are therefore comparable to other years in the dataset. School-level racial composition and proportion of special education students, ELL, and FARM recipients and mobility metrics, such as the number of new students in each year, and the number of midyear exits, are calculated by aggregating the individual-level data to the school level.

Crime data for this study come from incident reports of victim-based crimes published by the BPD on the OpenBaltimore Data Portal for 2010 through 2016 (BPD, 2017). This dataset includes the date, time, location, code, and description of all officially reported incidents during this time period. Violent crimes include all assaults, robberies, rapes, shootings, and homicides. We create two measures of violent crime exposure for every student. First, we measure violent crime exposure at school. In order to identify crimes that likely took place at school we include all crimes that occur on either side of all streets that define each school's city block. These

crimes either took place on school grounds and were reported at the closest physical address or they took place just outside of school grounds, but on the street that runs along the school grounds. Either way, the police presence would have been visible from the school itself. The idea here is not to explore whether the neighborhood that the school is located in is safe, but whether the immediate location of the school is safe. There is wide variation from block-to-block in violent crime rates (see Braga et al 2010) and even in generally violent neighborhoods the immediate area of the school may be quite safe or vice versa. For our school violent crime measure we include only violent crimes that occur during the day (6:00am to 7:00pm) on weekdays between the first and last days of school. These crimes represent events that students and their families are most likely to be aware of and to which students are most likely to be exposed. This time period is long enough so that we can reasonably assume that there will be some students in the vicinity of the school, even if just for a one-time event, but not so short that it removes all variation in students' exposure.

Our second measure of violent crime captures students' exposure in their neighborhood. Here we count all violent crimes that take place in each students' residential census tract at any time of day and day of the week during the full calendar year from the first day of school to the start of the next school year. Given the skewed distribution of exposure to violent crime, both measures have been transformed using the inverse hyperbolic sine (IHS) function. This transformation is frequently used when modeling wealth and has the benefit of a similar interpretation as the log transformation, but can be used when values include zero (Burbridge et al., 1988). This means that the coefficients represent approximate percent change in exposure rather than an increase in a specific number of crimes.

One limitation of the administrative data is that it does not include any direct measures of family background. Instead, we rely on student addresses to capture at least some differences in socio-economic circumstances and adjust for other aspects of the students' neighborhood that may be associated with violent crime exposure. Specifically, we include tract-level measures of median household income and percent of residents with a bachelor's degree or higher from the 2011-15 American Community Survey. Including additional neighborhood measures, such as the poverty, unemployment, or welfare rates does not add anything to the models.

The use of administrative enrollment records means that every student has a complete record and there are no missing values in our population of stably enrolled students. Around 4.5 percent of midyear mobile observations, mostly late entry kindergarteners, have addresses that we were not able to geocode, but these observations are not included in the analytic sample. Moreover, since we count a student as leaving their school regardless of their destination, leaving the district does not generate any missing values.

Methods

The analytic dataset for this study includes repeated annual measures of students nested within schools. Assessing the relationship between exposure to school violent crime and school mobility is difficult due to the selection of different types of students into different schools. In order to adjust for as much of this selection as possible we include a number of individual- and school-level characteristics in the model as well as a school-level fixed-effect.[2] The covariates include not only demographic and academic student- and school-level characteristics, but also indicators of prior mobility for both students and their peers. The school fixed-effect adjusts for

[2] School mobility is too rare to use a student fixed-effects model and compare students to themselves over time. Any student who never changes schools would be dropped from the analysis due to lack of variation.

unobserved, constant differences between schools that might confound the relationship between safety and mobility, such as proximity to transit and commercial areas (Cohen & Felson, 1979) or structural features of the school building that limit adult supervision (Sánchez-Jankowski, 2016). In other words, the coefficient for the school violent crime represents the estimated relationship between mobility and year-to-year changes in school violent crime. These fixed-effects essentially allow us to compare students in the same school, but different calendar years to see if students are more likely to leave in years with higher violent crime rates.

The formal model is as follows:

$$\log((P(Y_{tijk}=1)/(1-P(Y_{tijk}=1))) = \eta_{tijk} \quad (1)$$

$$\eta_{tijk} = \beta_0 + \beta_1 V_{tj} + \beta_2 X_{ti} + \beta_3 M_{ti} + \beta_4 N_{tik} + \beta_5 S_{tj} + d_t + s_j + \varepsilon_{tijk}$$

Where Y_{tijk} is an indicator for whether or not student *i* living in neighborhood *k* made a non-promotional exit from school *j* in the summer following school year *t*; V_{tj} is the IHS-transformed measure of violent crime *j* at school in year *t*; X_{ti} are the individual-level characteristics of student *i* in school year *t* (including gender, race/ethnicity, special education status, English Language Learner status, FARM, and grade-level); M_{ti} are additional mobility indicators for student *i* in year *t*, including whether the student changed addresses in the prior calendar year or changed schools last summer; N_{tik} are the characteristics of the student's census tract including the IHS-transformed violent crime count, median household income, and percent of residents with a bachelor's degree or higher; S_{tj} are time-varying characteristics of school *j* in year *t*, including total enrollment, total number of student entries and exits during the school year, and percentages of students who are identified as Black, Hispanic, ELL, FARM, and special education eligible; d_t are dummy variables for each school year; ε_{tijk} are the individual-level error

terms; and s_j are fixed-effects for each school. All standard errors are robust and clustered at the school level.

Results

Descriptive Summary

Table 1 reports the distribution of the types of crimes that occur at Baltimore City elementary schools during the 2010-11 through 2014-15 school years. In the average school year there are around 7 reported assaults and 1 robbery, leading to a total of approximately 8 violent crimes. However, these distributions are quite skewed with a few schools reporting more than 50 violent crimes in a single school year. Most schools do not have any serious reported crimes, but there are a few schools that have dealt with up to 3 homicides and 2 rapes or shootings in one school year.

[Table 1 about here]

Table 2 describes the analytic sample and compares that to students who are excluded from the analysis due to mid-year mobility. Around 13 percent of all observations and 12 percent of stable enrollments result in a summer move. Mid-year moves are slightly less common. Only around 10 percent of all observations are excluded due to a midyear move. As expected, midyear movers are generally more mobile by other measures as well. They are substantially more likely than stably enrolled students to have changed residences in the last year and to change schools during the previous or following summers. They are slightly more likely to be black and are more disadvantaged than the rest of the population in terms of special education, English language learning, free and reduced-price meals, tract demographics, and violent crime exposure in both their neighborhoods and schools, but these differences are relatively small. The number

of students in the stable and midyear-mobile groups does not add up to the total number of students because some students are mobile in some years and stable in others.

[Table 2 about here]

For descriptive purposes, Table 3 presents the school characteristics in years with low, medium, and high levels school violent crime. School years in the bottom third of violent crime (fewer than 3 reported crimes) are considered low, schools in the top third of average violent crime (more than 8 reported crimes) are considered high, and all other schools fall in the medium category. Exposure to violent crime is somewhat associated with school size, with highest-exposure school years enrolling approximately 48 students more than the lowest-exposure schools on average. The biggest differences between high and low violent crime school years is reflected in their racial composition. More than 90 percent of the students in the high violent crime school years are black, compared to 75 percent in the low violent crime years. Only 5.5 percent and 2.7 percent of students in high violent crime school years are white or Hispanic, respectively. These numbers show that while not all students in predominantly black schools in Baltimore are exposed to violent crime, those who are exposed are much more likely to be black. Schools in the highest-exposure category also serve disadvantaged students in terms of FARM and special education, although they serve fewer ELL students than schools in the other two exposure categories. Test scores are also somewhat lower in the highest exposure years. Importantly for our analysis, higher violent crime school years also have somewhat higher turnover rates with larger numbers of new students (123 in the lowest violent crime years versus 152 in the highest) and midyear movers (34 versus 53). The last row of the table shows how many schools are represented in each of these groups. The numbers in each column do not sum to the total because many schools change categories from year to year.

[Table 3 about here]

Figure 1 shows the geographic distribution of these school violent crimes across Baltimore for the 2013-14 academic year. Tract level violent crime is shown in the background as a reference. The schools with no reported violent crimes are marked in gray. Larger black circles represent schools with larger numbers of reported violent crime. Two things are worth noting about the spatial distribution of school violence. First, while the most violent schools are generally closer to more violent neighborhoods, there are both still quite a few reported school crimes in what otherwise appear to be relatively safe areas of the city and very safe schools in otherwise dangerous neighborhoods. Second, schools that are very close to one another geographically can have dramatically different violent crime rates. This spatial variability is due to the highly concentrated nature of violent crime. Even in the most dangerous neighborhoods in Baltimore and elsewhere, most crimes take place on a relatively low number of specific block faces (Braga et al., 2010; Cohen & Felson, 1979; St. Jean 2008).

[Figure 1 about here]

There is also quite a bit of temporal variability from year to year, especially in schools on the higher end of the violent crime distribution. Figure 2 shows reported violent crime rate for 12 randomly selected schools over time.[3] Violent crime rates in some of these schools vary dramatically from year to year with the most violent school-year peaking near 60 incidents but dropping below 20 in other years. Even in the lowest crime schools there is variability. In fact, only one elementary school in the city (a charter school in the northwest part of the city) reported no violent crimes in any year.

[3] We chose to show 12 schools because it is around 10 percent of the sample and is a large enough number to show a range of schools, but small enough that one can still make out the individual lines in the figure.

[Figure 2 about here]

Multilevel Results

Table 4 presents results for the multilevel logistic regressions of student mobility on school violent crime. Model 1 includes only student-level covariates. Unsurprisingly, the largest predictor of school mobility is prior residential mobility. The log-odds of school mobility for students with an address change in the prior calendar year is more than 2 points higher than those who did not change addresses. Students who changed schools during the previous summer are also more likely to move again, reflecting the general instability among some Baltimore City Schools students. On average, black students are more likely to change schools than non-black and non-Hispanic students. Hispanic and FARM recipients are less likely to change schools. Since we have used the IHS transformation, this coefficient for school violent crime represents predicted change in the log-odds of mobility when in violent crime rates at a school double (one hundred percent change). Since school violent crime rates are relatively low, in many cases the rate could double with just a few additional crimes. In this first model, adjusting for student characteristics, doubling the school violent crime rate predicts a .139 (s.e. 0.008) change in the log-odds of a student leaving the school.

With all of the student and school-level adjustments, tract median household income and education levels do not predict school mobility, but a one hundred percent increase in the violent crime rate in students' neighborhoods is associated with a 0.06 reduction in the log-odds of school mobility. The negative coefficient may come as a surprise. However, since baseline tract violent crime rates are much higher than school violent crime rates (108 on average), it is much more difficult for these crime rates to double in a single year. Moreover, many students do not attend school near their home neighborhood, meaning that violence near home does not indicate

violence near school for many students (BCPS, 2018). Instead, high rates of violence near home likely reflect additional sources of instability and disadvantage, factors which may impede families' available bandwidth to react to school violence through transfer (Schilbach, Schofield, & Mullainathan, 2016). Alternatively, spatial variability of violent crime may contribute to this pattern. Families living in neighborhoods with high levels of violent crime may already avoid spending time outside of their homes (see Rosenblatt & DeLuca, 2012) such that student mobility is less responsive to increases in violent crime in the home neighborhood than in the school. Interaction effects may also help elucidate this pattern, which we address below.

[Table 4 about here]

Model 2 adds neighborhood and school characteristics. Students are more likely to leave schools with higher midyear mobility rates, lower test scores, and higher proportions of black, ELL, and FARM students. In this model, the relationship between a one percent change in violent crime and the log odds of student mobility is reduced substantially to 0.037 (s.e. 0.17), suggesting that a large proportion of summer mobility can be explained by observed differences in school demographics and achievement.

The next model adds in school fixed-effects to account for any unobserved, constant differences between schools that might be related to both mobility and violent crime. Here, the coefficient remains essentially the same, but slightly larger than the previous model. When school violent crime doubles, the fixed-effects model predicts a 0.042 log-odds increase in school mobility. The predicted marginal association between a one hundred percent change in school violent crime and summer student mobility, holding all covariates at their mean, is 0.37 percentage points. For context, the predicted probability of leaving the school over the summer for students with otherwise average characteristics in schools with no violent crimes is 11.4, with

average violent crime exposure (8 violent crimes in a year) is 12.4, and with exposure one standard deviation above the mean (17 violent crimes in a year) is 12.7. This means that approximately 5.8 additional students are expected to leave an average sized school (approx. 443 students) in a high violent crime year than a year with no reported violent crimes.

Interactions

There is no evidence of differential associations by grade, race, gender, English language learner, special education status, or school proficiency levels (results not shown in tables). However, there is some evidence that the relationship between violent crime exposure and school transfer is stronger for more advantaged students. Model 4 shows the interaction between exposure to violent crime near school and FARM status. Non-FARM eligible students are much more likely to leave their school following a year with relatively high violent crime. In fact, the predicted marginal increase in the probability of mobility when school violent crime doubles and all other covariates at their mean for FARM students is only 0.31 percentage points (s.e. 0.17), but 1.0 percentage points (s.e. 0.37) for non-FARM students.

The same general relationship can be seen with neighborhood violence: students from safer neighborhoods are more sensitive to exposure to violence at school (Model 5). This is true whether or not we include the FARM interactions. For students in the safest decile of neighborhoods (with fewer than 27 violent crimes in a year), doubling school violent crime predicts a 1 percentage point increase in the probability of school changing schools. In neighborhoods with above average violent crime rates (100 or more), the relationship between doubling school violence and mobility is negligible (marginal effect = 0.008, s.e. = .003). Again, this interaction provides more evidence that students with more resources are more willing and able to leave schools that they perceive to be unsafe.

Finally, there is no evidence that students are more likely to leave the entire district, rather than just their school, in summers following exposure to violent crime near their school (results not shown). In other words, increased rates of violent crime are related to churning within the city of Baltimore, not flight to the suburbs.

Robustness Checks

Below we describe three different robustness checks that are used to examine potential bias in our measures and estimates. First, our measure of school violence relies on the fact that crimes that take place on school grounds will need to be reported with addresses on the streets that surround the school campus. To test whether these crimes are just capturing the general area around the school and not what is going on inside the grounds, we also created measures of violent crime in the census tract that the school is located and within a half-mile buffer of the school. The correlation between these measures and the crime rates at school is relatively low (0.27 and 0.16 respectively) and these measures do not significantly predict student mobility (results not shown). This suggests that families are responding to—and our school violent crime measure is capturing—something about the school itself rather than the larger area around the school. One potential explanation for this difference is that general safety in the area is likely already taken into account when selecting the school and, therefore, less likely to influence subsequent student mobility decisions.

Second, individual-level standardized test scores are only available for students starting in third grade. In order to include as many elementary school students as possible we do not include measures of individual achievement in the main models. However, analysis using only third grade and older students and including the test scores shows that the test scores are not predictive of mobility after adjusting for the other covariates ($\beta = 0.024$, s.e. = 0.018) and the

coefficients for exposure to violence are substantively similar (β = 0.057, s.e. = 0.023). This suggests that our results are not biased by leaving out achievement scores in the main models.

Finally, despite the rigorous school and student-level adjustments, these findings do not necessarily represent a causal effect. Administrative data allow us to examine the entire population of Baltimore City public school students, but do not provide detailed information on family background or on the kinds of acute stressors, such as eviction or family change, that might lead to school mobility. We have tried to adjust for as much of this as possible with the available demographic and mobility measures, but it is possible that unobserved differences between students account for some of the association between school violent crime and student mobility. One way to assess whether there are still unobserved differences between schools and students that drive the association between school violent crime and mobility is with a placebo test. Here we use a measure of violent crime that took place at the school following the summer when we observed student mobility. If there is something about the school or student that is generating bias in our estimate, we might expect that this "future crime" measure would also be related to the likelihood of school mobility. On the other hand, if timing matters and this "future" violent crime measure is not related to prior mobility, it is more evidence that our estimates are not driven entirely by bias. The results of this placebo test are clear: measures of school violent crime in the following year are not related to student mobility (β = 0.022, s.e. = 0.020).

Discussion and Conclusion

Student mobility and exposure to violence are both well documented problems in many urban school districts. In this study, we show that these two phenomena should not be considered in isolation and are in fact related. Specifically, we show that in academic years with higher levels of reported violent crime at school, students are more likely to transfer from that school at

the end of the year. For the average student, when school violent crime doubles, we predict approximately half a percentage point increase in the likelihood of school transfer. Doubling of the violent crime rate may seem like a high benchmark for the marginal effect, but since school violent crime rates are generally low it is actually quite common. Of the 352 school years where it is possible to calculate the change from one year to the next, around 23 percent of school years experienced a change from one year to the next of at least 100 percent.

Moreover, these predicted associations are substantially larger for students who do not qualify for FARM. This suggests that it is relatively more advantaged students who are most sensitive to and able to respond to changes in safety around their school. This does not mean that lower income families are not aware of or worried by violent crime at school, but that they may feel less empowered to take concrete action in response (see Pattillo, 2015; Schilbach, Schofield, & Mullainathan, 2016). Therefore, violent crime around a school may not only influence individual students' transfer rates, but may also shape the composition of the student body by pushing out some of the most advantaged students.

The association between exposure to violence and student mobility has important implications for educational inequality. First, it provides even more evidence of the collateral damage of violent crime on urban areas. Not only do high crime rates cause stress and trauma for individual students, but they may be a source of churning and instability in already disadvantaged areas. This instability may, in turn, be part of the mechanism linking exposure to high-violence schools and neighborhoods to worse academic outcomes. Moreover, these results uncover a source of hidden disadvantage for urban, minority students. Research repeatedly finds that minorities are more likely to change schools than white students with similar family background characteristics (Welsh, 2017). Our results show that even the more advantaged

Baltimore City Schools students of color face substantially higher levels of violent crime exposure than their white peers. These findings suggest that this exposure is a source of instability in these students' lives, leading to school transfers that likely would not have happened in safer environments and may not be in the best academic interests of the students.

Second, the literature on student mobility tends to focus on purely academic rationales for defining how students make "strategic" moves between schools. Consequently, existing studies generally treat other types of moves as less rational or as evidence of "churning" aimlessly between schools of similar academic quality. Kerbow (1996) and others have argued that high rates of student mobility in urban districts reflects the instability in students' home lives and indicates a lack of rationality in school choice decisions. By contrast, we argue that students and their families may be behaving with much greater rationality than this literature generally attributes to them and in response to factors that previous studies have not fully considered. By demonstrating that changes in violent crime near school help to predict student mobility, we provide evidence for the perspective that student mobility is about more than just students' own residential instability. Moreover, we suggest that even in the face of instability, this study demonstrates that there remains plenty of room for agency and rationality of various types within student mobility. Even mobility which may not appear strategic by traditional metrics of school academic quality may be strategically oriented around other metrics of quality, such as exposure to violent crime.

Finally, instability and churning in urban school systems is a serious problem in and of itself. Not only do individual students tend to do poorly after a school transfer, but schools and classrooms with high mobility rates are harder to teach (Raudenbush et al. 2011, Whitesell et al. 2016). Students with higher exposure to violence on the way to school may also be less likely to

show up in class and teachers who fear for their safety are more likely to leave their school (Burdick-Will, Stein, & Grigg, 2019; Boyd et al. 2011). Moreover, students exposed to violent crime near their previous school who then transfer to other schools may bring with them stress and trauma that can negatively impact their new peers (Burdick-Will, 2018). Unfortunately, this relationship between violence exposure and mobility is likely dynamic and magnified over time. Given the year-to-year fluctuations in school violent crime rates, students may leave one school because they experienced violence for another that they think is safer, only to find that in the next year, their new school experiences as much or more violence than they expected.

In order to reduce student turnover rates, policymakers in urban districts must think beyond students' individual-level rationale for school transfer and begin to consider the larger urban context. The results of this study suggest that districts may be able to reduce student turnover by expanding their definition of school safety. Although many districts have begun to place safety officers inside school buildings, violent crime reported just outside of the school building can significantly impact families' decisions about school enrollment. Focusing on reducing exposure to violent crime in the area surrounding the school and having more adult supervision outside the school building can help prevent students' exposure to crime, with potential implications for students' enrollment and mobility patterns at the district level.

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Table 1. Violent Crimes at Baltimore City Elementary Schools Per Academic Year (2010-11 through 2014-15

	Mean	Standard deviation	Median	Minimum	Maximum
Violent	7.93	9.00	5	0	56
Assault	6.63	7.53	4	0	52
Robbery	1.11	2.14	0	0	19
Rape	0.06	0.25	0	0	2
Shooting	0.07	0.28	0	0	2
Homicide	0.06	0.30	0	0	3

Source: Authors' calculation based on data from the Baltimore City Police Department and the Baltimore City Public Schools.

Table 2: Student Characteristics by Enrollment Status

	Stable	Midyear Move	All
Midyear School Move	0	100	10.05
	(0)	(0)	(30.07)
Summer School Move	12.31	19.77	13.06
	(32.86)	(39.82)	(33.70)
School Move Last Summer	15.83	25.58	16.81
	(36.50)	(43.63)	(37.40)
Residential Move	30.02	62.47	33.28
	(45.83)	(48.42)	(47.12)
Male	51.26	52.76	51.41
	(49.98)	(49.93)	(49.98)
Black	80.36	83.86	80.71
	(39.73)	(36.79)	(39.46)
Hispanic	8.32	7.42	8.23
	(27.62)	(26.21)	(27.49)
Special Education	11.86	13.73	12.05
	(32.34)	(34.42)	(32.56)
English Language Learner	4.74	6.21	4.90
	(21.26)	(24.14)	(21.58)
Free and Reduced-Price Meals	88.92	92.64	89.30
	(31.39)	(26.12)	(30.92)
Grade	2.22	1.97	2.19
	(1.61)	(1.61)	(1.61)
Tract Median Household Income	39477.0	36497.3	39177.4
	(17989.3)	(14942.6)	(17729.3)
Tract Percent with Bachelor's Degree	19.58	16.79	19.30
	(16.42)	(13.91)	(16.21)
Tract Violent Crime	107.5	113.5	108.1
	(55.94)	(56.21)	(56.00)
Violent Crime at School	8.04	8.80	8.12
	(9.17)	(9.42)	(9.21)
Observations	122,245	13,666	135,911
Students	54,235	11,958	60,971

Note: Percent for dichotomous variables and mean for continuous variables. Standard deviation in parentheses.

Source: Authors' calculation based on data from the Baltimore City Police Department and the Baltimore City Public Schools.

Table 3: School Characteristics by Thirds of School Violent Crime

	Low	Medium	High	All
Total Enrollment	423.4	440.4	470.4	443.2
	(203.7)	(208.7)	(174.5)	(197.6)
Number of New Students	122.6	136.3	152.0	136.0
	(72.13)	(68.64)	(59.95)	(68.43)
Number of Midyear Exits	33.80	44.42	52.80	43.00
	(19.32)	(22.51)	(23.77)	(23.12)
Proficiency Percentile	66.58	53.58	47.45	56.57
	(24.58)	(25.67)	(25.55)	(26.45)
Percent Black	75.36	82.99	90.38	82.39
	(28.77)	(22.35)	(16.48)	(24.26)
Percent Hispanic	9.224	7.643	2.779	6.756
	(16.39)	(14.32)	(4.152)	(13.36)
Percent English Language Learner	5.302	4.405	1.644	3.901
	(10.32)	(9.570)	(3.869)	(8.715)
Percent Special Education	11.97	12.55	13.93	12.75
	(3.752)	(4.074)	(3.528)	(3.873)
Percent Free and Reduced-Price Meals	84.72	89.11	94.20	89.02
	(16.25)	(14.25)	(6.875)	(13.89)
School Violent Crimes	1.56	5.77	18.06	7.93
	(1.04)	(1.47)	(10.29)	(9.0)
Number of School-Years	188	163	153	504
Number of Schools	79	82	65	129

Note: Standard deviations in parenthesis. Low violent crime school years have fewer than 3 reported violent crimes. High violent crime years have more than 8 reported violent crimes. Medium violent crime school years are those in between. The number of schools in each category does not add up to the total number of schools because schools may be counted in multiple groups depending on the violent crime count in each year.
Source: Authors' calculation based on data from the Baltimore City Police Department and the Baltimore City Public Schools.

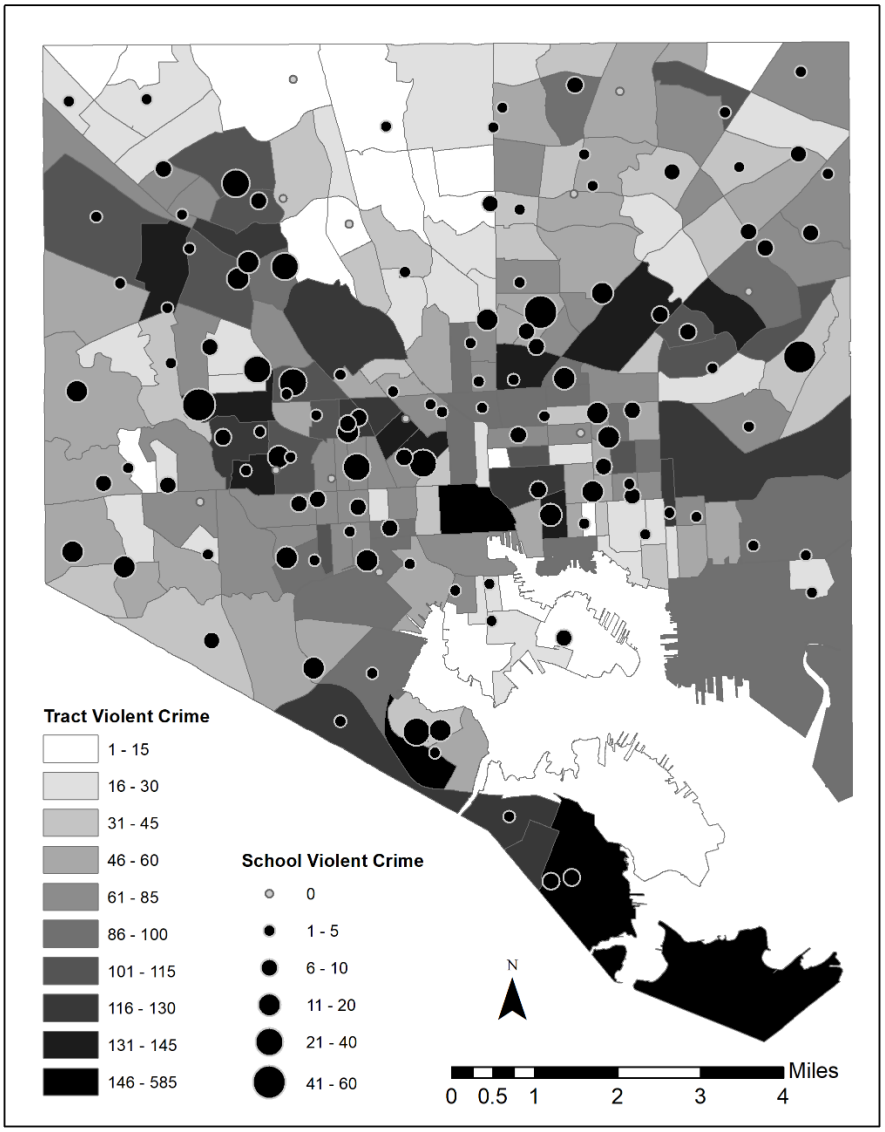
Table 4: Predicted Log Odds of Student Mobility

	Model 1	Model 2	Model 3	Model 4	Model 5
School Violent Crime	0.139***	0.037***	0.042*	0.103**	0.272**
	(0.009)	(0.011)	(0.019)	(0.037)	(0.093)
Male	0.069***	0.067***	0.064***	0.064***	0.064***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
Black	0.581***	0.175***	0.163***	0.160***	0.159***
	(0.040)	(0.050)	(0.047)	(0.047)	(0.047)
Hispanic	-0.156*	-0.263***	-0.285***	-0.291***	-0.293***
	(0.066)	(0.071)	(0.068)	(0.068)	(0.068)
Special Education	0.009	-0.003	-0.014	-0.014	-0.013
	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)
English Language Learner	-0.195**	-0.152*	-0.136	-0.137	-0.133
	(0.074)	(0.076)	(0.073)	(0.073)	(0.073)
Free and Reduced-Price Meals	0.039	-0.196***	-0.204***	-0.060	-0.204***
	(0.037)	(0.040)	(0.040)	(0.083)	(0.040)
Residential Move	2.154***	2.128***	2.148***	2.148***	2.148***
	(0.019)	(0.020)	(0.020)	(0.020)	(0.020)
Change Schools Last Summer	0.226***	0.209***	0.228***	0.228***	0.228***
	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)
Tract Median Household Income		0.024	0.019	0.019	0.020
		(0.017)	(0.022)	(0.022)	(0.022)
Tract Percent Bachelor's Degree		0.033*	0.011	0.012	0.014
		(0.016)	(0.022)	(0.022)	(0.022)
Tract Violent Crime		-0.090***	-0.096***	-0.096***	0.006
		(0.019)	(0.023)	(0.023)	(0.046)
Total Enrollment		-0.317***	-0.226***	0.223***	0.226***
		(0.023)	(0.057)	(0.057)	(0.057)
Total New Students		0.080***	-0.108***	-0.107***	-0.107***
		(0.021)	(0.032)	(0.032)	(0.032)
Total Midyear Moves		0.182***	0.136***	0.136***	0.134***
		(0.014)	(0.026)	(0.026)	(0.026)
Test Score Percentile		-0.096***	-0.068***	-0.068***	-0.068***
		(0.011)	(0.018)	(0.019)	(0.019)
School Percent Black		0.285***	0.467	0.460	0.450
		(0.029)	(0.286)	(0.286)	(0.286)
School Percent Hispanic		-0.076*	-0.051	0.050	0.049
		(0.037)	(0.157)	(0.157)	(0.157)
School Percent English Language Learners		0.162***	0.336***	0.338***	0.336***
		(0.032)	(0.100)	(0.100)	(0.100)
School Percent Special Education		-0.015	0.029	0.029	0.030
		(0.011)	(0.027)	(0.027)	(0.027)

School Percent Free and Reduced-Price Meals		0.075***	-0.137	-0.138	-0.141
		(0.021)	(0.098)	(0.098)	(0.098)
School Violent Crime*FARM				-0.067*	
				(0.034)	
School Violent Crime*Tract Violent Crime					-0.044*
					(0.017)
Constant	-3.346***	-2.129***	-1.18***	-1.305***	-1.707***
	(0.060)	(0.125)	(0.225)	(0.235)	(0.308)
School Fixed-effects			X	X	X
Observations	122,245	122,245	122,245	122,245	122,245
Number of Schools	129	129	129	129	129

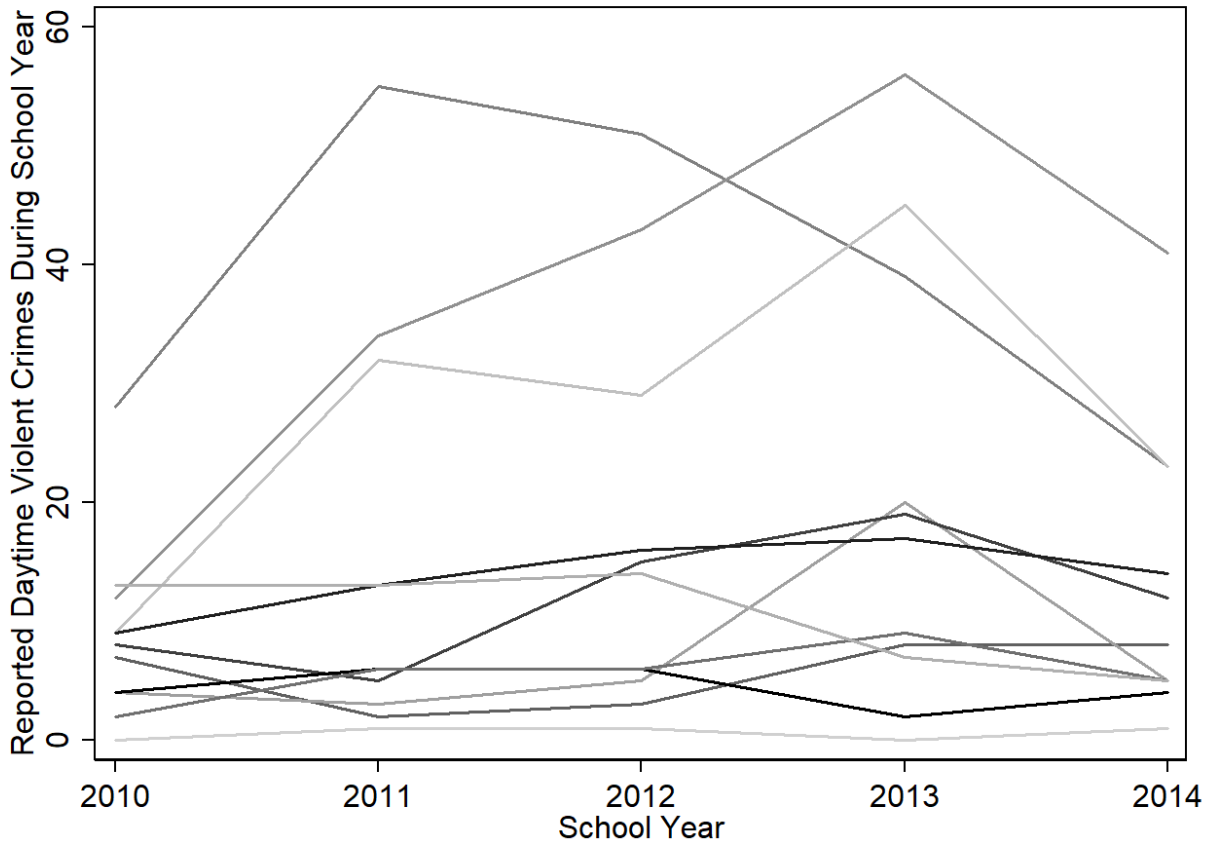
Note: Robust standard errors in parentheses. Violent crime measures have been transformed using the inverse hyperbolic sine function. All other continuous measures have been standardized. All models include indicators for grade and school year. *** p<0.001, ** p<0.01, * p<0.05.
Source: Authors' calculation based on data from the Baltimore City Police Department and the Baltimore City Public Schools.

Figure 1: Reported Violent Crimes at Baltimore City Public Elementary Schools and Census Tracts during the 2013-14 School Year



Source: Authors' calculation based on data from the Baltimore City Police Department and the Baltimore City Public Schools.

Figure 2: Trend in School Violent Crime in Randomly Selected Baltimore City Public Elementary Schools (2010-2014 School Years)



Note: Each line represents a single, randomly selected elementary school.
Source: Authors' calculation based on data from the Baltimore City Police Department and the Baltimore City Public Schools.