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The Academic Effects of Moving to Middle School on Students with Disabilities Relative to their General Education Peers

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Abstract

Middle school transitions are increasingly required, despite documented negative effects on general education students (GENs). We explore if and how the move to middle school differentially affects students with disabilities (SWDs), a large and low-performing group of students. Using an instrumental variables strategy and NYC data on nine cohorts of students, we find the middle school transition causes a 0.29 standard deviation decline in SWD math performance, a 0.16 standard deviation decline in ELA performance, and a one percentage point increase in grade retention. However, after accounting for potential mediators (e.g. peer cohort stability) effects are similar for SWDs and GENs, suggesting the need to ease the middle school transition for all students.

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The Academic Effects of Moving to Middle School on Students with Disabilities Relative to their General Education Peers

Literature on school organization policies finds structural transitions to middle school negatively affect general education student (GEN) performance (most recently, Atteberry *et al.*, 2022). Though the middle school transition is increasingly required for most students in the United States (DiSalvo, 2022), there is limited evidence about its effect on the performance of students with disabilities (SWDs), who comprise 14% of public school students and are generally low achieving. Moreover, there is a large gap between the performance of GENs and SWDs: only 14% of SWDs were proficient on the fourth grade NAEP math exam in 2019, compared to 44% of GENs, and this gap is a particular focus of federal education accountability (Every Student Succeeds Act, 2016).[1] It is possible that the middle school transition widens the SWD-GEN gap, if SWDs are more adversely affected by disruptions that accompany a move to a new school than GENs. Alternatively, the gap may narrow given SWDs receive additional supports, and they have an opportunity to make an improved match between elementary and middle school. Whether middle school entry differentially affects SWD performance is an important policy issue, as the move to middle school can be a key point of intervention.[2] It is particularly relevant for local policymakers and practitioners who set grade spans and choose programs to facilitate structural transitions.

This paper estimates the effect of the structural middle school transition on the academic performance of public school students with disabilities in New York City (NYC), with a particular focus on the effects relative to their general education peers. NYC provides an

[1] Under the Every Student Succeeds Act (ESSA), states must develop accountability plans for low-performing districts and schools or students, *including students with disabilities*, who are not progressing on annual statewide assessments.

[2] Academic performance, attendance, and attitudes in grades 6-8 are strong predictors of high school dropout, and improving performance by eighth grade may lead to improved high school graduation rates (Balfanz, 2009).

excellent site to study the academic effects of the middle school transition on the SWD-GEN gap given the size of the student population (and the SWD population in particular), meaningful welfare consequences, and results that are relevant for policymakers. We use individual level longitudinal data from 2006-2019 on nine cohorts of students to examine the impact of the middle school transition on student outcomes through eighth grade. Following Rockoff and Lockwood (2010) and Schwerdt and West (2013), we use students' elementary school grade span as an instrument to predict whether students will make a middle school transition and isolate the causal effect of the transition on student outcomes.

Overall, we find that moving to middle school has a large, negative effect on SWD outcomes: the middle school transition causes a 0.29 standard deviation (sd) decline in math performance, a 0.16 sd decline in ELA performance, and increases the incidence of grade retention by one percentage point (the move to middle school does not appear to affect attendance). In addition, the SWD-GEN gap in math widens by 0.09 sd, although effects on ELA and retention are similar for SWDs and GENs (i.e. there is no change to the SWD-GEN gap). Controlling for changes in peer and teacher characteristics (mediators) when students transition to middle school results in only small changes to estimated effects on math and ELA performance, but in opposite directions for SWDs and GENs, such that the estimated effect on the SWD-GEN gap in math is only 0.045 sd and not statistically significant. Mediators completely attenuate the effect of the middle school transition on retention, which is an estimated null for both SWDs and GENs after controlling for these peer and teacher characteristics.

The impact of middle school entry is negative, meaningful, and statistically significant for almost every subgroup of SWDs considered, and students with a specific learning disability or emotional disturbance, students in self-contained classrooms, and students declassified from

special education experience the largest declines in performance in sixth grade. Given the significant impact on these SWD subgroups, the estimated gap from GENs grows by practically significant amounts in some cases (e.g. the LD-GEN gap grows by 0.08 sd), however, they are not statistically significant, and impacts as of eighth grade are smaller, so there is not definitive evidence that the transition is worse for these students than their GEN peers. Regardless, the middle school transition is a critical point of intervention that could improve all students'—including SWDs'—performance, and districts may wish to consider grade configurations with fewer mandated transitions or programs to support students in the transition.

Literature Review

The literature on student mobility documents a negative association between changing schools and academic outcomes among GENs (see Welsh, 2017, for a recent comprehensive review). Further, *structural* transitions to middle school have a significant negative—and sometimes sustained—impact on GEN academic achievement (Cappella *et al.*, 2019; DiSalvo, 2022; Hong *et al.*, 2018; Rockoff & Lockwood, 2010; Schwartz *et al.*, 2017; Schwerdt & West, 2013).[3] However, few studies have examined the effect of the middle school transition on SWDs, or the gap in SWD-GEN outcomes, and no studies consider both.[4] Schwartz *et al.* (2011), in a heterogeneity analysis, find no statistically significant difference in SWD performance between the K-5/6-8 and K-8 grade configurations, but they do not consider the SWD-GEN gap, nor do

[3] Rockoff and Lockwood (2010) also find the middle school transition increases absences and suspensions (although these do not necessarily explain the effects on achievement) and Schwerdt and West (2013) note there could be differences in grade retention (p. 318). Grade retention is of particular interest given retention in Grade 6 or 7 (compared to retention in earlier grades) is associated with a higher likelihood of high school dropout (Giano *et al.*, 2022).

[4] Hong *et al.* (2018), Rockoff & Lockwood (2010), Schwartz *et al.* (2017), and Schwerdt & West (2013) have data on whether students were in special education and include SWDs in their samples, but none of these studies consider differential effects between SWDs and GENs.

they establish causal impacts.[5] Akos *et al.* (2015), also in a heterogeneity analysis, find SWDs fare worse in the transition to middle school than GENs, but they also do not establish causal impacts. Qualitative studies have examined the effect of the middle school transition on SWDs, and they have focused on non-academic outcomes, finding that while SWDs struggle with adjusting to new routines and building peer connections (challenges similar to those faced by their GEN peers), they also take advantage of extra support provided in special education settings (James, 2018 and cites therein, e.g. Knesting *et al.*, 2008).

Research on the move to middle school for GENs has illuminated potential mechanisms through which the transition negatively affects students—new classmates with different characteristics; new teachers and principal; a new building and neighborhood; a new schedule; and/or changes in school climate—some of which may differentially affect SWDs. SWDs may also face their own, unique changes in the move: changes in classification, services, and/or service providers. In addition, while navigating middle school choice in large, choice-rich districts may be more difficult for SWDs (Jessen, 2013), it also provides students a new opportunity to re-match to a school that is potentially a better fit and increases the chances that their school can meet their needs. This may be especially true for students who did not account for these needs in their elementary school choice because they were placed in special education after elementary school entry. Lastly, services that SWDs receive through their Individual Education Program (IEP)[6] may be protective, ameliorating some of the negative effects of the

[5] Schwartz *et al.* (2011) find the magnitude of the difference in performance between SWDs across the two grade spans is -0.04 sd in math and -0.09 sd in ELA, though neither is statistically significant ($p > 0.05$). However, this is half of the magnitude of the difference in performance between the two grade spans for all students on average: -0.13 sd in math and -0.15 sd in reding (both of which are statistically significant). While this might suggest the transition to middle school actually narrows the SWD-GEN gap because it is worse for GENs, we note that their overall estimates are for *all* students (not GENs alone), and therefore it is not possible to explicitly compare the differences for SWDs and GENs between the two grade spans.

[6] The Individuals with Disabilities Education Improvement Act (IDEA) of 2004 specifies that students are eligible for special education if they exhibit delays in thinking and learning, understanding and using language, self-help

move to middle school.

In summary, while the overall evidence on middle school transitions suggests SWDs are likely to be harmed by the move to middle school, it is unclear if that move affects SWDs' academic outcomes differently than their GEN peers—they may fare worse, the same, or better. Put differently, it is unclear if and how the move to middle school affects the SWD-GEN gap in academic outcomes.

Mechanisms for Effects of the Move to MS, And Differential Effects for SWDs

We review potential mechanisms through which the move to middle school might affect students, both positively and negatively, with a particular focus on how they might affect SWDs differently than their GEN peers. While we focus our attention on mechanisms that we are able to capture with our data, we also note other mechanisms that may contribute to the overall effect of moving to middle school.

Because middle schools are typically larger than elementary schools and serve students from multiple elementary schools, moving to middle school often results in a larger cohort and a more diverse student body. Similarly, students' new middle school classmates may differ in terms of academic performance (or peer quality in general). Even if the size, demographic composition, and performance of students' cohorts do not change significantly, cohort instability—that is, that their classmates will include new students from other elementary schools—may itself be costly. Indeed, prior research on the middle school transition suggests the increase in cohort size and diversity and the decline in cohort stability contributes to GEN's decline in academic performance (DiSalvo, 2022; Rockoff & Lockwood, 2010; Schwartz *et al.*,

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skills, physical ability, or behavior that impairs their ability to perform academically. Parents, teachers, or other school personnel can refer students for special education. If an examination determines services are appropriate school staff develop an IEP, which documents the student's disability, identifies supports, and sets academic goals. IEPs are re-evaluated annually, and services are modified, continued, or discontinued as appropriate.

2011; Schwerdt & West, 2013).

It is unclear how these changes would affect SWDs. For example, larger cohort sizes and increased diversity might result in SWDs being more segregated from their GEN peers, having a *negative* effect on SWD achievement.[7] Conversely, SWDs may be educated alongside peers with shared disabilities or needs in middle school, which may have a *positive* effect on their achievement. In addition, the anonymity that comes with larger cohort sizes and a decline in peer cohort stability may have a *positive* effect on SWDs. Altogether, it is *unclear* how changes in cohort size, stability, and demographic and academic characteristics after the middle school transition will affect SWD outcomes and thus the SWD-GEN gap.

Middle schools are typically departmentalized (Merlin, 2020), meaning teachers may be more specialized; their level of education and experience may also differ. There is mixed evidence on whether middle schools have less experienced, less educated, and/or lower quality teachers than elementary schools (Goldring *et al.*, 2014; Marinell & Coca, 2013), and whether SWDs have lower quality teachers than GENs (Gilmour & Henry, 2018; Lai *et al.*, 2021). Even if the qualifications of teachers do not change between elementary and middle school, the departmentalization of middle schools requires that students have multiple teachers, and the instability of the educator-student relationship itself may be costly. Educators may also provide less individualized attention, especially since pupil-teacher ratios are typically larger in middle school than elementary school (Rockoff & Lockwood, 2010; Schwerdt & West, 2013). SWDs specifically may face disruptions in access to educational supports or other IEP-mandated services, such as a change in service provider (for speech or dyslexia, for example). Altogether,

[7] There is some evidence of a positive association between SWD inclusion and academic performance (e.g. Cosier *et al.*, 2013; Jones & Winters, 2022).

changes in teacher characteristics, less contact with the same teacher, and increased class sizes may affect SWD outcomes particularly negatively and *increase* the SWD-GEN gap.

Middle schools have higher rates of suspension than elementary and K-8 schools (Arcia, 2007; Rockoff & Lockwood, 2010) and less favorable perceptions of school climate (Kim *et al.*, 2014; Rockoff & Lockwood, 2010; Schwerdt & West, 2013). In addition, SWDs are disproportionately suspended from school (Anderson, 2021; Morgan *et al.*, 2019; Welsh & Little, 2018) and SWDs' perceptions of school climate in middle school are worse compared to GENs' (Stiefel *et al.*, 2018). Although we do not empirically explore student discipline or school climate in this study, these changes in school context may also negatively impact student outcomes after the move to middle school, particularly for SWDs, and this may *increase* the SWD-GEN gap.

Heterogeneity in the Effects of the Move to Middle School

Research on the effects of the middle school transition for all students on average suggests that the transition may be particularly costly for Black and Hispanic students (Atteberry *et al.*, 2022; DiSalvo, 2022; Schwartz *et al.*, 2011; Schwerdt & West, 2013), for students with low third grade performance (Atteberry *et al.*, 2022; Rockoff & Lockwood, 2010; Schwerdt & West, 2013), and low-income students (Schwartz *et al.*, 2011). Because SWDs are disproportionately Black, Hispanic, low-income, and low-performing, the average effect on SWDs may be worse than the effect on GENs, *increasing* the SWD-GEN gap. Given that heterogeneity in impacts of the middle school transition by sociodemographic and academic performance characteristics has been established by prior research, we focus on dimensions of heterogeneity specific to SWDs: their disability classification, their service setting, and when/whether they are declassified.

Disability. Specific disability classifications vary significantly in the stigma attached to

them, the types of services provided, and students' underlying educational challenges.[8] Students may face greater or fewer challenges in the middle school transition, depending on their circumstances. Students with speech and language impairments (SI) are declassified from special education at a relatively high rate (SRI International, 2005), suggesting an impermanent need such that these students may be less affected by the middle school transition. Students with "high-status" disabilities, a grouping Fish (2019) presented that includes SI but also other health impairments (OH)[9] and autism (AU), may also face fewer challenges when entering middle school due to the lower stigma attached to their classification; the reverse may be true for students with "low-status" disabilities, including students with an emotional disturbance (ED) or LD. SWD-GEN gaps may *increase* for low status groups.

Service Setting. Even in traditional public schools, while some SWDs are in classrooms alongside GEN peers for most or all of the day (a less restrictive setting), other students are in self-contained classrooms with only SWD peers for most or all of the day (a more restrictive setting). Research suggests SWDs who spend more time in classrooms with GEN peers have higher achievement (e.g. Cosier *et al.*, 2013; Jones & Winters, 2022), although this may be because SWDs in self-contained classrooms may have greater educational challenges. Either way, the costs of the middle school transition may be particularly high for SWDs in self-contained classrooms in elementary school and the SWD-GEN gap may *increase* for these students.

Declassification. When SWDs move to middle school, a new set of pedagogical staff

[8] There are 13 federal disability classifications. In order of prevalence in NYC in 2019, they are: specific learning disability (LD), speech or language impairment (SI), other health impairment (OH), autism (AU), emotional disturbance (ED), intellectual disability, multiple disabilities, hearing impairment, orthopedic impairment, visual impairment, traumatic brain injury, deafness, and deaf-blindness.

[9] "Other health impairment" includes a range of health needs that can affect learning but is most commonly for attention deficit/hyperactivity disorder (ADHD) (Grice, 2002; Schnoes *et al.*, 2006).

evaluate their Individual Education Program (IEP)[10], which may lead to declassification from special education. This could remove stigma SWDs may have felt in elementary school or lead to higher expectations from parents or teachers (Shifrer, 2013), which could then positively affect student outcomes. There is also evidence that declassified students can thrive in high quality general education settings (Setren, 2021). Conversely, the loss of academic supports for students who are declassified after the middle school transition could contribute to a decline in academic performance (Ballis & Heath, 2021; Hanushek *et al.*, 2002; Hurwitz *et al.*, 2020; Schwartz *et al.*, 2021). It is unclear how the effect of the middle school transition might differ for students who are declassified in middle school compared to students who remain in special education, and thus *unclear* how the SWD-GEN gap might change.

Summary and Implications for Empirical Work

The literature indicates that, overall, the middle school transition affects school outcomes negatively, and points to several features of schools and students that might mediate that effect, including potential differential effects for SWDs and GENs (e.g. peer cohort size and stability) or moderate the effect (e.g. specific disability classification). The effects on the SWD-GEN gaps are *unclear* from the literature in many cases. To address these unanswered empirical questions, we first estimate the overall effect of the transition on SWDs and GENs to ascertain *how* moving to middle school affects students, and how it affects the SWD-GEN gap. We follow this analysis with evidence on changes in school characteristics (mediators) between elementary and middle school and then estimate the effect of the transition (on SWDs, GENs, and the SWD-GEN gap) accounting for these potential mediators. Finally, we estimate the effect of the transition

[10] School staff develop a student's IEPs, which documents the student's disability, identifies supports, and sets academic goals. IEPs are re-evaluated annually, and services are modified, continued, or discontinued as appropriate.

stratified by special education characteristics (e.g. disability classification) to understand how these characteristics moderate results.

Data, NYC Context, and Sample

We use NYC Public Schools student-level administrative data from 2006-2019, including school identifiers and indicators for grade, race/ethnicity, gender, eligibility for free or reduced-price lunch (FRPL), English language learner (ELL) status, math and English language-arts (ELA) test scores for Grades 3-8 (standardized by subject-grade-year to mean zero and standard deviation one)[11], and attendance rate. These also include an identifier for students with an IEP, who are required to receive special education services, and their federal disability classification. We determine our retention outcome using these student-level data; retention is an indicator equal to one if a student is in the same grade they were in the prior year. We combine student-level data with school-level data on grade span, enrollment, student-teacher ratio, and the portion of teachers teaching out of certification from the publicly available New York State school report cards. Student-level data are aggregated to create *cohort size* (the number of students per school-grade) and measures capturing *cohort sociodemographics* (the percentage of each school-grade cohort that are FRPL-eligible, ELL, SWD, and in each race/ethnicity subgroup). As a proxy for one dimension of school quality, we construct cohort average prior attendance rate: the mean of a student's grade-school cohort's prior year attendance rates (not including the student's own prior year attendance rate). While this is a limited proxy, research has found student attendance is positively and significantly related to achievement for both elementary and middle school

[11] New York State provides annual technical reports on the reliability and validity of these exams, see *Grades 3-8 Technical Information and Reports* (n.d.).

students (Gottfried, 2010).[12] We also construct a student-specific school-grade level measure of *cohort stability*, defined as the fraction of a student's school-grade cohort in the current year who were in the student's school-grade cohort in the prior year.[13]

NYC is the largest school district in the country, with roughly 1.1 million students. The students are disproportionately low income (nearly three-quarters eligible for free or reduced-price lunch) and diverse: 41% Hispanic, 25% Black, 18% Asian, Native American/Pacific Islander, or multi-racial, and 15% White. Over one-eighth of students are ELLs. Between 2006 to 2019, the SWD population grew substantially, from 162,000 (15%) to 237,000 (20%), with some change in the distribution across the 13 federal disability classifications. Specifically, the percentage of SWDs with a specific learning disability (LD) dropped (from 48% to 39%) as did the percentage with emotional disturbance (ED) (12% to 5%), while the percentage with a speech impairment (SI), other health impairment (OH), and autism (AU) increased (SI: 27% to 34%; OH: 5% to 9%; AU: 3% to 10%).

As shown in Figure 1A, the number of SWDs expected to move from elementary to middle school increased from 2006 to 2019, due to both increased enrollment of SWDs in traditional public schools[14] and the growth in the SWD population. K-5 and K-8+ (i.e. a school where the highest grade is eighth or higher, typically K-8 or K-12) are the dominant forms of

[12] Using lagged average cohort test scores would require us to remove third grade observations from the sample, since third grade is the first tested grade in New York. However, analyses using lagged cohort test scores have similar findings; see Appendix Tables A5 and A6, Row 6.

[13] We rely on school-grade level measures of peer characteristics since our data do not allow us to identify the different classes attended by middle school students.

[14] IDEA requires that schools educate SWDs in the "least restrictive environment" (Individuals with Disabilities Education Improvement Act, 2004; Every Student Succeeds Act, 2016). In addition to federal policy, beginning in the 2000s, many large districts such as Los Angeles, Los Vegas, Miami, Chicago, and New York City implemented policies designed to place more SWDs in classrooms with GENs (Hehir & Lesauz, 2008; Perry and Associates, 2012; Samuels, 2013). SWDs are increasingly included alongside GEN peers: in 2018, 64% of SWDs nationwide were educated in a "regular class" for 80% or more of the school day, an 18 percentage point increase from 1996 (NCES, 2020).

public elementary schools in NYC (K-6 is rare), which means middle school transitions are predominantly made after fifth grade. As of 2019, 97% of third grade students in NYC, both SWDs and GENs, attended either a K-5 or a K-8+ (see Figure 1A and 1B). This mirrors the national trend toward the K-5 and K-8 configurations and away from K-6 (DiSalvo, 2022).

Our main sample consists of nine cohorts of NYC students who first attend third grade between 2006 and 2014, and tracks them through eighth grade (students in third grade in 2014 who make standard academic progress are in eighth grade in 2019). We exclude students not continuously enrolled in a traditional public school (i.e. special education-only school or charter school) and those who attend a school with a grade span other than K-5 or K-8+ elementary school.[15] Finally, we exclude students missing math scores, ELA scores, or attendance rate in fifth or sixth grade (the years immediately before and after the middle school transition); missing more than one math score, ELA score, or attendance rate; missing school or school grade span data; retained more than twice; or who drop or skip a grade.[16]

Requiring that students are continuously enrolled in traditional public schools for six years results in some sample attrition, which we present in Appendix Table A1. Although there is some differential sample attrition for SWDs and GENs, it is relatively small. Differences in sample attrition arise from excluding students who are ever in District 75 schools—these are special education only schools, so we expect more SWDs to attrit from our sample based on this criterion. We also lose a slightly higher percentage of SWDs than GENs based on our math and

[15] While we only restrict the sample by the terminal grade of the students' elementary school, in practice, 99% of students in the sample attend an elementary school that starts in kindergarten. For ease of exposition, we refer to these as K-5 and K-8+ schools. Results are robust when we restrict the sample to the students whose elementary school actually starts in kindergarten (see Appendix Tables A5 and A6 Row 5).

[16] Because we allow students to be retained up to two times, and we allow them to be missing one year of outcome data, we have between five and eight observations for each student (the average is 5.9). Students in third grade in 2014 are only tracked through eighth grade if they make standard academic progress, if they are retained once or twice they are only observed through seventh or sixth grade, respectively. Similarly, students in third grade in 2013 are only tracked through seventh grade if they are held back twice.

ELA score inclusion criteria, because SWDs are less likely to take these standardized exams. In sensitivity analyses we use alternate samples limited to fewer grades that include more students and the results are robust (see Appendix Tables A5 and A6 Row 3). Students who ever attend a charter school between third and eighth grade are excluded from our main sample because we are missing attendance rate data for most charter school students, but including them does not significantly change results for academic performance outcomes (see Appendix Tables A5 and A6 Row 4).

Our sample consists of approximately 82,000 unique SWDs and 491,000 student-year observations; our comparison sample of GENs includes approximately 321,000 unique GENs and 1.9 million student-year observations. Table 1 presents summary statistics for the full sample, for SWDs and GENs, and for K-5 and K-8+ schools. As expected, SWDs and GENs differ in some key characteristics. SWDs are disproportionately Hispanic or Black, male, FRPL-eligible, and ELLs in both K-5 and K-8+ schools. SWDs also have lower mean performance in math and ELA exams, higher retention rates, and slightly lower attendance.

As shown in Table 1, students in K-8+ schools differ from those in K-5 schools. SWDs in K-8+ schools are disproportionately Black (34% v. 27%), with fewer Hispanic, Asian or other race, or ELL students; the same is true for GENs in K-8+ schools compared to GENs in K-5 schools. Further, SWDs in K-8 schools perform worse on third grade math and ELA exams (-0.656 vs. -0.60 average math z-scores) and have a slightly lower attendance than SWDs in K-5 schools. Again, these patterns are similar for GENs. The distribution across specific disability classifications in K-5 and K-8+ schools is quite similar—students with LD are the most common (42%), followed by students with SI (33-34%) and OH (7%) with small populations of students with ED (3-4%) and AU (1%).

Empirical Strategy

We begin with a parsimonious model for academic performance as follows:

$$y_{it} = M_{ig}\beta_g + M_{ig\times SWD}\tau_g + \delta_g + \theta_{g\times SWD} + X_{it}\gamma + X_{it\times SWD}\omega + \alpha_i + \varepsilon_{it} \quad (1)$$

where y_{it} represents the outcome (math score, ELA score, grade retention, or attendance) for student i in year t, M_{ig} is a set of indicators for whether student i in grade g ($g = 4 \ldots 8$) moves to middle school[17] in sixth grade, *SWD* is an indicator for whether a student ever has an IEP before sixth grade, δ_g is a grade fixed effect ($g = 4 \ldots 8$), $\theta_{g\times SWD}$ is a grade by SWD fixed effect, X_{it} represents a set of time-varying student characteristics,[18] $X_{it\times SWD}$ is a set of time-varying student characteristics interacted with the *SWD* indicator (allowing them to affect outcomes differently for SWDs and GENs), and α_i is a student fixed effect. Coefficients on the grade indicators (δ_g) capture the average, regression-adjusted academic outcomes for grade g of GENs who *do not transition* to middle school in sixth grade. The sum of these coefficients and the coefficients on the grade indicators interacted with the SWD indicator ($\delta_g + \theta_{g\times SWD}$) capture the average, regression-adjusted outcomes for grade g of SWDs who *do not transition* to middle school in sixth grade. The relative performance of students who *do transition* to middle school in sixth grade are the estimates of interest: β_g captures the difference in academic performance of GENs in grade g who *do move* (relative to their GEN peers who do not) and $\beta_g + \tau_g$ captures the difference in academic performance of SWDs in grade g who do move (relative to their SWD peers who do not). Together, the set of grade effects and transition-grade interaction effects

[17] Following prior literature (Atteberry *et al.*, 2022; Schwerdt & West, 2013), we define this as moving to a school in the lowest grade served. Since we examine the middle school transition in sixth grade, this is an indicator if a student moves to a new school in sixth grade where sixth grade is the lowest grade served (e.g. a 6-8 school).

[18] Because our models use student fixed effects, we only include independent variables that are time-varying (FRPL-eligible, ELL, retained, and off standard academic progress). Models where retention is the outcome do not include controls for retention or whether a student is off standard academic progress. These time-varying student characteristics may be affected by the middle school transition (i.e. endogenous), but in our sensitivity analysis we show the results are robust when these time-varying controls are omitted (see Appendix Tables A5 and A6 Row 7).

allows us to track the academic trajectory of GENs and SWDs before and after the middle school transition. We focus on the immediate impact of the middle school transition in sixth grade, and the cumulative effect as of eighth grade. Specifically, the immediate impact of moving to middle school in sixth grade for GENs is $\beta_6 - \beta_5$ and the cumulative impact is β_8. The immediate impact of moving to middle school in sixth grade for SWDs is $\beta_6 + \tau_6 - \beta_5 - \tau_5$ and the cumulative impact is $\beta_8 + \tau_8$. Finally, the immediate impact of the move to middle school on the SWD-GEN gap is $\tau_6 - \tau_5$ and the cumulative impact is τ_8.

The challenge to a causal interpretation is the possibility that families select into schools with particular grade spans, as suggested by the differences between students in K-5 schools and K-8 schools. If selection into schools with particular grade spans is only correlated with *time-invariant* student characteristics, the student fixed effect model will still recover unbiased estimates. However, it is possible that the middle school transition is related to unobserved *time-varying* factors: for example, parents of students in K-8+ schools may send their student to middle school in sixth grade due to a bad experience in the elementary grades, a residential move that prompts the choice of a middle school that begins in sixth grade, or other changes in circumstances that impact outcomes independently of the transition itself.

To derive credibly causal estimates, we follow previous research and instrument for moving to middle school in sixth grade (M_{ig} and $M_{ig \times SWD}$) with an indicator for whether the student's third grade school was a K-5 school (Atteberry *et. al*, 202; Rockoff & Lockwood, 2010; Schwartz *et al.*, 2017; Schwerdt & West, 2013). We estimate first stage equations with M_{ig} and $M_{ig \times SWD}$ as the dependent variables (where $g = \{4, 5, 6, 7, 8\}$ and Grade 3 is the omitted grade) and with T_{ig}, a set of indicators for whether the student i's third grade school was a K-5

school[19] interacted with the student's grade g (as well as $T_{ig\times SWD}$), as the instrument. That is, the set of ten first stage equations are:

$$M_{ig} = T_{ig}\tilde{\beta}_g + T_{ig\times SWD}\tilde{\tau}_g + \tilde{\delta}_g + \tilde{\theta}_{g\times SWD} + X_{it}\tilde{\gamma} + X_{it\times SWD}\tilde{\omega} + \tilde{\alpha}_i + \mu_{it} \qquad (2a)$$

$$M_{ig\times SWD} = T_{ig}\bar{\beta}_g + T_{ig\times SWD}\bar{\tau}_g + \bar{\delta}_g + \bar{\theta}_{g\times SWD} + X_{it}\bar{\gamma} + X_{it\times SWD}\bar{\omega} + \bar{\alpha}_i + u_{it} \qquad (2b)$$

where all other variables are as previously defined (we follow standard practice in two stage least squares estimation by including all exogenous regressors in the first stage equations, see Angrist & Pischke, 2008).

T_{ig} serves as a good instrument because it is unlikely that attending a K-5 school in third grade would affect a student's *change* in performance in sixth grade through anything other than the transition itself. If, for example, parents knew when their child was in third grade that they planned to make a residential move during the summer between fifth and sixth grade, anticipated that this move would affect their child's outcomes, and chose to put their child in a K-5 school rather than a K-8 school because of this, then the choice of grade configuration would have affected the students' change in performance through something other than the middle school transition (that is, the planned residential move). However, we think such scenarios, in which families select into certain grade configurations based on anticipated changes in student outcomes between fifth and sixth grade, are unlikely or rare. Put differently, shocks to student outcomes in sixth grade are likely not reflected in the choice of grade configuration of a student's third grade elementary school (conditional on student controls and fixed effects). Additionally, the grade configuration of a students' third grade schools should be a good predictor of whether

[19] The instrument for entering middle school in sixth grade is an indicator for whether the student's third grade school ends at Grade 5 two years later, which captures when schools change grade spans, in line with prior literature (Rockoff & Lockwood, 2010; Schwerdt & West, 2013). Results are robust to defining this instrument as an indicator for whether the student's third grade school ends at Grade 5 as of the year the student is in third grade (see Appendix Table A5 and A6 Row 8).

they transition to a middle school in sixth grade.

Estimating Model 1 using 2SLS, β_g captures the difference in the trajectory of GENs from fourth through eighth grade who make the *structural* middle school transition in sixth grade, because we are estimating the effect for students who move to middle school *as predicted by them attending a K-5 elementary school* (this is a "local average treatment effect" relative to GENs who do not make the structural transition). Similarly, $\beta_g + \tau_g$ captures the difference in the trajectory of SWDs from fourth through eighth grade who make the *structural* middle school transition in sixth grade. Finally, τ_g captures the trajectory of the SWD-GEN gap from fourth through eighth grade for students who make the *structural* middle school transition in sixth grade relative to students who do not make the transition.

Mechanisms

We provide descriptive evidence on how students' schools change after middle school entry by estimating models with measures of school and cohort characteristics (e.g. school and cohort size, pupil-teacher ratio) as the dependent variables. We then add these characteristics to our model (including interactions with the SWD indicator, to allow their effects to vary for SWDs and GENs—that is, these characteristics are added to the X_{it} vector in Equations 1, 2a, and 2b) to assess whether they mediate the effects of the middle school transition.

Do Effects Vary with Student Characteristics?

We estimate our model, including school and cohort characteristics as control variables, on samples stratified by special education subgroups (e.g. disability classification) to ascertain if effects change in ways consistent with our literature review. For example, we expect that the performance declines after middle school entry will be greater for students with low-status and/or high-need disability classifications (e.g. LD, ED) and students in self-contained settings,

and therefore the gap between these students and their GEN peers may widen after the move to middle school. When looking at effects by specific disability classification, students are defined as belonging to a specific disability category if they are classified with that disability before sixth grade and they are not classified with any other disability before sixth grade. When looking at effects by service setting, students are defined as being in a self-contained setting if they are ever in a self-contained setting before sixth grade. When looking at declassification, we consider separately students who are declassified prior to middle school,[20] declassified in one of the middle school grades (Grade 6, 7, or 8),[21] and never declassified (i.e. retain their IEP through eighth grade). We exclude students who are declassified and later reclassified from these subgroup analyses to clearly capture the moderating effect of continuous IEP services.

Multiple Hypothesis Testing

Since we consider impacts on multiple outcomes, estimate two models (with and without mediators), and consider outcomes for multiple subgroups, we may have elevated Type 1 errors (false positives). Therefore, we adjust the *p* values controlling for the false discovery rate (FDR), using the procedures described in Anderson (2008) to estimate the FDR-adjusted *p* values, called sharpened q values. We report these values for our estimates of interest in our results tables. When discussing results that are not statistically significant once we account for multiple hypothesis testing, we note this and caution against decisive interpretations.

Results

Appendix Table A2 shows results from the first stage regressions (Models 2a and 2b) that predict moving to middle school in sixth grade (M_{ig}) and the interaction of this move with the

[20] Some students are declassified prior to the transition because our definition of SWD is any student who is ever classified as a SWD prior to sixth grade.
[21] Results (available on request) are qualitatively similar when we separately examine SWDs declassified in each of the middle school grades.

SWD indicator ($M_{ig\ x\ SWD}$). The results suggest the grade span is a strong instrument: attending a K-5 elementary school means a student is approximately 58 percentage points more likely to move to middle school in sixth grade.

It is possible to estimate a simple first stage equation where we use grade span to predict whether a student moves to middle school without interactions with grade or SWD (since the indicators for the grade span of their third-grade school and whether a student moves to middle school are time-invariant within students). As a robustness check, we estimate our model with this simplified first stage regression, and the second stage results are very similar (see Appendix Tables A5 and A6 Row 2).[22] Therefore, for our main results we use the first stage models described in the methods section, in line with standard practice of including all exogenous regressors in the first stage.

Figure 2 and Table 2 show the second stage results for outcomes of students who make a structural middle school transition in sixth grade, relative to students who do not, separately for SWDs and GENs.[23] SWDs experience a large and statistically significant 0.29 standard deviation (sd) decline in math performance in the year of the transition (Figure 2A). However, the results indicate that their performance may recover to their third-grade baseline by eighth grade: the

[22] That is, in the first stage we do not interact the instrument or endogenous regressor with grade span or SWD, do not use student fixed effects, and do not include exogenous regressors (time-varying student characteristics or school- and school cohort-level characteristics).

[23] The math and ELA performance of students who do move to middle school is increasing relative to the performance of students who do not before the transition in sixth grade (reflected in the upward slope of the trend from third to fifth grade in Figure 2). This suggests that the decline in their relative performance after the move is from the transition itself, since it is a break in the prior trend, rather than a continuation of the trend. However, we conduct a robustness check in which we match students who do and do not make structural transitions to middle school based on their Grade 3-5 performance and attendance (and other observable characteristics) and then estimate Model 1 on this matched sample. Results for this analysis are presented in Appendix Tables A5 and A6, Row 9. The immediate effect of the middle school transition for GENs and SWDs is smaller than the effect in our main results since, by design, we are comparing SWDs who are performing similarly in fifth grade (i.e. β_5 and $\beta_5 + \tau_5$ are constrained to 0). However, the results for the immediate impact from the matched sample are similar to the difference in performance in sixth grade in our main results (e.g. the immediate effect on math performance for SWDs as estimated by matching is -0.08 sd and the estimate of β_6 from Appendix Table A4—gr6#msgr6 + gr6#msgr6#SWD—is -0.12 sd).

estimated -0.07 sd difference from the performance of SWDs who do not make a structural middle school transition is not statistically significant ($p > 0.05$). Results for ELA performance (Figure 2B) follow a similar pattern to math, although the immediate effects of the transition are of a smaller magnitude (a 0.17 sd decline). SWDs' likelihood of grade retention (Figure 2C) increases by 1 percentage point (pp) in the year of the transition ($p < 0.01$)[24] although again, the difference in likelihood of grade retention as of eighth grade (also approximately +1 pp) is not statistically significant. Finally, results for attendance (Figure 2D) suggest there is no statistically significant difference in attendance outcomes for SWDs who do and do not move to middle school, either in the year of the transition or cumulatively. As such, this is unlikely to be a mechanism for the impacts on performance or retention.

As expected, GENs also experience declines in math and ELA performance, and increases in grade retention, immediately after the transition to middle school (Figure 2 and Table 2). The outcome trajectories for GENs are similar to those for SWDs for all outcomes. However, in some cases, the magnitude of the effects differs, resulting in changes to the SWD-GEN gap. For math performance, the SWD-GEN gap for students who move to middle school in sixth grade grows by 0.09 sd in the year of the transition (i.e. the negative effect is greater for SWDs than GENs), and is statistically significant ($p < 0.01$). However, the cumulative impact on math scores as of eight grade suggests no change in the SWD-GEN gap: the cumulative impact on GENs is approximately -0.08 sd[25] and for SWDs is -0.07 sd, and this difference (0.01 sd) is

[24] The confidence intervals in Figure 2C are for the coefficients on each grade. While the confidence intervals for the coefficient on Grade 5 and Grade 6 overlap, we are reporting the difference between these coefficients (i.e. the change between Grade 5 and 6) and its statistical significance. While it would seem intuitive that if the confidence intervals on each coefficient overlap the difference is not statistically significant, that is not necessarily the case (Schenker & Gentleman, 2001).

[25] Though GENs alone are not the focus of our paper, our finding that the cumulative impact of the structural middle school transition on GENs math performance is statistically significant aligns with Rockoff and Lockwood (2010), who find persistent or increasing negative effects for GENs in the NYC context using data on earlier cohorts of third

not statistically significant. For ELA performance, the result is the opposite: there is no statistically significant change in the SWD-GEN gap in the year of the transition (the difference between the impact on SWDs and GENs, -0.17 sd versus -0.15 sd, is small and not statistically significant). The cumulative impact on ELA scores as of eighth grade suggests that the SWD-GEN gap may grow for students who move to middle school: the cumulative impact on GENs is approximately 0 and for SWDs is -0.05 sd, suggesting the gap grows by 0.05 sd. While this is a practically meaningful difference in performance, it is not statistically significant after accounting for multiple hypothesis testing (the sharpened q value is 0.06), so we are cautious in interpreting it as definitive evidence of a widening of the SWD-GEN gap in ELA.

For grade retention and attendance, there are no differential impacts of the transition to middle school—put differentially, the SWD-GEN gaps in retention and attendance remain the same after the transition to middle school.[26]

Altogether, these results suggest that the middle school transition is similarly harmful for SWDs and GENs, though the immediate effects of the transition may be particularly large for SWDs in math. We now turn to whether our observed mechanisms explain any of these effects.

Mechanisms

Table 3 presents the results of models with school and school-grade characteristics as the dependent variable in order to provide descriptive evidence on how these characteristics change for SWDs and GENs who make a structural middle school transition (relative to their peers who do not). Rather than presenting full estimates, for conciseness we present the parameter of

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grade students (1999-2003). However, it differs from recent findings using national data, which show GENs recover by eighth grade (Atteberry *et al.*, 2022; DiSalvo, 2022).

[26] While the eighth grade attendance rate for GENs who move to middle school is 0.14 pp lower than the attendance rate for GENs who do not (sharpened q value of 0.002), this does not appear to be a result of the middle school transition, because the attendance rate for students who move to middle school is declining relative to students who do not in *fifth* grade—that is, prior to the move (as shown in Figure 2D). In addition, the magnitude of the difference is not practically meaningful.

interest: an estimate of how the potential mediator changes between Grades 5 and 6, when the middle school transition occurs, separately for SWDs and GENs, and the difference in the change for SWDs and GENs. As expected, there is a significant increase in total school size and cohort size,[27] and a large decrease in cohort stability; all of these changes are statistically significant. The large decrease in cohort stability is a ubiquitous condition of the middle school transition; in sixth grade, almost all students who transition have 50% or lower cohort stability (while over half of students who do not transition have cohort stability above 50%). The portion of students' cohort that are SWDs declines and the portion that are FRPL-eligible increases; the changes in other cohort demographics (race and ELL-status) are smaller and/or not statistically significant. The average prior attendance rate of students' cohorts decreases by 0.14 pp for SWDs and 0.17 pp for GENs between fifth and sixth grade, changes that seem unlikely to be practically significant (and only the latter is statistically significant). Finally, the percentage of teachers teaching out of certification increases by 11-12 pp between fifth and sixth grade and the pupil-teacher ratio increases by 0.3-0.4. Directionally, all of the changes in potential mediators could explain decreases in performance (for example, we would expect decreases in cohort stability to be associated with worse outcomes). In general, the direction and magnitude of changes in school and school-grade characteristics after the transition are similar for SWDs and GENs. However, as reflected in the SWD-GEN difference column of Table 3, some of these changes differ for SWDs in ways that might explain larger negative effects for SWDs. SWDs have a larger decrease in cohort stability (75 pp vs. 72 pp for GENs), a larger decrease in the portion of their cohort that are SWDs (3 pp vs. 1.5 pp for GENs), and a larger increase in the

[27] Because middle schools typically serve only three grades (6-8), while K-5 schools serve six grades, the increase in average cohort size when students move to middle school in sixth grade is larger than the increase in total enrollment.

percentage of teachers out of certification (11.9 pp vs. 11 pp for GENs).

To determine if these school- and school-grade characteristics change (mediate) the relationship between the structural middle school transition and SWDs' academic performance, we add these potential mediators to our main specification as controls, and then ascertain if the effect of the transition changes.[28] These results are presented in Figure 3 and Table 4. When all of the potential mediators are included in the model they only slightly attenuate the negative effects on math and ELA performance. Estimates of the immediate effect on SWDs in math attenuate from 0.29 sd to 0.28 sd (that is, the mediators explain less than 7% of the negative effect of the transition on math performance). The estimated negative effect on GENs' math performance increases from 0.20 sd to 0.23 sd. For ELA performance, the mediators attenuate the immediate negative effect on SWDs from 0.17 sd to 0.15 sd (that is, the mediators explain approximately 12% of the negative effect of the transition on ELA performance). Again, the estimated negative effect on GENs' performance increases from 0.15 sd to 0.16 sd.[29] That is, there is still a large and statistically significant negative effect of the structural move to middle school on both SWDs and GENs accounting for school and school-grade characteristics.

However, the addition of mediators changes the findings with regard to the SWD-GEN gap in outcomes. The immediate impact on the SWD-GEN gap in math is approximately halved (from -0.09 to -0.045 sd), and is not statistically significant. The estimated cumulative impact on the SWD-GEN gap in math is +0.06 sd—suggesting a narrowing of the SWD-GEN gap (that is, SWDs performance increases more than GENs do)—but, again, the difference is not statistically

[28] This is comparable to looking for bias in an OLS coefficient by including additional variables; that is, we are assessing if our main estimates suffer from omitted variable bias when we do not include these school, school-grade cohort, and student-specific school-grade cohort characteristics.

[29] Cohort stability drives this attenuation: an increase from 0 to 100% cohort stability is associated with a 0.06 sd increase in test scores ($p < 0.01$).

significant. With the addition of mediators, both the immediate and cumulative impact of the middle school transition on the SWD-GEN gap in ELA is small and not statistically significant. Our initial results (Figure 2 and Table 2) suggested more negative impacts of the middle school move on SWDs than GENs (and therefore a widening of the SWD-GEN gap) in the immediate effect on math scores. The results with mechanisms (Figure 3 and Table 4) suggest these initial results for the SWD-GEN gap may have been driven by differential changes in middle school characteristics, because after accounting for these changes we *do not* see a widening of the SWD-GEN gap. That is, if SWDs and GENs experienced similar changes in, for example, cohort stability when moving to middle school, the transition itself would have no statistically significant effect on the SWD-GEN gap. Put yet a different way, if the move to middle school widens the SWD-GEN gap, it may be due to differences in observed characteristics of schools attended by SWDs and GENs, on average, rather than the move itself.

In contrast to the math and ELA performance results, the inclusion of all the mediators fully attenuates the grade retention result for SWDs; that is, accounting for school, student demographic, quality, and teacher characteristics, there is no difference in grade retention for SWDs who do and do not move to middle school (see Figure 3C). It also fully attenuates the grade retention result for GENs (estimates are close to zero and not statistically significant), so there remains no effect on the SWD-GEN gap for retention.[30]

Finally, while the initial results suggested the transition to middle school did not affect attendance, after controlling for potential mediators there is an *increase* in attendance rate in sixth grade for both SWDs and GENs (Figure 3D), and the increase is higher for SWDs than GENs. However, the magnitude of this change for SWDs is small: only 0.8 pp (the magnitude of

[30] After controlling for mediators, the 95% confidence interval around our retention effect estimate for SWDs is (-0.66 pp, 0.69 pp) and for GENs is (-0.13 pp, 0.49 pp).

the change in the SWD-GEN gap is also small: 0.3 pp), and short lived, as attendance rate differences from peers who do not transition to middle school are not statistically significantly different in seventh or eighth grade. Given the direction and magnitude of this change, and that it does not persist through the middle school grades, we believe it is unlikely to be a mechanism for the estimated negative effects on math and ELA performance.

Heterogeneity by Disability, Declassification, and Service Setting

Table 5 displays the results for estimating the model (with mediators) on sub-samples of SWDs and all GENs, to assess if the structural middle school transition is worse for particular subgroups of SWDs (as discussed in the literature review), and whether the transition widens the performance gap between GENs and SWDs with specific disability classifications (e.g. the LD-GEN gap). For ease of presentation, we show only the estimates of interest: the immediate effect of the structural transition to middle school (i.e. the change between fifth and sixth grade) on SWDs and the SWD-GEN gap, and the cumulative effect of the transition (i.e. the change between third and eight grade) on SWDs and the SWD-GEN gap. The estimated effects on GENs are the same as in the main model, because all GENs are included in the sample. The first row of Table 5 presents the results from the main model—that is, the results for all SWDs—for comparison (the results presented in Table 4 and Figure 3).

Disability Classification

The results suggest that the structural middle school transition is slightly larger for SWDs with a LD than the average SWD; these students experience an immediate decline of 0.31 sd in math and 0.18 sd in ELA. The negative effects on math performance persist through eighth grade for students with a LD; they have a 0.08 sd lower math performance than students with a LD who do not make a structural middle school transition, though this is not statistically significant

after accounting for multiple hypothesis testing. The transition to middle school is particularly harmful for SWDs with an ED, who experience a 0.45 sd decline in math performance and a 0.32 sd decline in ELA performance in the year of the transition. However, by eighth grade the performance of EDs who move to middle school is not statistically significantly different from EDs who do not move. Unlike any other SWD subgroup examined, students with autism appear to benefit from the move to middle school in terms of both the immediate and cumulative impact on ELA performance, although the estimates are less precise (not statistically significant), perhaps due to the smaller sample size. Indeed, across the subsamples, some estimates of practical significance are not statistically significant, potentially due to loss of precision from smaller sample sizes (for example, the cumulative effect of the move to middle school on the math performance of students with other health impairments is -0.15 sd, but this is not statistically significant).

Given the large, negative effects on students with the specific disability categories considered, some of the gaps between these students and their GEN peers widen after the move to middle school. However, there are no statistically significant immediate effects on the gap between students with specific disabilities and their GEN peers after accounting for multiple hypothesis testing. In addition, in many cases the magnitude of the cumulative effects on the gap between students with specific disabilities and their GEN peers is small (or even suggests a narrowing of the gap; that is, the change as of eighth grade in the SWD-GEN gap is positive).

Declassification & Service Setting

The immediate negative effect of the transition on math performance is greatest for students declassified in middle school (-0.31 sd) and for ELA performance is greatest for students never declassified (-0.17 sd). The cumulative negative effects of the middle school

transition are the smallest (and not statistically significant) for the two groups of students with stable classification in middle school grades: those declassified before the move to middle school and those never declassified. As expected, the immediate negative effect of the structural middle school transition on both math and ELA performance is greater for students served in self-contained classrooms in elementary school: -0.36 sd vs. -0.25 sd in math, and -0.20 sd vs. -0.14 sd in ELA. For both timing of declassification and setting, there are no statistically significant changes to the SWD-GEN gap after accounting for multiple hypothesis testing.

Ultimately, the heterogeneity analyses suggest SWDs with low- or stratified disability status (LD and ED), SWDs who are declassified in middle school, and SWDs in self-contained settings fare worse in the transition to middle school than the average SWD. Differences in immediate impacts from their GEN peers on math scores, while large in magnitude in some cases (suggesting a widening of the gap for students with an LD, students declassified in middle school, and students in self-contained classrooms), are not statistically significant. We return to this in the discussion.

Sensitivity Analyses

We explore the sensitivity of our analyses by estimating results using alternate sample inclusion criteria, control variables, definitions of the instrument, and estimation. These results are presented in Appendix Table A5 for math and Table A6 for ELA. Row 1 (in both tables) presents our main results for performance, with mediators (the same as the results presented in Figure 3 and Table 4) for comparison. Row 2 presents results using a simplified first stage, where only the instrument is used to predict the move to middle school (as discussed at the beginning of our results section; see note 21). Rows 3-5 present alternate samples: students continuously enrolled in NYC traditional public schools from third to *sixth grade*, rather than

through eighth grade (Row 3); students in traditional *and charter* public schools (Row 4); and students *whose elementary school begins in Kindergarten* (Row 5). Row 6 presents the analysis on the main sample with a measure of average prior cohort achievement as an additional mediator (note this requires us to drop third grade observations, as third grade is the first tested grade in New York). Row 7 presents the analysis on the main sample with *no time-varying student controls*. Row 8 presents the analysis with an alternate instrument: the grade span of the students' third grade school *as of the year they are in third grade*. Row 9 presents the results from a matching analysis: students who do and do not go to middle school are matched using Mahalanobis matching on test scores and attendance rates from Grades 3-5, with exact matching constraints on SWD, gender, race, how many times the student was retained, if they were ever FRPL-eligible before Grade 6, and if they were ever an ELL before Grade 6 (see note 23 for additional clarification regarding the robustness of the matching analysis). Overall, the results are similar regardless of sample or analysis choices.

Discussion

Overall, we find that the middle school transition has a large, negative effect on the academic performance of both SWDs and GENs, and increases the likelihood of grade retention, although it does not appear to affect attendance. Accounting for cohort stability, peer characteristics, and teacher characteristics largely does not change the estimated effects on academic performance, although controlling for these mediators does result in an estimated null effect on retention. One possible explanation is that middle schools (with larger cohorts and overall school size, and less experienced and less qualified teachers) are more likely to retain students in response to poor performance. This is concerning given evidence that retention in middle school leads to higher likelihood of high school dropout (Mariano *et al.*, 2018).

When we add potential mediators to our models, there is no longer a statistically significant widening of the SWD-GEN math gap in the year of the transition; the estimate attenuates from -0.09 sd to -0.045 sd. This suggests the widening of the SWD-GEN math gap caused by the move to middle school may be due to differences in observed characteristics of schools attended by SWDs and GENs, on average, rather than the move itself. SWDs experience more cohort instability in the move to middle school, as well as attend schools with fewer SWDs, higher percentages of teachers teaching out of certification, and higher pupil-teacher ratios, relative to their GEN peers.

Although the impact of the middle school transition is negative, meaningful, and statistically significant for almost every subgroup considered, there is heterogeneity among SWDs in the size of the impact. The negative effects are larger for students with LDs or EDs, students in self-contained settings, and students declassified in one of the middle school grades (6-8). Declassification may cause additional disruption and students may lose access to support that would have otherwise allowed them to recover. While these findings suggest the gap in performance for these subgroups and their GEN peers widens, at least in the year of the transition, none of the changes in the SWD-GEN gap for specific subgroups are statistically significant. Finally, only students with autism do not experience a decline in performance after the middle school transition. It is possible these students receive additional supports that mitigate the negative effects of the transition: a significant portion of the students with autism in our sample attend a school with an ASD-NEST program, a specialized program that serves students with autism and includes integrated classrooms with GEN peers, professional development for teachers, and social-emotional supports for students (“NYC Department of Education ASD Nest Program”, n.d.).

Limitations

There are three main limitations to the current study. The first is that we cannot identify the causal impact of attending a K-5 elementary school (as opposed to a K-8+ school) on outcomes in the elementary school grades. While we are confident that the decline in performance in sixth grade we find is due to the middle school transition, we are not able to fully account for the (potentially positive) effects of attending a K-5 school relative to attending a K-8+ school in the elementary school years. Thus, it is unclear if the cumulative effect (as of eighth grade) is negative. It is challenging to estimate the causal impact of attending a K-5 school on outcomes given students are not randomly assigned to K-5 or K-8+ schools, and even the use of a student fixed effect does not eliminate the possibility of bias coming from selection into a K-5 school that is correlated with a student's learning trajectory (Hong e*t al.*, 2018). In addition, one reason that students who move to middle school may "catch up" to their peers by eighth grade may be because students in K-8+ schools are more likely to make non-structural moves. Approximately 36% of students in our sample who are in K-8+ schools in third grade still switch schools between third and eighth grade. By comparison, only 14% of students in our sample in K-5 schools in third grade switch schools at a point other than the move to middle school. Prior research has found that students are less likely to make non-structural moves as they near the terminal grade of their school (Schwartz *et al.*, 2017). Therefore, non-structural moves being more common for students in schools with longer grade span is a feature of grade configuration policy and must be considered as part of the effect of grade span on outcomes. Nonetheless, this study, in line with prior research, provides suggestive evidence that students who move to middle school may be worse off by eighth grade.

Second, the set of the potential mediators we explore are limited by data availability.

While we find school and school-grade cohort variables do not explain most of the negative effect of the middle school transition on academic performance, it is possible a richer set of school context factors, including classroom-level measures of peer and teacher characteristics, would more fully explain the impact on student outcomes. Future research should explore the extent to which elementary and middle school classrooms differ from each other, and differ from K-8 classrooms, in terms of not only peers and teachers, but also other contextual characteristics (e.g. discipline and climate). This could inform the focus of policy interventions to mitigate the negative effects of the middle school transition.

Third and finally, because of our focus on the middle school transition in sixth grade, we are not able to speak to whether or not a mandated transition is more costly in earlier or later grades (in other contexts with different grade spans, the move to middle school could happen anytime between Grade 4 and 8). Evidence from prior research is mixed in terms of whether the negative effects of the middle school transition are larger in certain grades than others (Atteberry *et al.*, 2022; Cappella *et al.*, 2019; DiSalvo, 2022; Rockoff & Lockwood, 2010; Schwartz *et al.*, 2011). In addition, districts may want to know, for example, if a K-8 school followed by a 9-12 high school is preferable to a K-5 school followed by a 6-12 secondary school (each of these sets of grade spans involves only one mandated transition). However, because we cannot track students' performance into the high school grades, we cannot speak to this question directly.

Conclusion

Despite the limitations, there are some clear implications for school districts. The most straightforward is that districts may wish to implement formal programs in transition years to help prevent or alleviate the negative impact of the move to middle school for *all* students. Transition programs can range from one-day events (such as a tour or orientation) to a

comprehensive year-long program that involves both the feeder elementary and the receiving middle schools. However, while some studies of specific interventions have found positive impacts on self-reported measures of learning and adjustment, no research has formally examined the impact of transition programming on mitigating declines in academic performance (Akos, 2017).

Though we find average impacts are similar for SWDs and GENs once we account for potential mediators, students with disabilities deserve particular attention, given the need to coordinate continued access to IEP-mandated services and longstanding gaps in achievement. The IEP team itself is one potential means of supporting SWDs in the transition to middle school (James, 2018; Knesting, 2008), especially as student involvement in IEP meetings may improve academic outcomes broadly (Barnard-Brak & Lechtenberger, 2010). Engaging families is another potential means to support SWDs in the middle school transition, though there is also limited research on parent involvement interventions (Goldman & Burke, 2016). Since the negative impact is particularly large for SWDs with potentially more severe disabilities (LD, ED) those in self-contained classrooms, and students who lose access to supports (those declassified in the middle school grades), districts may want to target these students to receive additional supports in the middle school transition.

Additionally, this research, especially when considered as part of the larger body of research on structural school transitions, suggests districts may wish to increase the availability of K-8+ schools. Some districts, such as Boston, have begun explicitly to move toward standardizing longer grade spans to reduce the number of transitions students must make between schools (Boston Public Schools, 2018). However, transitioning from separate elementary and middle schools to K-8+ schools may be costly. It can require spending on school

construction to expand school building space or making changes to existing school buildings (this is the case in Boston). There is also some evidence that new K-8+ schools do not perform as well as established K-8+ schools (Byrnes & Ruby, 2007; Hong *et al.*, 2018; Mac Iver & Mac Iver, 2006), so if a district begins serving more students in K-8+ schools, the benefits may not materialize in the short-term. In NYC specifically, expanding the number of seats in K-8+ schools at the expense of stand-alone middle schools could limit middle school choice; this might be unpopular given NYC currently has a robust, centralized middle school choice process. However, both charter and private schools in NYC and nationally are more likely to serve students in schools with longer grade spans (Rockoff & Lockwood, 2010), suggesting demand for K-8+ schools. In addition, in terms of physical space, NYC might be particularly well-suited to create schools with longer grade spans, because many middle school buildings are under-utilized and could be the sites of new or expanded K-8+ schools (Edwards, 2019).

Our study extends the literature on the effect of grade configurations to a large and low-performing population: students with disabilities, who are increasingly likely to be educated alongside their general education peers and therefore make a structural transition from elementary to middle school. We confirm and extend the prior literature that suggests structural transitions almost universally have large negative impacts on student outcomes, these negative effects may persist, and they are particularly large for some vulnerable subgroups. While we do not find evidence that the SWD-GEN gap *increases*, there is still a significant SWD-GEN gap in performance, and SWDs may deserve particular attention in the transition. While further research is needed to determine the optimal grade configuration of schools and the best way to support students, particularly SWDs, during the move to middle school, districts should consider ways to ameliorate the negative effects of structural transitions.

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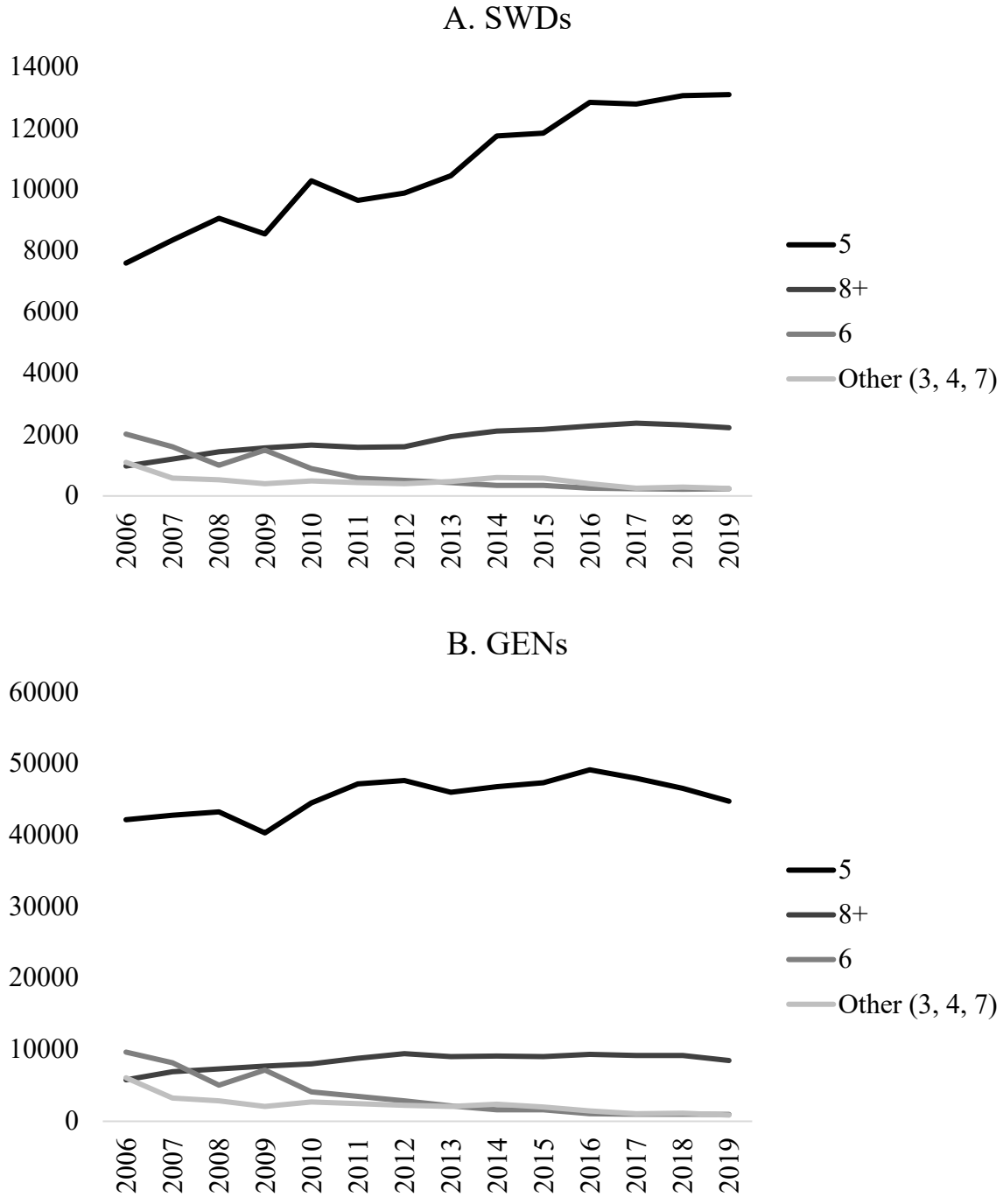
Figure 1.

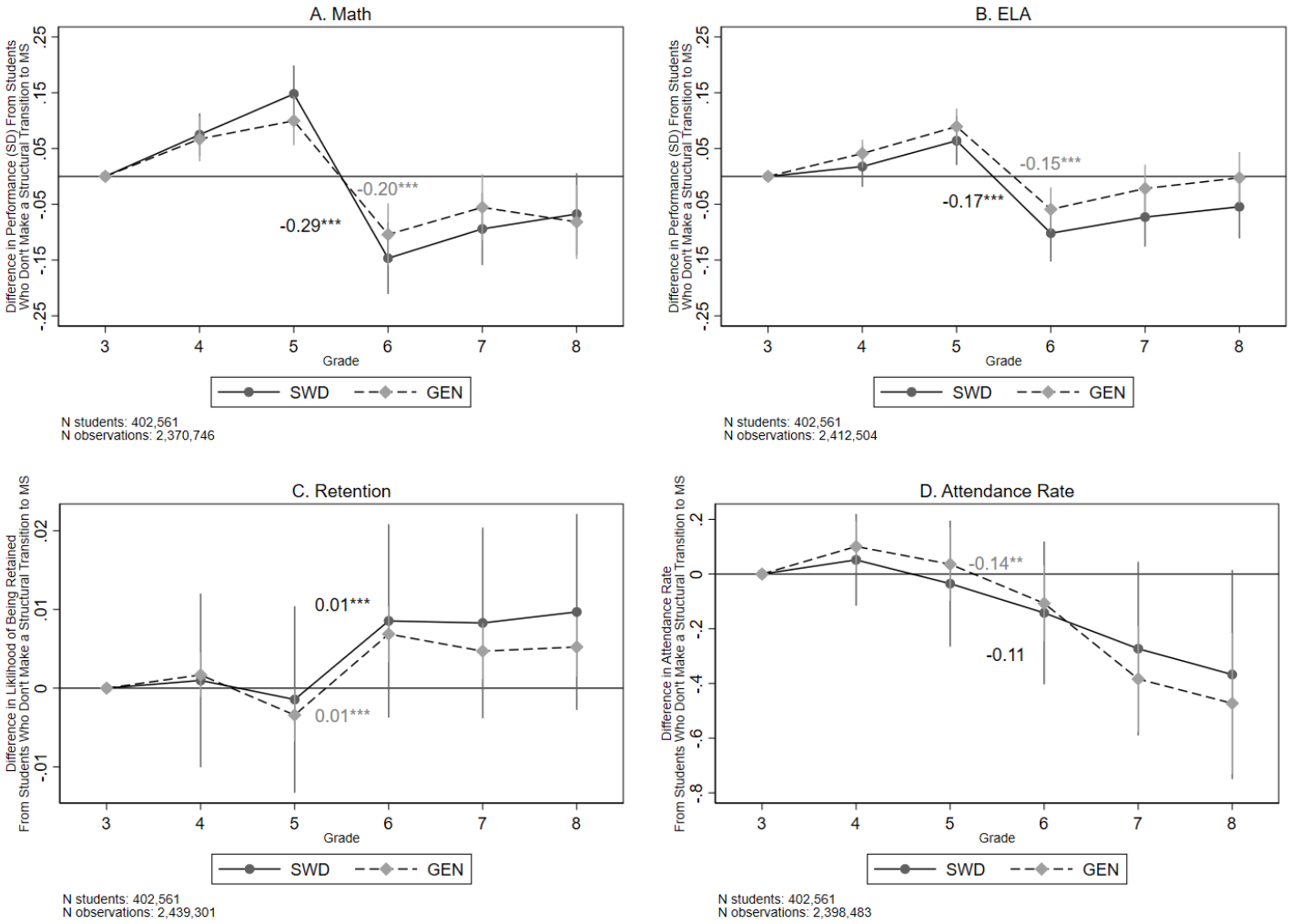
Third Grade Students in NYC Public Schools, by Terminal Grade of School



Note. These graphs include all students in traditional public schools (i.e. students in special education only school, and charter school, are excluded). The category "8+" includes all schools that end in Grades 8-12, although the predominant grade configurations in this category end in Grade 8 or 12.

Figure 2.

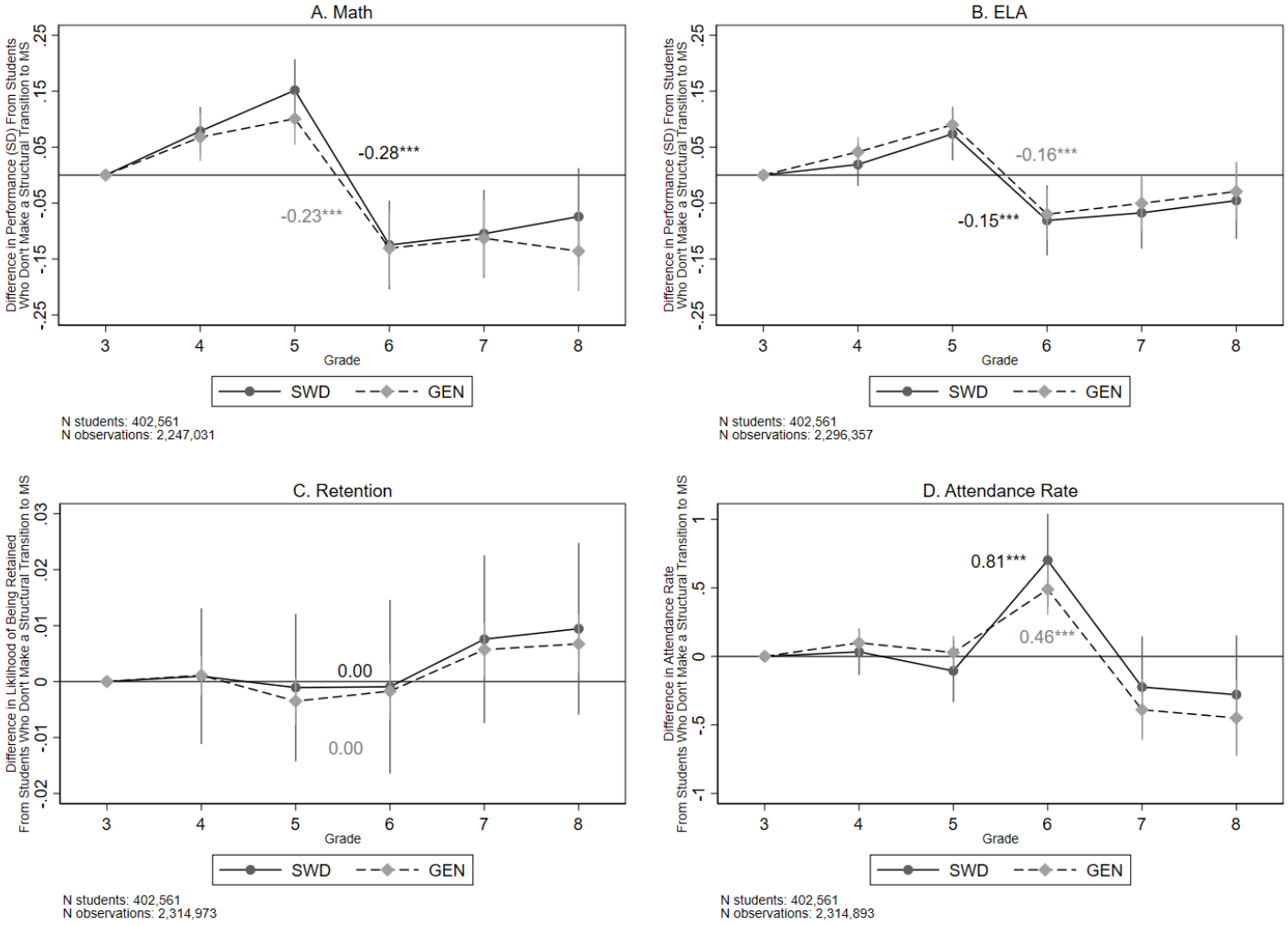
Effect of the Structural Transition to Middle School



Note. ***p < 0.01. This figure shows results for students in each grade who transition to middle school compared to students who do not. Vertical bars represent 95% confidence intervals on these estimates. Students are being compared to their peers (i.e. SWDs are being compared to SWDs and GENs to GENs), so these graphs do not present the SWD-GEN performance gap. Recall the estimate of interest is the change between Grade 5 and 6; the estimated magnitude of this change is the number in black for SWDs and in grey for GENs (the confidence intervals for these estimates are not shown). See Table 3 for estimates of interest (including standard errors and Anderson sharpened q values).

Figure 3.

Effect of the Structural Transition to Middle School ***with Mediators***



Note. ***p < 0.01. This figure shows results for students in each grade who transition to middle school compared to students who do not. Vertical bars represent 95% confidence intervals on these estimates. Students are being compared to their peers (i.e. SWDs are being compared to SWDs and GENs to GENs), so these graphs do not present the SWD-GEN performance gap. Recall the estimate of interest is the change between Grade 5 and 6; the estimated magnitude of this change is the number in black for SWDs and in grey for GENs(the confidence intervals for these estimates are not shown). See Table 4 for estimates of interest (including standard errors and Anderson sharpened q values).

Table 1.

Sample Summary Statistics – NYC Students Who Attend Third Grade from 2006-2014

	All Students (N = 402,561)			
	SWD (N = 81,733, 20%)		GEN (N = 320,828, 80%)	
	Terminal Grade of Elementary School			
	5	8+	5	8+
N students	70,072	11,661	272,272	48,556
% Students	86%	14%	85%	15%
N schools	602	163	602	163
White	15%	14%	17%	18%
Black	27%	34%	23%	33%
Hispanic	50%	46%	39%	34%
Asian or other race	8%	6%	20%	15%
Female	36%	36%	53%	54%
Retained Once	10%	12%	5%	5%
Retained Twice	1%	1%	<1%	<1%
Classification (Before MS Transition)				
LD	42%	42%		
SI	34%	33%		
OH	7%	7%		
ED	3%	4%		
AU	1%	1%		
Other/Missing	8%	7%		
Grade 3 Characteristics				
FRPL-eligible	76%	79%	68%	69%
ELL	25%	21%	16%	12%
Math Performance (SD)	-0.597	-0.653	0.243	0.204
ELA Performance (SD)	-0.701	-0.746	0.256	0.260
Attendance Rate (%)	93.04	92.63	94.96	94.63

Note. Table 1 reflects the main sample as defined in the text: students continuously enrolled in traditional public schools in third grade and for the following five years, who are not missing math scores, ELA scores, or attendance rate in Grade 5 or 6, and are not missing more than one math score, ELA score, or attendance rate. SWD includes students who were classified as a SWD in any year before Grade 6. For students who attend third grade multiple times, the Grade 3 characteristics reflects their first attempt. FRPL-eligible is an indicator for whether a student is eligible for free or reduced-price lunch. ELL is an indicator for English language learner.

Table 2

Results –Effect of the Structural Middle School Transition on Student Outcomes

	Math	ELA	Retention	Attendance
GEN Performance Change				
Grade 5 to 6	-0.204***	-0.148***	0.0103***	-0.143**
	(0.0215)	(0.0134)	(0.00121)	(0.0687)
	[0.001]	[0.001]	[0.001]	[0.087]
Grade 3 to 8	-0.0817**	-0.00246	0.00523***	-0.473***
	(0.0339)	(0.0236)	(0.00192)	(0.132)
	[0.043]	[0.940]	[0.021]	[0.002]
SWD Performance Change				
Grade 5 to 6	-0.295***	-0.166***	0.00999***	-0.107
	(0.0278)	(0.0181)	(0.00230)	(0.105)
	[0.001]	[0.001]	[0.001]	[0.436]
Grade 3 to 8	-0.0676	-0.0545	0.00968	-0.367
	(0.0374)	(0.0290)	(0.00635)	(0.199)
	[0.136]	[0.121]	[0.217]	[0.121]
SWD-GEN Gap Change				
Grade 5 to 6	-0.0906***	-0.0175	-0.000296	0.0362
	(0.0216)	(0.0161)	(0.00255)	(0.0937)
	[0.001]	[0.394]	[0.939]	[0.757]
Grade 3 to 8	0.0141	-0.0520**	0.00445	0.105
	(0.0283)	(0.0232)	(0.00545)	(0.171)
	[0.0706]	[0.060]	[0.534]	[0.653]
Observations	2,370,746	2,412,504	2,439,301	2,398,483
N students	402,561	402,561	402,561	402,561

Note. **p<0.05, ***p<0.01. Standard errors clustered at the third-grade school level, in parenthesis. Anderson sharpened q values, to account for multiple hypothesis testing, in brackets. All estimated coefficients on grade indicators, grade indicators interacted with the SWD indicator, grade indicators interacted with the move to middle school indicator, and grade indicators interacted with the SWD indicator and the move to middle school indicator (from which these estimates of interest are derived) are presented in Appendix Table A3; the estimates presented here are the estimates of interest as discussed in the text. The models also include student fixed effects and time-varying student characteristics: indicators for whether the student was repeating the grade, whether the student had repeated any prior grade, FRPL-eligibility, ELL status, and whether each of these variables was missing in the original data and replaced. The analysis with grade retention as the outcome does not include controls for repeating the grade or whether the student had repeated any prior grade. Standard errors clustered at the third-grade school level, in parenthesis. Math and ELA scores are standardized for each grade and year, citywide, with a mean of zero and a standard deviation of one.

Table 3.

Effect of the Structural Middle School (MS) Transition on Potential Mediators

Potential Mediator (Dependent Variable)	Change from Grade 5 to 6 for Students who make a Structural Transition to MS		
	SWDs	**GENs**	**SWD-GEN Difference**
Total Enrollment	143.8***	177.3***	-33.51**
	(32.31)	(38.77)	(17.01)
	[0.001]	[0.001]	[0.103]
Cohort Size	161.7***	179.8***	-18.03***
	(10.36)	(11.92)	(5.553)
	[0.001]	[0.001]	[0.005]
Cohort Stability (0-1)	-0.745***	-0.719***	-0.0264**
	(0.0187)	(0.0190)	(0.0105)
	[0.001]	[0.001]	[0.034]
Portion of Cohort (0-1):			
SWDs	-0.0298***	-0.0150***	-0.0148***
	(0.00562)	(0.00511)	(0.00401)
	[0.001]	[0.012]	[0.001]
White	-0.00424	0.00921	-0.0135**
	(0.00919)	(0.0110)	(0.00594)
	[0.721]	[0.530]	[0.058]
Black	0.00467	0.0191**	-0.0144***
	(0.00832)	(0.00940)	(0.00552)
	[0.672]	[0.094]	[0.027]
Hispanic	-0.00881	-0.0158	0.00696
	(0.00944)	(0.00933)	(0.00550)
	[0.481]	[0.166]	[0.310]
Asian or other race	0.00838	-0.0125	0.0209***
	(0.00818)	(0.0117)	(0.00631)
	[0.433]	[0.408]	[0.004]
ELL	-0.00331	-0.0150***	0.0117***
	(0.00479)	(0.00546)	(0.00331)
	[0.608]	[0.019]	[0.002]
FRPL	0.0536***	0.0422***	0.0113
	(0.0120)	(0.0117)	(0.00660)
	[0.001]	[0.002]	[0.160]
Cohort Avg. Prior Att. Rt.	-0.143	-0.166**	0.0224
	(0.0875)	(0.0829)	(0.0575)
	[0.178]	[0.097]	[0.757]
% Teachers out of Cert. (0-100)	11.88***	11***	0.871***

Potential Mediator (Dependent Variable)	Change from Grade 5 to 6 for Students who make a Structural Transition to MS		
	SWDs	**GENs**	**SWD-GEN Difference**
	(0.531)	(0.470)	(0.301)
	[0.001]	[0.001]	[0.013]
PTR	0.399**	0.330	0.0687
	(0.158)	(0.195)	(0.111)
	[0.034]	[0.166]	[0.653]

Note. **$p < 0.05$, ***$p < 0.01$. The model includes student fixed effects, grade fixed effects, grade fixed effects interacted with the moving to middle school indicator, grade fixed effects interacted with the SWD indicator, and a three-way interaction between grade, moving to middle school, and SWD, as well as time-varying student characteristics. Standard errors clustered at the third-grade school level, in parenthesis. Anderson sharpened q values, to account for multiple hypothesis testing, in brackets.

Table 4.

Effect of the Structural Middle School Transition on Student Outcomes ***with Mediators***

	Math	ELA	Retention	Attendance
GEN Performance Change:				
Grade 5 to 6	-0.232***	-0.160***	0.00180	0.462***
	(0.0266)	(0.0172)	(0.00157)	(0.0981)
	[0.001]	[0.001]	[0.371]	[0.001]
Grade 3 to 8	-0.136***	-0.0292	0.00673**	-0.449***
	(0.0365)	(0.0263)	(0.00268)	(0.142)
	[0.001]	[0.388]	[0.034]	[0.006]
SWD Performance Change:				
Grade 5 to 6	-0.276***	-0.155***	0.000141	0.806***
	(0.0336)	(0.0227)	(0.00346)	(0.149)
	[0.001]	[0.001]	[0.974]	[0.001]
Grade 3 to 8	-0.0743	-0.0455	0.00944	-0.279
	(0.0442)	(0.0350)	(0.00782)	(0.221)
	[0.167]	[0.301]	[0.340]	[0.310]
SWD-GEN Gap Change:				
Grade 5 to 6	-0.0450	0.00543	-0.00165	0.345***
	(0.0261)	(0.0200)	(0.00355)	(0.137)
	[0.160]	[0.830]	[0.721]	[0.034]
Grade 3 to 8	0.0617	-0.0163	0.00271	0.170
	(0.0328)	(0.0281)	(0.00662)	(0.200)
	[0.121]	[0.672]	[0.754]	[0.522]
Observations	2,247,031	2,296,357	2,314,973	2,314,893
N students	402,561	402,561	402,561	402,561

Note. **p<0.05, ***p<0.01. Standard errors clustered at the third-grade school level, in parenthesis. Anderson sharpened q values, to account for multiple hypothesis testing, in brackets. All estimated coefficients on grade indicators, grade indicators interacted with the SWD indicator, grade indicators interacted with the move to middle school indicator, and grade indicators interacted with the SWD indicator and the move to middle school indicator (from which these estimates of interest are derived) are presented in Appendix Table A4; the estimates presented here are the estimates of interest as discussed in the text. The models also include student fixed effects, time-varying student characteristics: indicators for whether the student was repeating the grade, whether the student had repeated any prior grade, FRPL-eligibility, ELL status, and whether each of these variables was missing in the original data and replaced; and a set of school and school-grade mediators listed in Table 3. The analysis with grade retention as the outcome does not include controls for repeating the grade or whether the student had repeated any prior grade. Standard errors clustered at the third-grade school level, in parenthesis. Math and ELA scores are standardized for each grade and year, citywide, with a mean of zero and a standard deviation of one.

Table 5.

Effects on SWD Performance (and SWD-GEN Gap) by Disability Classification, Grade of Declassification, & Service Setting

	Math				ELA			
	Immediate Effect (5th-6th Grade)		Cumulative Effect (3rd-8th Grade)		Immediate Effect (5th-6th Grade)		Cumulative Effect (3rd-8th Grade)	
	SWD	SWD-GEN Gap	SWD	SWD-GEN Gap	SWD	SWD-GEN Gap	SWD	SWD-GEN Gap
All SWDs	-0.276***	-0.0453	-0.0748	-0.0748	-0.152***	0.00795	-0.0432	-0.014
	(0.0336)	(0.0261)	(0.0443)	(0.0443)	(0.0229)	(0.0200)	(0.0351)	(0.0282)
	[0.001]	[0.160]	[0.167]	[0.121]	[0.001]	[0.830]	[0.301]	[0.672]
LD	-0.310***	-0.0795**	-0.114**	0.0222	-0.175***	-0.0146	-0.0745	-0.0454
	(0.0389)	(0.0350)	(0.0494)	(0.0403)	(0.0278)	(0.0265)	(0.0411)	(0.0350)
	[0.001]	[0.056]	[0.053]	[0.678]	[0.001]	[0.621]	[0.123]	[0.277]
SI	-0.234***	-0.00372	-0.0686	0.0679	-0.108***	0.0527**	-0.00814	0.0210
	(0.0415)	(0.0332)	(0.0520)	(0.0425)	(0.0296)	(0.0262)	(0.0416)	(0.0374)
	[0.001]	[0.988]	[0.302]	[0.186]	[0.002]	[0.094]	[0.830]	[0.712]
OH	-0.285***	-0.0546	-0.147	-0.0106	-0.154***	0.00635	-0.121	-0.0920
	(0.0576)	(0.0525)	(0.0860)	(0.0789)	(0.0552)	(0.0527)	(0.0663)	(0.0628)
	[0.001]	[0.446]	[0.166]	[0.939]	[0.019]	[0.931]	[0.129]	[0.235]
ED	-0.445***	-0.215	-0.0723	0.0642	-0.321***	-0.16	-0.0645	-0.0353
	(0.116)	(0.117)	(0.127)	(0.126)	(0.107)	(0.106)	(0.121)	(0.120)
	[0.001]	[0.123]	[0.672]	[0.699]	[0.006]	[0.173]	[0.757]	[0.931]
AU	0.332	0.562	0.832	0.968**	0.373	0.534**	0.247	0.276
	(0.343)	(0.344)	(0.438)	(0.443)	0.262	(0.262)	(0.316)	(0.318)
	[0.473]	[0.182]	[0.121]	[0.071]	[0.249]	[0.094]	[0.544]	[0.513]
Elem Declass	-0.202***	0.0281	-0.0529	0.0836	-0.123**	0.0370	-0.0461	-0.0170
	(0.0534)	(0.0489)	(0.0638)	(0.0596)	(0.0538)	(0.0511)	(0.0610)	(0.0546)
	[0.001]	[0.672]	[0.518]	[0.277]	[0.053]	[0.608]	[0.562]	[0.800]

	Math				ELA			
	Immediate Effect (5th-6th Grade)		Cumulative Effect (3rd-8th Grade)		Immediate Effect (5th-6th Grade)		Cumulative Effect (3rd-8th Grade)	
	SWD	SWD-GEN Gap	SWD	SWD-GEN Gap	SWD	SWD-GEN Gap	SWD	SWD-GEN Gap
MS Declass	-0.311***	-0.0810**	-0.172***	-0.0356	-0.0552	0.105***	-0.115**	-0.0856**
	(0.0490)	(0.0399)	(0.0597)	(0.0510)	(0.0392)	(0.0368)	(0.0466)	(0.0412)
	[0.001]	[0.097]	[0.013]	[0.573]	[0.218]	[0.021]	[0.024]	[0.056]
No Declass	-0.274***	-0.0433	-0.0577	0.0788**	-0.166***	-0.00547	-0.0289	0.000200
	(0.0354)	(0.0294)	(0.0478)	(0.0379)	(0.0250)	(0.0229)	(0.0378)	(0.0325)
	[0.001]	[0.235]	[0.349]	[0.082]	[0.001]	[0.790]	[0.534]	[0.974]
Ever SC	-0.360***	-0.130**	-0.111	0.0256	-0.194***	-0.0333	0.0110	0.0401
	(0.055)	(0.0532)	(0.0715)	(0.0685)	(0.0450)	(0.0432)	(0.0646)	(0.0606)
	[0.001]	[0.043]	[0.218]	[0.754]	[0.001]	[0.514]	[0.942]	[0.671]
Never SC	-0.245***	-0.0143	-0.0587	0.0779**	-0.142***	0.0183	-0.0660**	-0.0369
	(0.0345)	(0.0253)	0.0466	(0.0333)	(0.0218)	(0.0189)	(0.0334)	(0.0266)
	[0.001]	[0.672]	[0.310]	[0.053]	[0.001]	[0.515]	[0.096]	[0.246]

Note. **p<0.05, ***p<0.01. Standard errors clustered at the third-grade school level, in parenthesis. Anderson sharpened q values, to account for multiple hypothesis testing, in brackets. The results for "All SWDs" in the first row reproduces the results with all mediators presented in Figure 3 and Table 4 for comparison. The rest of the results are based on samples that include all GENs and sub-samples of SWDs with the listed characteristic: LD is specific learning disability, SI is speech and language impairment, OH is other health impairment, ED is emotional disturbance, AU is autism, "Elem. Declass." are students declassified in elementary school grades (3-5), "MS Declass." are students declassified in middle school grades (6-8), "Never Declass." are students never declassified (i.e. still SWD in eighth grade), "Never SC" are students never in a self-contained class in the elementary school grades (3-5), and "Ever SC" are students ever in a self-contained class in the elementary school grades (3-5).

The Academic Effects of Moving to Middle School on Students with Disabilities Relative to their General Education Peers

Appendix

Table A1

Attrition from Sample Inclusion Criteria

	GENs		SWDs	
Inclusion Criteria	Students Remaining After Applying Inclusion Criteria	% of Students Remaining (from previous line)	Students Remaining After Applying Inclusion Criteria	% of Students Remaining (from previous line)
Unique Third Graders, 2006-2014	521,734		159,879	
Continuously enrolled for six years	418,269	80%	124,213	78%
Never D75	417,157	>99%	111,034	89%
Traditional public school	376,536	90%	100,941	91%
Not missing grade span	375,786	>99%	100,814	100%
Retained <2x, don't skip/drop grade	375,003	>99%	100,303	99%
Math/ELA score inclusion criteria	365,312	97%	92,441	92%
Att. Rt. Inclusion criteria	365,283	>99%	92,427	>99%
K-5 or K-8+	320,828	88%	81,733	88%

Notes. Highlighted rows reflect where there is differential sample attrition for SWDs and GENs. D75 schools are special education only schools. Math/ELA score inclusion criteria is that a student must have both math and ELA scores in fifth and sixth grade, and is not missing more than one math score or more than one ELA score. Attendance rate (Att. Rt.) inclusion criteria is that a student must have attendance rate data in fifth and sixth grade, and is not missing more than one attendance rate.

Table A2.

First Stage Results

	Transition to MS interacted with:				
Instrument interacted with:	**Grade 4 (M_{i4})**	**Grade 5 (M_{i5})**	**Grade 6 (M_{i6})**	**Grade 7 (M_{i7})**	**Grade 8 (M_{i8})**
Grade 4 (T_{i4})	0.586*** (0.0213)				
Grade 5 (T_{i5})		0.587*** (0.0213)			
Grade 6 (T_{i6})			0.586*** (0.0213)		
Grade 7 (T_{i7})				0.587*** (0.0213)	
Grade 8 (T_{i8})					0.595*** (0.0225)
	Transition to MS interacted with SWD and:				
Instrument interacted with SWD and:	**Grade 4 ($M_{i4\ x\ SWD}$)**	**Grade 5 ($M_{i5\ x\ SWD}$)**	**Grade 6 ($M_{i6\ x\ SWD}$)**	**Grade 7 ($M_{i7\ x\ SWD}$)**	**Grade 8 ($M_{i8\ x\ SWD}$)**
Grade 4 ($T_{i4\ x\ SWD}$)	0.575*** (0.0181)				
Grade 5 ($T_{i5\ x\ SWD}$)		0.577*** (0.0180)			
Grade 6 ($T_{i6\ x\ SWD}$)			0.576*** (0.0181)		
Grade 7 ($T_{i7\ x\ SWD}$)				0.577*** (0.0181)	
Grade 8 ($T_{i8\ x\ SWD}$)					0.583*** (0.0183)

Note. ***$p < 0.01$. This table shows the relevant coefficient and associated standard error (SE) from each first stage equation (Models 2a and 2b), that is, how well *Tig* (the instrument) predicts *Mig* (the indicator for the middle school transition in Grade 6) for each grade $g = \{4, 5, 6, 7, 8\}$. Each first stage equation also includes the grade fixed effect, student fixed effect, and set of time-varying student controls included in the second stage equation (Model 1). The coefficient (and SE) in the first row is the coefficient on T_{i4} in the equation predicting M_{i4}, the coefficient (and SE) in the second row is the coefficient on T_{i5} in the equation predicting M_{i5}, and so forth. As an example interpretation, the coefficient on T_{i4} in the equation predicting M_{i4} suggests a GEN in Grade 4 whose third-grade school ends at fifth grade two years later is 59 percentage points more likely to move to middle school than a GEN in Grade 4 who attended a K-8+ school in third grade, conditional on a student fixed effect and time-varying student characteristics. The Kleibergen-Paap F-statistic (Kleinbergen & Paap, 2006), which is 142.769, is high enough that we reject the null hypothesis of weak instruments. This suggests the instruments are relevant (that is, strongly predictive of moving to middle school). These statistics, and all second stage results presented, are calculated using xtivreg2 in Stata (Schaffer, 2010).

Table A3

Results –Effect of the Structural Middle School Transition on Student Outcomes

	Math	**ELA**	**Retention**	**Attendance**
gr3 (omitted)	.	.	.	.
	.	.	.	.
gr4	-0.0393**	-0.0178*	-0.00710***	0.232***
	(0.0162)	(0.00964)	(0.00113)	(0.0370)
gr5	-0.0675***	-0.0589***	-0.00536***	0.397***
	(0.0174)	(0.0129)	(0.00134)	(0.0519)
gr6	0.0816***	0.0625***	-0.00880***	0.343***
	(0.0221)	(0.0156)	(0.00147)	(0.0528)
gr7	0.0480**	0.0512***	-0.00841***	0.301***
	(0.0229)	(0.0166)	(0.00147)	(0.0750)
gr8	0.141***	0.0492***	-0.0122***	-0.752***
	(0.0256)	(0.0177)	(0.00155)	(0.102)
gr3#SWD (omitted)	.	.	.	.
	.	.	.	.
gr4#SWD	-0.0678***	-0.0367**	-0.0241***	0.0541
	(0.0166)	(0.0146)	(0.00414)	(0.0626)
gr5#SWD	-0.0777***	0.0347**	-0.0372***	0.109
	(0.0197)	(0.0166)	(0.00422)	(0.0792)
gr6#SWD	-0.0462**	0.0309	-0.0426***	-0.166
	(0.0199)	(0.0183)	(0.00427)	(0.0936)
gr7#SWD	-0.0561***	0.0384**	-0.0433***	-0.560***
	(0.0218)	(0.0173)	(0.00433)	(0.116)
gr8#SWD	-0.0760***	0.0377**	-0.0413***	-0.631***
	(0.0220)	(0.0181)	(0.00427)	(0.136)
gr3#msgr6 (omitted)	.	.	.	.
	.	.	.	.
gr4#msgr6	0.0670***	0.0410***	0.00168	0.101**
	(0.0204)	(0.0126)	(0.00144)	(0.0477)
gr5#msgr6	0.0998***	0.0893***	-0.00342**	0.0360
	(0.0224)	(0.0164)	(0.00171)	(0.0684)
gr6#msgr6	-0.104***	-0.0590***	0.00687***	-0.107
	(0.0286)	(0.0201)	(0.00182)	(0.0710)
gr7#msgr6	-0.0555	-0.0218	0.00470***	-0.384***
	(0.0302)	(0.0219)	(0.00182)	(0.0992)
gr8#msgr6	-0.0817**	-0.00246	0.00523***	-0.473***
	(0.0339)	(0.0236)	(0.00192)	(0.132)
gr3#msgr6#SWD (omitted)	.	.	.	.
	.	.	.	.
gr4#msgr6#SWD	0.00776	-0.0234	-0.000699	-0.0489
	(0.0210)	(0.0184)	(0.00525)	(0.0798)
gr5#msgr6#SWD	0.0480	-0.0254	0.00197	-0.0711
	(0.0249)	(0.0211)	(0.00538)	(0.0998)
gr6#msgr6#SWD	-0.0426	-0.0429	0.00168	-0.0349

Table A3

Results –Effect of the Structural Middle School Transition on Student Outcomes

	Math	**ELA**	**Retention**	**Attendance**
	(0.0254)	(0.0230)	(0.00556)	(0.118)
gr7#msgr6#SWD	-0.0386	-0.0512**	0.00358	0.111
	(0.0277)	(0.0222)	(0.00557)	(0.146)
(gr8#msgr6#SWD)	0.0141	-0.0520**	0.00445	0.105
	(0.0283)	(0.0232)	(0.00545)	(0.171)
Observations	2,370,746	2,412,504	2,439,301	2,398,483
N students	402,561	402,561	402,561	402,561

Note. **p<0.05, ***p<0.01. The variables "gr3", "gr4", and so forth represent grade indicators; the variables "gr3#ms6" represent the grade indicators interacted with the indicator for moving to middle school in sixth grade, and the variables "gr3#SWD" represent the grade indicators interacted with the SWD indicator. The models also include student fixed effects and time-varying student characteristics: indicators for whether the student was repeating the grade, whether the student had repeated any prior grade, FRPL-eligibility, ELL status, and whether each of these variables was missing in the original data and replaced. The analysis with grade retention as the outcome does not include controls for repeating the grade or whether the student had repeated any prior grade. Standard errors clustered at the third-grade school level, in parenthesis. Math and ELA scores are standardized for each grade and year, citywide, with a mean of zero and a standard deviation of one.

Table A4

*Effect of the Structural Middle School Transition on Student Outcomes **with Mediators***

	Math	ELA	Retention	Attendance
gr3 (omitted)	.	.	.	.
	.	.	.	.
gr4	-0.0393**	-0.0225**	-0.00754***	0.0421
	(0.0169)	(0.0101)	(0.00141)	(0.0380)
gr5	-0.0715***	-0.0655***	-0.00707***	0.141***
	(0.0182)	(0.0130)	(0.00170)	(0.0468)
gr6	0.0804***	0.0574***	-0.0124***	0.132**
	(0.0228)	(0.0152)	(0.00181)	(0.0546)
gr7	0.0377	0.0408**	-0.0102***	-0.0315
	(0.0227)	(0.0161)	(0.00178)	(0.0713)
gr8	0.127***	0.0371**	-0.0129***	-1.117***
	(0.0248)	(0.0175)	(0.00193)	(0.0965)
gr3#SWD (omitted)	.	.	.	.
	.	.	.	.
gr4#SWD	-0.0968***	-0.0597***	-0.0271***	0.0253
	(0.0186)	(0.0154)	(0.00448)	(0.0637)
gr5#SWD	-0.114***	-0.00578	-0.0415***	0.0882
	(0.0213)	(0.0172)	(0.00456)	(0.0847)
gr6#SWD	-0.0832***	-0.0106	-0.0460***	-0.183*
	(0.0213)	(0.0181)	(0.00463)	(0.0972)
gr7#SWD	-0.0910***	-0.00151	-0.0476***	-0.562***
	(0.0218)	(0.0180)	(0.00463)	(0.115)
gr8#SWD	-0.110***	-0.00154	-0.0459***	-0.634***
	(0.0224)	(0.0198)	(0.00462)	(0.134)
gr3#msgr6 (omitted)	.	.	.	.
	.	.	.	.
gr4#msgr6	0.0677***	0.0413***	0.00112	0.0991**
	(0.0217)	(0.0136)	(0.00180)	(0.0494)
gr5#msgr6	0.101***	0.0901***	-0.00351	0.0280
	(0.0237)	(0.0168)	(0.00217)	(0.0633)
gr6#msgr6	-0.131***	-0.0700***	-0.00171	0.490***
	(0.0343)	(0.0233)	(0.00258)	(0.0954)
gr7#msgr6	-0.113***	-0.0504**	0.00570**	-0.389***
	(0.0343)	(0.0246)	(0.00248)	(0.114)
gr8#msgr6	-0.136***	-0.0292	0.00673**	-0.449***
	(0.0365)	(0.0263)	(0.00268)	(0.142)
gr3#msgr6#SWD (omitted)	.	.	.	.
	.	.	.	.
gr4#msgr6#SWD	0.0107	-0.0224	-0.000169	-0.0657
	(0.0234)	(0.0196)	(0.00576)	(0.0817)
gr5#msgr6#SWD	0.0507*	-0.0165	0.00243	-0.134
	(0.0268)	(0.0220)	(0.00587)	(0.106)
gr6#msgr6#SWD	0.00575	-0.0111	0.000778	0.211

Table A4

Effect of the Structural Middle School Transition on Student Outcomes ***with Mediators***

	Math	**ELA**	**Retention**	**Attendance**
	(0.0309)	(0.0267)	(0.00692)	(0.161)
gr7#msgr6#SWD	0.00821	-0.0171	0.00186	0.165
	(0.0320)	(0.0261)	(0.00671)	(0.175)
gr8#msgr6#SWD	0.0617	-0.0163	0.00271	0.170
	(0.0328)	(0.0281)	(0.00662)	(0.200)
Observations	2,247,031	2,296,357	2,314,973	2,314,893
N students	402,561	402,561	402,561	402,561

Note. **p<0.05, ***p<0.01. Standard errors clustered at the third-grade school level, in parenthesis. The variables "gr3", "gr4", and so forth represent grade indicators; the variables "gr3#ms6" represent the grade indicators interacted with the indicator for moving to middle school in sixth grade, and the variables "gr3#SWD" represent the grade indicators interacted with the SWD indicator. The models also include student fixed effects, time-varying student characteristics: indicators for whether the student was repeating the grade, whether the student had repeated any prior grade, FRPL-eligibility, ELL status, and whether each of these variables was missing in the original data and replaced; and a set of school and school-grade mediators listed in Table 3. The analysis with grade retention as the outcome does not include controls for repeating the grade or whether the student had repeated any prior grade. Standard errors clustered at the third-grade school level, in parenthesis. Math and ELA scores are standardized for each grade and year, citywide, with a mean of zero and a standard deviation of one.

Table A5

Robustness of Results – Math

		Immediate Effect (5th-6th Grade)			Cumulative Effect (3rd+-8th Grade)		
		SWD	**GEN**	**SWD-GEN Gap**	**SWD**	**GEN**	**SWD-GEN Gap**
(1)	**Main Results**	-0.276***	-0.232***	-0.0453	-0.0748	-0.136***	-0.0748
		(0.0336)	(0.0266)	(0.0261)	(0.0443)	(0.0365)	(0.0443)
(2)	**Simple First Stage**	-0.229***	-0.186***	-0.0430**	-0.0424	-0.105***	0.0625**
		(0.0254)	(0.0197)	(0.0210)	(0.0388)	(0.0327)	(0.0294)
(3)	**Sample observed from Grade 3 to 6**	-0.270***	-0.222***	-0.0479	N/A	N/A	N/A
		(0.0368)	(0.0291)	(0.0283)	N/A	N/A	N/A
(4)	**Sample including charter school students**	-0.261***	-0.223***	-0.0381**	-0.0705	-0.128***	0.0576
		(0.0334)	(0.0257)	(0.0255)	(0.0440)	(0.0353)	(0.0325)
(5)	**Sample where the elementary school starts in K**	-0.284***	-0.234***	-0.0495	-0.0854	-0.138***	0.0527
		(0.0338)	(0.0268)	(0.0262)	(0.0442)	(0.0367)	(0.0328)
(6)	**Prior attendance rate included as mechanism**	-0.277***	-0.224***	-0.0524**	-0.122***	-0.178***	-0.0553
		(0.0331)	(0.0258)	(0.0265)	(0.0349)	(0.0309)	(0.0292)
(7)	**Main sample; no time-varying student controls**	-0.276***	-0.230***	-0.0456	-0.0834	-0.130***	0.0463
		(0.0336)	(0.0264)	(0.0259)	(0.0443)	(0.0364)	(0.0331)
(8)	**Main sample; instrument is grade span as of Grade 3**	-0.289***	-0.226***	-0.0634**	-0.117***	-0.139***	0.0215
		(0.0351)	(0.0275)	(0.0268)	(0.0446)	(0.0375)	(0.0333)
(9)	**Main sample; matching analysis**	-0.0790***	-0.0634***	-0.0157	-0.0664***	-0.0723***	0.00588
		(0.0122)	(0.00937)	(0.0108)	(0.0161)	(0.0129)	(0.0133)

Note. **p<0.05, ***p<0.01. Each row reflects estimates of the parameters of interest from a robustness check. Standard errors clustered at the third-grade school level are in parenthesis. Math scores are standardized for each grade and year, citywide, with a mean of zero and a standard deviation of one. All models include student fixed effects; grade fixed effects; grade indicators interacted with the SWD indicator; grade indicators interacted with the move to middle school indicator; grade indicators interacted with the move to middle school indicator and the SWD indicator; a set of student-level time-varying controls (except for Row 7, which excludes these); and the full set of school and school-grade cohort level mediators. The instrument for moving to middle school is an indicator for whether the students' school ended at fifth grade in the year the student was in fifth grade, as defined in the text, except for Row 8,

where the instrument is an indicator for whether the student's school ended at fifth grade in the year the student was in third grade, and Row 9, which uses OLS on a matched sample (as described in the text). See endnote 22 for additional clarification on the robustness of the matched sample results. [+]Row 6 excludes Grade 3 observations, because there is no average cohort prior attendance rate in Grade 3, so the cumulative results reflect Grade 8 performance relative to Grade 4, which is the omitted grade in these results (i.e. cumulative results reflect the difference from fourth through eighth grade).

Table A6

Robustness of Results – ELA

		Immediate Effect (5th-6th Grade)			Cumulative Effect (3rd+-8th Grade)		
		SWD	**GEN**	**SWD-GEN Gap**	**SWD**	**GEN**	**SWD-GEN Gap**
(1)	**Main Results**	-0.152***	-0.160***	0.00795	-0.0432	-0.0292	-0.014
		(0.0229)	(0.0172)	(0.0200)	(0.0351)	(0.0263)	(0.0282)
(2)	**Simple First Stage**	-0.129***	-0.135***	0.00529	-0.0282	-0.0121	-0.0160
		(0.0175)	(0.0125)	(0.0163)	(0.0307)	(0.0233)	(0.0252)
(3)	**Sample observed from Grade 3 to 6**	-0.146***	-0.168***	0.0221	N/A	N/A	N/A
		(0.0252)	(0.0194)	(0.0224)	N/A	N/A	N/A
(4)	**Sample including charter school students**	-0.148***	-0.156***	0.00849	-0.0247	-0.0279	0.00328
		(0.0224)	(0.0168)	(0.0195)	(0.0342)	(0.0250)	(0.0270)
(5)	**Sample where the elementary school starts in K**	-0.157***	-0.160***	0.00385	-0.0497	-0.0291	-0.0206
		(0.0230)	(0.0173)	(0.0201)	(0.0351)	(0.0265)	(0.0281)
(6)	**Prior attendance rate included as mechanism**	-0.161***	-0.153***	-0.00769	-0.0461	-0.0555	0.00936
		(0.0224)	(0.0166)	(0.0199)	(0.0292)	(0.0225)	(0.0241)
(7)	**Main sample; no time-varying student controls**	-0.155***	-0.160***	0.00429	-0.0548	-0.0233	-0.0315
		(0.0228)	(0.0169)	(0.0199)	(0.0352)	(0.0265)	(0.0284)
(8)	**Main sample; instrument is grade span as of Grade 3**	-0.156***	-0.164***	0.00745	-0.0788**	-0.0338	-0.0451
		(0.0230)	(0.0180)	(0.0206)	(0.0350)	(0.0270)	(0.0283)
(9)	**Main sample; matching analysis**	-0.0652***	-0.0556***	-0.00960	-0.0626***	-0.0277***	-0.0349***
		(0.00902)	(0.00639)	(0.00846)	(0.0120)	(0.00930)	(0.0113)

Note. **p<0.05, ***p<0.01. Each row reflects estimates of the parameters of interest from a robustness check. Standard errors clustered at the third-grade school level are in parenthesis. ELA scores are standardized for each grade and year, citywide, with a mean of zero and a standard deviation of one. All models include student fixed effects; grade fixed effects; grade indicators interacted with the SWD indicator; grade indicators interacted with the move to middle school indicator; grade indicators interacted with the move to middle school indicator and the SWD indicator; a set of student-level time-varying controls (except for Row 7, which excludes these); and the full set of school and school-grade cohort level mediators. The instrument for moving to middle school is an indicator for whether the students' school ended at

fifth grade in the year the student was in fifth grade, as defined in the text, except for Row 8, where the instrument is an indicator for whether the student's school ended at fifth grade in the year the student was in third grade, and Row 9, which uses OLS on a matched sample (as described in the text). See endnote 22 for additional clarification on the robustness of the matched sample results. [+]Row 6 excludes Grade 3 observations, because there is no average cohort prior attendance rate in Grade 3, so the cumulative results reflect Grade 8 performance relative to Grade 4, which is the omitted grade in these results (i.e. cumulative results reflect the difference from fourth through eighth grade).