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School Transitions and Students' Achievement in the Fifth Grade

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ABSTRACT. Although separate schools that attend to the specific needs of students are generally considered to be beneficial, the school-to-school transitions they necessitate are often harmful. Drawing on cumulative stress theory, the author examined the relationship between school transitions and students' Grade 5 achievement. Propensity score matching methods are used on data from 2 panel-waves of the Early Childhood Longitudinal Study to test the hypothesis that these transitions result in adverse academic outcomes. Estimates from matched samples indicate that transitions between Grades 3 and 5 are not significantly associated with decreases in mathematics, reading, or science achievement. The results of this study directly challenge extant research and demonstrate a critical methodological perspective on the relationship between school transitions and students' achievement.

Keywords: achievement, education, quantitative research, school reform

Much popular and scholarly attention has been given to the importance of continuity in children's lives (e.g., Kagan & Neuman, 1998; Mangione & Speth, 1998; Silvern, 1988). This attention has rightly focused on the importance of stable family structures (Bradley, Caldwell, & Rock, 1988), consistent living situations (Evans, Wells, & Moch, 2003), and coherence in children's schooling experiences (Lash & Kirkpatrick, 1990). Because of the importance of the latter, school districts and communities in the United States have sought ways to minimize children's mobility between schools. These efforts are supported by a vast amount research on student mobility—defined as the changing of schools for reasons other than grade promotion—that has consistently demonstrated that moves between schools are associated with negative outcomes, particularly for disadvantaged children of color (e.g., Engec, 2006; Ingersoll, Scamman, & Eckerling, 1989; Rumberger & Larson, 1998).

While the antecedents and adverse effects of student mobility have received a bulk of this attention (e.g., National Research Council and Institute of Medicine, 2010), a related line of research has examined another type of move that students make between schools: those planned school-to-school transitions due to grade promotion that children and adolescents experience as part of their K–12 educational lives (referred to here as "transitions"). Those that have studied these transitions have typically focused on either the move from elementary to middle school, roughly corresponding with the life course transition into early adolescence, or from middle to high school during middle adolescence. The general consensus from this work and its emphasis on school structure is that although separate schools that attend to the specific needs of children and adolescents are beneficial, the transitions they necessitate are often harmful (Akos & Galassi, 2004; Alspaugh, 1998). Consequently, a number of school districts in the United States, notably the large urban districts of Philadelphia, Baltimore, and Cincinnati, have eliminated these transitions between schools by moving away from the traditional elementary school, typically serving Grades K–5, and moving toward K–8 models (Rockoff & Lockwood, 2010). It should be noted, however, that the research base on which these K–8 initiatives has been founded has yielded inconsistent results (e.g., Carolan & Chesky, 2012; Holas & Huston, 2012).

In the United States, children generally attend one of three school configurations: elementary schools (typically K–5 or K–6), primary schools (typically K–2 or K–3), or combined schools (typically K–8; Aud et al., 2011). Whereas students most often transition to a new destination school for Grade 6, planned transitions earlier in children's schooling lives occur when children may be at an even more turbulent life course stage. For instance, over 7.0% of regular public elementary schools in the United States require that children switch schools after Grades 3 or 4 (Snyder & Dillow, 2011). While a bulk of the research on school transitions has examined these effects during the middle level grades, little, if any, has focused on their effects earlier in children's school lives.

The primary purpose of this study was to contribute to the literature on school transitions by estimating their effects on children's learning in Grade 5. Using propensity score matching methods on panel data from the Early Childhood

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Longitudinal Study–Kindergarten Class 1998–1999 (ECLS-K; Tourangeau, Nord, Lê, Sorongon, & Najarian, 2009), this study adds to the growing literature on school transitions by focusing attention on a structural characteristic of elementary schools that has surprisingly received little empirical attention from the research community.

Schooling Forms for Children Grades K–8

The landscape of Grades K–8 schooling forms for children in the United States has shifted in recent years. For example, in 2008–2009, of the approximately 67,000 regular, public elementary schools in the United States, 7.3% served students in prekindergarten, kindergarten, or Grade 1 (P/K/1) to Grade 3 or 4; 37.2% covered P/K/1 through Grade 5; 17.4% spanned P/K/1 through Grade 6; 9.0% of covered P/K/1 through Grade 8; 19.4% ranged from Grade 4, 5, or 6 to Grade 6, 7, or 8; and 9.5% consisted of some other grade span configuration. The average number of students in these schools was 475 (Snyder & Dillow, 2011).

About 10 years prior to these data, this landscape looked different (Snyder & Hoffman, 2000). Specifically, in 1996–1997, of the approximately 62,000 regular elementary schools in the United States: 8.1% served Grade P/K/1 through Grade 3 or 4; 33.3% spanned P/K/1 through Grade 5; 25.6% covered P/K/1 to the Grade 6; 7.5% ranged from P/K/1 through Grade 8; 17.2% served students in Grade 4, 5, or 6 to Grade 6, 7, or 8; and 9.4% consisted of some other grade span configuration. The average number of students in these schools was 484. Aside from the obvious that the number of schools serving the elementary grades has increased, while their average size has decreased, the other notable trend is that schools have moved from the P/K/1 through Grade 5 model and more toward models that require a later transition. However, despite this trend, over 4,800 regular public schools still require students to transition to another school after Grade 3 or 4.

This persistence of the latter has been motivated by a number of developments, three of which are noteworthy. First, across the nation, particularly in rapidly expanding suburban and exurban districts, schools have had to adapt to demographic shifts that have strained resources (Duke, 2005). Consequently, even large districts such as Minneapolis have had to manage these population bubbles by moving children from one building to another and reorganizing their schools' grade spans accordingly. Districts will need to continue to deal with this pressure as public school enrollment in Grades pre-K–8 is projected to increase from 34.2 million in 2007–2008 to an estimated high of 37.2 million in 2019–2020 (Aud et al., 2011).

Second, curricular fragmentation has pushed downward into the elementary curriculum, requiring students to switch classes and teachers for subject-specific instruction. For example, more than 250 elementary schools in South Florida have implemented this departmentalization strategy in some form (Sampson, 2009). While not suggesting that this departmentalization strategy results in separate schools, the splitting of the traditional elementary school into two distinct units is facilitated by this emphasis on subject-specific instruction. Whereas this used to first occur when students entered middle school, typically in Grade 6, content-specific teachers as early as Grade 3 or 4 now provide instruction in certain subject areas. About this time schools also begin to reflect this emphasis by separating children from their younger peers and ratcheting-up the academic focus in ways that are more tightly aligned with mandated curricular standards. This fragmentation has also paralleled changes in teacher certification spans (Kaye, 2012). For example, in 2013 Pennsylvania is shifting from a Grades K–6 to either a Grades 4–8 subject-specific or pre-K–3 certification. This mirrors the National Board for Professional Teaching Standards' certification spans, which offers generalist/early childhood (ages 3–8 years) or generalist/early adolescence (ages 7–12 years) certifications. The fragmentation of the elementary curriculum is reflected in changes in teacher certification spans and the subjects that teachers are eligible to teach.

Finally, there is also a set of developmental reasons why elementary schools may opt to create separate school structures for children. For example, starting around age 9 years (roughly corresponding to Grade 4), children enter a developmental stage where they strive to distance themselves from adults, become increasingly preoccupied with the perceptions of peers, strive for group membership, and typically lack self-confidence (Santrock, 2011). These developmental reasons suggest that separating these children from younger peers may be beneficial for both age ranges. Regardless of whether schools base this decision on demographic, curricular, or developmental reasons, the separation of traditional elementary schools into configurations that include fewer grades requires that children transition from one school to another upon grade promotion.

School Transitions

Informed by life course studies, research on school transitions has focused on late adolescents' or adults' transition out of secondary or postsecondary schools and into work, a body of literature referred to as school-to-work transitions (e.g., Arum & Shavit, 1995; J. E. Rosenbaum, 1996). A related body of research has focused on the planned transitions that children experience as they move from one school to school to another, mostly centering on the transition into and out of middle school (Alexander, Entwisle, & Dauber, 1996; Blyth, Simmons, & Bush, 1978). Fewer studies, however, have focused on the planned transitions prior to the middle level grades (a notable exception is Burkam, Michaels, & Lee, 2007).

The consensus of this research suggests that school transitions generally result in adverse outcomes, particularly for those from disadvantaged backgrounds (Alspaugh, 1998). A number of explanations have been offered. Foremost among these is cumulative stress theory (e.g., Hodges, Tierney, &

Buchsbaum, 1984; Simmons & Blyth, 1987), which posits that the transition between schooling forms compounds whatever developmental changes a student is experiencing. Studies that have operated from this framework suggest that gaps in educational outcomes result from the fact that students making the transition to a new school must simultaneously cope with developmental change and school change. And because coping with multiple changes is more challenging than coping with only one, these students are more likely to experience negative academic outcomes than those students who only have to cope with developmental changes (Eccles, Lord, & Midgley, 1991).

Three sets of mechanisms are used to account for general performance declines that follow these transitions (Weiss & Bearman, 2007). Referring specifically to children between Grades 3 and 5 (roughly corresponding to ages 7–11 years), the first set focuses on the natural progression of the life course and child development. From this developmental perspective, it may not be the transition that matters, but that this segment of childhood is a phase of life that is characterized by numerous physical, emotional, and cognitive changes (Broeren & Muris, 2009). The second class of explanation focuses on the social changes and disruptions triggered by transitioning to a new school. Even though the move from one school to another may be planned, it is still hard. A third class of factors centers on the school itself, with its specific characteristics and normative demands responsible for the changes that occur. It is worth mentioning that these three sets of mechanisms imply differences in the effect of the transition. The first of these posits that transitioning to a new school should have an effect, regardless of whether the change of grade is accompanied by a change of schools. The second and third explanations would result in adverse effects only for those students who change schools between kindergarten and Grade 5.

The first category of explanation—the developmental perspective—emphasizes that children, particularly in middle childhood (roughly ages 7–11 years), experience a number of psychological and physical changes that pose challenges for the social organization of classrooms and schools (Eccles, 1999). For example, socioemotional changes during these years include an awareness of the future, a stronger sense of right and wrong, and an increased desire for independence. Cognitive changes include greater ability to communicate thoughts and feelings and an increase in mental skills, including complex task completion. Children experience these changes at uneven rates, which further challenges the ways in which classrooms and schools are organized for learning. According to this line of explanation, children will experience stress even if the promotion from one grade to another is not accompanied by a change of schools.

The second line of explanation has largely focused on the disruption in children's and parents' social networks as students transition from one school to another. As noted by Weiss and Bearman (2007), this line of argument focuses on the loss of positive social connections to teachers and staff that are typically broken when moving to a new school (e.g., Roderick, 1993; Seidman, Aber, Allen, & French, 1996). Moreover, feeder patterns into new schools may mean that not all students move to the same school and friendships among children and their parents may split. From this perspective, the negative consequences of school transitions are attributable to the fractured social ties that are thought to be critical to students' success (Hepler, 1990).

A third line of explanation has focused on the changes in academic and normative climates that typically follow a school transition. As children age, academic expectations increase and the ability to consistently meet these expectations becomes more reliant on quality instruction and curricular alignment. Earlier studies on school transitions, for example, indicate that schools' grade spans negatively affect instructional continuity and communication across grades (Alley, 1992). Not only must children adapt to a new physical setting, but they must also adjust to new academic and normative expectations that are likely dissimilar and more demanding than their previous school. Weiss and Bearman (2007) also pointed out that differences in instructional organization—for example, switching to a period-based schedule—have been linked to lower levels of trust, greater emphasis on discipline on the part of teachers (Midgley & Edelin, 1998), and lower levels of connection and engagement for students (Eccles et al., 1991). These changes in schools' academic and normative climates require children to negotiate these changes while also simultaneously coping with an array of developmental changes they are experiencing.

Estimating the Effects of School Transitions

Much of the prior quantitative research on school transitions has used analytic techniques that rely on correlational analyses rather than randomized field experiments that are considered the gold standard for estimating causal effects (Shadish, Cook, & Campbell, 2002). Optimally, to determine whether school transitions affect students' achievement, it is an option to randomly assign students to make a transition to a new school (treatment) or to stay in the same school (control) following grade promotion, and then compare achievement outcomes. Because this is impractical, an alternative technique is to match students on a set of common characteristics and then statistically estimate the effect of either making or not making a transition. Using such a technique is especially important when examining the impact of school transitions on achievement because students who make a transition likely have background characteristics that are very different from those of students who do not. Therefore, in this study, propensity score matching techniques are employed (P. R. Rosenbaum, 2002; P. R. Rosenbaum & Rubin, 1983), which match students on a set of characteristics to estimate the effect of making a planned transition to a new school during the elementary years.

Summary Statement

Although the organization of the years of schooling into distinct units has been considered beneficial for students, the creation of separate structures requires that students make transitions between schools, which has generally been considered a negative occurrence. Therefore, a conflict exists between the supposed benefits of creating a distinct educational setting to meet the specific needs of children, on the one hand, and the supposed adverse consequences of school transitions, on the other (Weiss & Bearman, 2007). These transitions are thought to add to the stress children experience as a byproduct of their normal development, as well as the emphasis on task mastery and individual effort that accompanies the progression through the elementary grades.

Propensity score matching techniques allow this study to approximate an experiment whose purpose is to determine whether those students who experienced a planned transition to a destination school for Grade 5 would have had higher achievement had they not made a transition. In other words, if an experiment could be conducted in which students were randomly assigned to two groups (those who made a transition versus those who did not), would the achievement of students who made the transition differ significantly from those who did not? Based on previous research about school transitions and informed by cumulative stress theory, it was predicted that school transitions would be negatively associated with students' achievement in reading, mathematics, and science.

Method

Data Source and Variables

The data used to estimate these relationships are provided by the ECLS-K. Conducted by U.S. Department of Education and the Institute of Education Sciences, the ECLS-K focuses on children's early school experiences beginning with kindergarten and ending with Grade 8. ECLS-K is a multimethod and multisource study that includes interviews with parents, the collection of data from principals and teachers, and student records, as well as direct child assessments. Data were collected in the fall and the spring of kindergarten (1998–1999), the fall and spring of Grade 1 (1999–2000), the spring of Grade 3 (2002), the spring of Grade 5 (2004), and the spring of Grade 8 (2007). The data used in this study were drawn from Grades 5 and 6 collection waves, when most, but not all, students were in Grades 3 and 5.

Mathematics, reading, and science scores on Grade 5 ECLS-K direct cognitive assessments are used as outcome measures of children's achievement. These untimed, adaptive achievement tests were equated with item response theory scaling methods. These assessments maximized the accuracy of measurement that could be achieved in a limited amount of testing time while minimizing floor and ceiling effects by matching sets of test questions to initial estimates of students' achievement. The tests' specifications were derived from a variety of sources, including national and state performance standards in each domain. The scope and sequence of the materials from state assessments, as well as from major publishers were also considered. Though different types of scores were generated through these assessments, these analyses rely on standardized *t* scores ($M = 50.00$, $SD = 10.00$), which are appropriate for analyses that seek to illustrate the increase or decrease in gaps in achievement over time. Checks on the reliability and validity of all three assessments are reported in Tourangeau, Nord, Lê, Pollack, and Atkins-Burnett (2006).

The primary covariate-of-interest, transition, indicates whether a child transitioned to an assigned destination school for Grade 5 (1 = yes, 0 = no). Destination schools were schools for which it was determined before data collection that at least four ECLS-K children would move into them from a school that ended before a particular grade or a school that had closed. In the language of experimental design, those who experienced this transition are referred to as the treatment group (transition) and those who did not as the control group (nontransition). Transitions, of course, are different than transfers, as the latter result from reasons other than grade promotion.

The analyses are restricted to a subsample of students who meet three criteria. First, the sample is restricted to only those students with valid scores on all three achievement tests in the spring of Grade 5. Second, because achievement data from the previous round (spring of Grade 3) is employed in the analysis, only those students with a nonzero, nonmissing longitudinal weight are retained (ECLS-K source variable: C56CW0). Third, only those students with nonmissing values on the transition covariate are included.

Sample Description

Select descriptive statistics for the full analytic sample ($N = 11{,}028$) indicate that there are important systematic differences between those students who transition to a destination school for Grade 5 versus those who do not. For example, Table 1 shows that transition students have significantly higher spring Grade 3 mathematics and science scores. In addition, Hispanic and Asian students are significantly less likely to transition and the same goes for those students in the South and Midwest. Finally, students who transition are significantly more likely to attend a school where Grade 5 class has more than 100 students and live in a small town or rural area. These differences in background characteristics suggest that there are potential selection effects in these data and that an adjustment for selection effects should be conducted.

Analytic Procedure

One potential way to account for these selection effects is to conduct an experiment in which students are randomly assigned to transition (or not transition) to a destination

TABLE 1. Select Characteristics of Transition and Nontransition Students in Analytic Sample

	Transition	Nontransition	*t*
Grade 3 mathematics *t* score	52.20	51.29	2.23*
Grade 3 reading *t* score	51.82	51.78	0.11
Grade 3 science *t* score	53.15	51.45	4.05***
Socioeconomic status	0.07	0.00	2.10*
Race			
Black, not Hispanic	0.06	0.07	0.55
Hispanic	0.13	0.21	4.62***
Asian	0.02	0.08	5.45***
Other, not Hispanic	0.04	0.05	1.51
Region			
South	0.36	0.29	3.49***
Midwest	0.34	0.25	4.30***
West	0.06	0.27	11.70***
Urbanicity			
Suburban	0.41	0.43	0.86
Rural	0.40	0.24	8.01***
Grade 5 enrollment			
61–100 students	0.23	0.38	7.26***
> 100 students	0.60	0.34	12.73***
At or above grade level (1/0)	0.94	0.93	1.02
Food stamps last 12 months (1/0)	0.05	0.08	2.70***
Grade 5 school % free lunch	32.73	34.98	1.91
N	1,004	10,024	

Note. For sample means on the full list of covariates included in the analysis, see the Appendix. Reference categories for race, region, urbanicity, and Grade 5 enrollment are White non-Hispanic, Northeast, large or midsized city, and 0–60 students. *t* values are presented in absolute terms.
*$p < .05$ (two-tailed). **$p < .01$ (two-tailed). ***$p < .001$ (two-tailed).

school for Grade 5. In this way, the selection effects would be accounted for by random assignment, and the differences in achievement could be estimated for these two groups. However, it would obviously be quite difficult to conduct such an experiment. Because it is not possible to assume that school transitions would have the same effect on students with different characteristics, an alternative strategy is needed.

The use of propensity score matching methods is one of a small number of alternative strategies that address the issue of selection bias inherent to observational studies such as the ECLS-K. The use of propensity scores is predicated on the assumption that those students who make a transition and those who do not are similar on a set of observed characteristics can stand as valid counterfactuals for one another. Though propensity scores depend on the assumption that there are no omitted confounding variables (similar to standard multiple linear regression models) they do have three advantages (Reardon, Cheadle, & Robinson, 2008): (a) propensity scores do not rely on the model's functional form, (b) propensity scores estimate average treatment effects only for those students who have matches in the opposite condition, and (c) they facilitate treatment effect heterogeneity.

There is a number of different ways in which propensity scores can be used, including stratification on the propensity score, caliper matching on the propensity score, or nearest neighbor matching, among others (Abadie & Imbens, 2002). The choice among these options involves a trade-off between precision and bias (Reardon et al., 2008). For example, matching each student who made a transition to those many students who did not (as would be the case with stratification on the propensity score) would produce a large matched sample of students who did not make transition, leading to perhaps greater precision in treatment effect estimates, but do so at the potential risk of introducing more bias. This may occur because the more matches that are used, the less similar, on average, they may be to their counterparts who made a transition. Similar to Reardon et al. (2008), to balance this trade-off, these analyses employ a narrow caliper and match with replacement to ensure that each student who made a transition is either matched to one or more very similar nontransition students or is dropped from the estimation. The main advantage of using this narrow caliper approach is that it makes use of only as many comparison units as are available within the calipers, allowing for the use of extra (fewer) units when good matches are (not) available (Cochran & Rubin, 1973; Dehejia & Wahba, 1999).

The calculation and implementation of the propensity score estimator follows a series of five steps (Caliendo & Kopeinig, 2008). First, for each student in the full analytic sample, a predicted probability (the propensity score) for making a school transition is calculated. This is done by using the full set of covariates described in the Appendix and fitting a probit model that predicts whether a student makes a transition to an assigned destination school. These observed variables, related to children's demographic, social, and academic backgrounds, are considered predictors of a child's transition status; that is, these variables are likely related to a child's probability of assignment into a school structure that requires a transition between Grades 3 and 5. In addition, these pretreatment variables are not necessarily determinants of learning, although they can be considered as such (Morgan, 2001). Other variables, such as schools' Grade 5 enrollment, percentage of students eligible for free lunch, and percentage of minority students are also included in the propensity score estimator. The inclusion of these covariates follows the guidance offered by Sianesi (2004) and Smith and Todd (2005) to include only variables that simultaneously influence the treatment status and the outcome variables. It was the aim, however, to keep this model as parsimonious as possible, as overspecification can increase variance and make estimates unreliable.

The propensity score, $e(x_i)$, can be formally represented by the following equation (P. R. Rosenbaum & Rubin, 1983):

$$e\left(x_i\right) = pr\left(T = 1|x_i\right), \tag{1}$$

where $e(x_i)$ is the true predictive probability (between 0 and 1) that the ith student with characteristics x_i would be exposed to a transition, T.

Second, students are matched using these propensity scores. The caliper matching process described previously matched all students who made a transition to all those within one percentage point (on their propensity score) who did not. Matching was done with replacement, so that a student who did not make a transition may be used as a match for more than one student who did make a transition (10–1 matching with a .01 caliper and replacement).

Third, the balance of the matched samples is evaluated. This step checks the extent to which the matching has eliminated, or more likely reduced, the association between transition status and the observed covariates. This check is done two ways. The first is by fitting—for each covariate used in the calculation of the propensity score—a regression model that includes an indicator for students' transition status. This equation takes the following form:

$$X_i = \beta_o + \beta_1\left(T_i\right) + \varepsilon_i, \tag{2}$$

where T_{i} is an indicator for a student's transition status. The estimated coefficient, β_1, indicates the average difference in the covariate X between the matched samples. If the coefficient for this indicator is not significantly different than zero, this then indicates that there is no average posttreatment difference between the two groups on this covariate. This process is repeated for all covariates.

The second way in which balance is checked is through P. R. Rosenbaum and Rubin's (1985) formula for standardized bias, which should be less than 5% after the matching. This follows the suggestion of Imai, King, and Stuart (2008) and stands in contrast to the first approach in which balance is typically assessed by whether one fails to reject the null hypothesis that each $\beta_1 = 0$.

Standardized bias is a standardized version of the difference in means of a single covariate, X, for the transition and nontransition groups:

$$B = \frac{\left|\bar{X}_T - \bar{X}_C\right|}{\sqrt{\left(S_T^2 + S_C^2\right)/2}}, \tag{3}$$

where S^2 is the variance, and the subscripts T and C denote treatment (transition) and control (nontransition) groups. The standardized bias basically measures the difference in means between the treatment and control group in terms of the number of standard deviations it is away from zero. The standard deviation in the denominator is similar to an average of the standard deviation of the covariate in the treatment and control groups. When the variances are small, as is typically the case when observations are selected to be similar to one another, even a small difference in the covariate means can create a sizable standardized bias (Harding, 2003). It is recommended that overall balance—the average standardized bias across all covariates—should be less than 5% to proceed (P. R. Rosenbaum & Rubin, 1985).

Fourth, the transition effect on students' achievement in mathematics, reading, and science is estimated by calculating the average treatment effect for the treated (ATT). It is during this step where, once each transition student is matched with one or more nontransition students, the difference between the outcomes of the transition students and the outcomes of the matched control students is computed. Formally, this is represented as

$$\hat{Y}_i\left(0\right) = \sum_{j \in C(i)} T_{ij} Y_j^{obs}, \tag{4}$$

where $C(i)$ is the set of neighbors with $T = 0$ of the treated subject i and t_{ij} is the weight of nontreated j. The ATT is then computed by averaging across these differences:

$$ATT = \frac{1}{N^T} \sum_{i:T_i=1} \left[Y_i^{obs} - \hat{Y}_i\left(0\right)\right], \tag{5}$$

where N^T is the number of matched treated in the sample. A t value derived from the standard error of this difference indicates whether it is statistically significant.

Finally, a sensitivity analysis is performed to check the degree to which any omitted covariates may have affected the analyses. This step involves a series of procedures, including a recalculation of the propensity scores using a different set of covariates, a modification of the matching method, and rechecking balance. Once this is done, the estimated causal effects derived from these alternative specifications are compared to the original to identify whether and to what degree the results differ.

Results

Balance of the Matched Samples

The results begin by first describing the balance achieved by the propensity score matching models. Table 2 presents information on a select number of covariates in the matched samples (the complete list of variables used in the matching process can be found in the Appendix). Balance was checked two different ways. The first used a regression approach that fit each covariate used to calculate the propensity score and an indicator for whether a student made a transition (Equation 2). None of these coefficients were significantly different than zero, indicating that there is balance between the groups on each covariate in the matched samples.

Because the quality of the analyses hinges on the balance of the matched samples, balance was also verified using P. R. Rosenbaum and Rubin's (1985) formulae for standardized bias (Equation 3). Only four covariates had standardized bias values over 5%, with the highest being 8.5% on the small town or rural covariate. Overall, the average standardized bias was 2.22%, well under the recommended maximum value. Checking balance through these two different means provides evidence that the propensity score model has been correctly specified. Therefore, the matching model can be considered successful at capturing differences between transition and nontransition students in factors that may influence their Grade 5 achievement.

Effects on Fifth Grade Test Scores

Table 3 presents the estimated transition effects on students' Grade 5 achievement in mathematics, reading, and science. Contrary to what has been predicted, transitions are not significantly related to decreases in achievement between Grades 3 and 5 in any of the three subject areas. In fact, there is a significant positive ATT.

Specifically, in regards to mathematics and reading scores, students who transition are estimated to score 0.55 points less than those who do not transition. These nonsignificant differences contrast with a number of studies that have found school transitions to be associated with adverse cognitive impacts. However, few, if any, of these studies have focused specifically on transitions between Grades 3 and 5.

TABLE 2. Select Characteristics of Transition and Nontransition Students in Matched Sample

	Transition	Nontransition	% standardized bias
Grade 3 mathematics *t* score	51.83	51.82	0.00
Grade 3 reading *t* score	52.20	52.34	1.50
Grade 3 science *t* score	53.15	53.02	1.40
Socioeconomic status	0.07	0.10	3.10
Race			
Black, not Hispanic	0.06	0.07	4.60
Hispanic	0.13	0.15	5.50
Asian	0.02	0.02	0.30
Other, not Hispanic	0.04	0.04	0.20
Region			
South	0.36	0.36	1.00
Midwest	0.34	0.32	3.80
West	0.06	0.06	1.50
Urbanicity			
Suburban	0.41	0.43	3.80
Rural	0.40	0.36	8.50
Grade 5 enrollment			
61–100 students	0.23	0.22	3.6
>100 students	0.60	0.63	5.6
At or above grade level	0.94	0.95	2.5
Food stamps last 12 months	0.05	0.05	0.07
Grade 5 school % free lunch	32.72	33.31	2.40
Average standardized bias			2.22
N	5,137	590	

Note. The full list of covariates used to create the matched samples is noted in the Appendix. Reference categories for race, region, urbanicity, and Grade 5 enrollment are White non-Hispanic, Northeast, large or midsized city, and 0–60 students. See text for details on how the percentage of standardized bias is calculated.

TABLE 3. Estimated Effects of Transition on Grade 5 Mathematics, Reading, and Science Scores

	Mathematics	Reading	Science
Transition	51.64	52.02	53.68
Nontransition	52.18	52.57	52.80
Difference (*SE*)	−0.55 (0.44)	−0.55 (0.44)	0.89 (0.43)*
n (transition)	590	590	590
n (nontransition)	5,137	5,137	5,137

*$p < .05$.

Not only were there negligible differences in mathematics and reading, but there is a significant positive average treatment effect on science scores. Students who transition are estimated to score 0.89 points higher than those who did not transition. While this may seem trivial, it is slightly less than 0.10 standard deviation units (0.89/9.65, where 9.65 equals 1 standard deviation unit). This estimate should be considered in light of Rockoff and Lockwood's (2010) contradictory finding that student scores decrease 0.15 standard deviations in mathematics and English when they moved from elementary schools to middle schools. While such estimates may seem miniscule, they are similar to what one may expect from raising teacher effectiveness by one standard deviation (Rivkin, Hanushek, & Kain, 2005). Therefore, the significant positive impact of the transition on science scores cannot be considered minor or unimportant.

Sensitivity Analyses

However, this significant treatment estimate for science, as well as the nonsignificant estimates for mathematics and reading, is based on the conditional independence assumption (CIA), which states that the outcome is independent of the treatment. Therefore, it is important to check the sensitivity of this result with respect to differences from this identifying assumption. If, for example, there are unobserved variables that simultaneously affect assignment into treatment (transition) and the outcome variables, a hidden bias might arise to which matching estimators are not robust (P. R. Rosenbaum, 2002). The basic question is whether inference about the transition effect may be altered by unobserved factors; that is, variables that have been omitted for one reason or another from the calculation of the propensity score estimator. After specifying a series of alternative propensity score models and modifying matching methods, which yielded similar average treatment estimates, the CIA was verified through a set of simulations (described in Ichino, Mealli, & Nannicini. 2006). Each simulation includes an unobserved variable that was then used to re-estimate the propensity score and compute the matching estimate of the ATT. For each set of values of the sensitivity parameters, the matching estimation is repeated many times to obtain an estimate of the ATT, which is an average of the ATTs over the distribution of an unobserved variable. These simulations, using a number of unobserved confounds that have been differentially calibrated, produced estimates that support the robustness of the original matching estimator. Therefore, it is unlikely that the CIA has been violated.

Discussion

This study extends previous studies by examining the relationship between school transitions at a specific point during the elementary years and children's achievement. While most research in this general area has focused on the transitions into and out of middle school, or out of high school and into work or college, this study focused on the planned transitions children experience between Grades 3 and 5. This focus is important, as districts reconfigure school forms in ways that deviate from the traditional K–5 model and possibly require that children move between schools at an earlier point in their educational lives.

Perhaps the most striking finding is that there is no evidence that the transition to a Grade 5 destination school has a negative effect on mathematics, reading, or science achievement. If anything, the transition is associated with a significant positive effect on science achievement. These results are somewhat incongruent with what is known about school transitions. How can these results be reconciled with what cumulative stress theory suggests about the supposed adverse effects of school transitions?

There are two possible interrelated explanations. The first is an extension of the developmental perspective, which suggests that fifth-grade students may actually benefit from being separated from their younger peers. Fifth-grade students, likely around 11 years old, are moving out of middle childhood and into early adolescence. This life course transition is marked by a number of important developmental changes. Most noteworthy are the changes associated with children's cognition, including a steady increase in the sophistication of information-processing and learning skills and an ability to apply new knowledge in different situations (Eccles, 1999). Of course, these same changes would occur without the transition to a destination school for Grade 5, which suggest that the effects of these changes are conditioned by the school environment to which one has transitioned.

Therefore, the transition to an assigned destination school for Grade 5 is likely coupled with a set of environmental factors that may explain the increase in science test scores. These environmental factors include a departmentalized curriculum that it taught by subject-specific teachers, a focus on academic content, and higher performance standards (Eccles, 1999). These factors may better suit children whose cognitive capacities are rapidly expanding as they engage in school-specific subject matter. In addition, transitioning to a new school at this point in their development may signal to themselves and others that they are becoming adolescents who are increasingly more responsible and deserve greater adult respect. This, in turn, shapes how others, particularly teachers and other nonkin adults, relate to them. However, both sets of explanations are speculative attempts to figure out what is driving the increase in science achievement for the transition students.

As highlighted by Burkam, Michaels, and Lee (2007), most research on student achievement has tended to focus on individual student characteristics and has given short shrift to modifiable structural and contextual influences, such as the planned transitions that students make as part of their K–12 schooling experience. The research on school transitions that does exist has largely investigated the transitions into and out of middle schools (Rockoff & Lockwood, 2010; Weiss & Kipnes, 2006) and has often employed qualitative methods (e.g., Hough, 2005) or cross sectional analyses of observational data (e.g., Espinoza & Juvonen, 2011). For these reasons, the quantitative modeling strategy employed in this research offers a critical methodological perspective on the estimated causal impact of school transitions on achievement across the elementary years.

One of the strengths of this propensity score matching approach is that it considers the relation between school transitions and student learning by controlling selection effects. However, one important limitation to this analysis is that it does not pinpoint the specific mechanisms through which school transitions influence science learning (what Heckman and Smith, 1995, referred to as the black-box). In Holland's (1986) terminology, this study has been able to estimate the effects of causes, but has done little to shed light on the causes of effects. More research is needed to identify the specific school- and classroom-level mechanisms that are likely responsible for the positive relationship between school transitions and students' Grade 5 science achievement. Fortunately, ECLS-K provides some of this school- and classroom-level information and future researchers should move in this direction.

While the analyses reported here have a moderate-to-strong degree of internal validity, they should not be the sole means of influencing any policy intervention. Therefore, these results should be interpreted along with other similar studies. Moreover, despite the strengths of the design and analytical procedure, caution must be exercised in interpreting any significant effect as causal; it is through the accumulation of similar estimates from studies with varying data and alternative plausible methodologies that a conclusion that estimated effects are indeed causal becomes justified.

These limitations not withstanding, there are three implications of this work. First, this study refocuses attention on an underappreciated aspect of school organization. It is interesting to note that one of the most modifiable school-level factors is also one whose research base is relatively sparse (Rockoff & Lockwood, 2010). Schools' grade spans (e.g., Grades K–2, 3–5) and the transitions they necessitate are factors that are malleable to policy preferences. Therefore, this research should encourage policymakers and other stakeholders to focus more intently on the (un)intended consequences of how they organize schools for children during a turbulent and developmentally uneven stage in their life course.

Second, this study also highlights the importance and strengths of propensity score matching methods. While researchers would obviously prefer randomized designs through which causal effects could be directly estimated, the fact is most educational research is based on observational data. The primary limitation of observational data such as those provided by the ECLS-K is that students are not randomly assigned to different conditions—those who make a transition versus those who do not. Consequently, researchers rely on a variety of statistical means to approximate randomization. The technique employed in this study—propensity score matching—provides an appropriate way to model observational data in ways that control for observed variables. Used primarily in microeconometrics, this technique is one of a small number of methodologies through which causal effects can (at best) be inferred from observational data such as ECLS-K (for a review of others, see Schneider, Carnoy, Kilpatrick, Schmidt, & Shavelson, 2007).

Third, drawing from cumulative stress theory, this study encourages stakeholders to appreciate the developmental, academic, and social challenges inherent to modern childhood and the ways in which school organization can either magnify or attenuate these influences. Despite popular perceptions of childhood being a seamless developmental stage, researchers have noted the rapid, uneven, and discontinuous changes that children undergo between Grades 3 and 5, including an increased ability to think abstractly and act rationally, which are not always smoothly negotiated (Annevirta & Vauras, 2006). As children experience these changes, it is contingent on the schools they attend to minimize other possible sources of stress in children's lives. However, these results indicate that transitions in and of themselves are not always harmful (Augst & Akos, 2009). Furthermore, these results encourage researchers and policymakers to focus more intently on factors related to classroom-level curriculum and instruction, which are the mechanisms most likely responsible for the transition students' increase in science achievement.

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APPENDIX
Means and Standard Deviations of Variables Used in the Analysis

	ECLS-K source variable	M	*SD*
Transition	R6DEST	0.09	0.29
Achievement test scores			
Grade 3 mathematics *t* score	C5R4MTSC	50.76	9.80
Grade 3 reading *t* score	C5R4RTSC	50.79	9.80
Grade 3 science *t* score	C5R2STSC	50.67	9.91
Grade 5 mathematics *t* score	C6R4MTSC	51.23	9.61
Grade 5 reading *t* score	C6R4RTSC	51.14	9.63
Grade 5 science *t* score	C6R2STSC	51.15	9.65
Family background characteristics			
Mother's education			
Less than high school	W5MOMED	0.10	0.30
High school diploma	W5MOMED	0.25	0.43
Vo/tech	W5MOMED	0.05	0.23
Some college	W5MOMED	0.30	0.46
Bachelor's degree or higher	W5MOMED	0.30	0.46
Father's education			
Less than high school	W5DADED	0.12	0.32
High school diploma	W5DADED	0.26	0.44
Vo/tech	W5DADED	0.05	0.23
Some college	W5DADED	0.22	0.42
Bachelor's degree or higher	W5DADED	0.34	0.47
SES	W5SESL	0.00	0.81
Received food stamps last 12 months	P6FSTAMP	0.11	0.32
Demographic characteristics			
Race			
White	RACE	0.56	0.50
Black, not Hispanic	RACE	0.15	0.36
Hispanic	RACE	0.18	0.38
Asian	RACE	0.06	0.24
Other, not Hispanic	RACE	0.05	0.22
Male	GENDER	0.51	0.50
At or above expected grade level	T6GLVL	0.90	0.29
Age			
110–125 months	R6AGE	0.01	0.11
126–131 months	R6AGE	0.29	0.46
132–137 months	R6AGE	0.46	0.50
138–143 months	R6AGE	0.21	0.41
144–166 months	R6AGE	0.02	0.15
Region			
Northeast	R6REGION	0.19	0.39
South	R6REGION	0.26	0.44
Midwest	R6REGION	0.32	0.47
West	R6REGION	0.23	0.42
Urbanicity			
Urban	R6URBAN	0.37	0.48
Suburban	R6URBAN	0.39	0.49
Rural	R6URBAN	0.24	0.43
School characteristics			
Percent free lunch	S6FLCH_I	0.39	28.44
Percent minority			
Less than 10%	S6MINOR	0.31	0.46
10%–24%	S6MINOR	0.17	0.38
25%–49%	S6MINOR	0.17	0.38
50%–74%	S6MINOR	0.10	0.30
75% or more	S6MINOR	0.25	0.43
Total Grade 5 school enrollment			
0–60 students	S6ENRL5	0.37	0.48
61–100 students	S6ENRL5	0.33	0.49
101 or more students	S6ENRL5	0.31	0.46

Note. $N = 11{,}028$. Descriptive statistics are unweighted. ECLS-K = Early Childhood Longitudinal Study–Kindergarten.