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ABSTRACT

This paper explores how high schools, through their structures and organizations, may influence their students' decisions about whether to stay in school until graduation or drop out. Traditional explanations for dropout behavior have focused on individual students' social background and academic behaviors. What high schools do to push out or hold onto their student has been systematically ignored. Using a sample of 3,840 students in 190 urban and suburban high schools from the High School Effectiveness Supplement (HSES) of the NELS:88 study, researchers used hierarchical linear-modeling methods to examine school effects on dropping out, once students' academic and social background had been taken into account. Findings center on three features of secondary schools: curriculum, school size, and social relations. In schools whose curricula are composed mainly of academic courses, with few nonacademic courses, students are less likely to drop out. Similarly, students in schools enrolling fewer than 1,500 students more often stay in school until graduation. Most importantly, students are less likely to drop out of high schools where relationships between teachers and students are consistently positive. The impact of positive teacher-student relations, however, is contingent upon the organizational and structural characteristics of high schools. (Contains 39 references.) (Author/RJM)

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Dropping Out of High School:

The Role of School Organization and Structure

Valerie E. Lee and David T. Burkam

University of Michigan

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Abstract

In this study, we explore how high schools, through their structures and organizations, may influence their students' decisions about whether to stay in school until graduation or drop out. Traditional explanations for dropout behavior have focused on individual students' social background and academic behaviors. What high schools might do to push out or hold in their students have been systematically ignored. Using a sample of 3,840 students in 190 urban and suburban high schools from the High School Effectiveness Supplement (HSES) of the NELS:88 study, we use hierarchical linear modeling (HLM) methods to explore school effects on dropping out, once students' academic and social background has been taken into account. Our findings center on three features of secondary schools: curriculum, school size, and social relations. In schools whose curricula are composed mainly of academic courses, with few non-academic courses, students are less likely to drop out. Similarly, students in schools enrolling fewer than 1,500 students more often stay in school until graduation. Most important, students are less likely to drop out of high schools where relationships between teachers and students are consistently positive. The impact of positive teacher-student relations, however, is contingent upon the organizational and structural characteristics of high schools.

Introduction

Who should be held responsible when a student drops out of high school? Although there is much agreement among policymakers, researchers, and educators that adolescents should remain in high school until graduation, many young people leave before they complete high school. Because opinions about the socially detrimental effect of this educational phenomenon are almost universal, there is much interest in (a) explaining why students drop out of high school, (b) attributing blame for this loss to our nation's stock of human capital, and (c) developing social policies that will keep students in school.

The most common explanations for dropping out focus on the *personal characteristics of individual students.* The list of potential risk factors associated with dropout behavior is long and quite consistent across a myriad of studies. Research that focuses on identifying these explanatory factors is often organized around comparisons of students who do and do not drop out. Such research typically highlights risk factors, which usually are grouped into three categories: (1) *social background* (e.g., race/ethnicity, gender, socioeconomic status [SES], family structure, inner-city residence); (2) *academic background* (e.g., ability, test scores, grade-repeating history) and (3) *academically related behaviors* (e.g., engagement with school, school grades, course completions and failures, truancy, school disciplinary encounters). By framing explanations in this way, leaving school before graduation is seen as a bad decision that individual students make, often based on a pattern of low commitment to school and behaviors that lead to school failure. Students characterized by several of these factors are often seen as being "at high risk of dropping out."

Much less common than individual explanatory factors for students leaving school before graduation are explanations that focus on the *schools* these students attend. Although the comparative perspective mentioned above might take into account such demographic characteristics of high schools as aggregate characteristics of individual students (e.g., minority enrollment, average SES, and average achievement), such school factors would simply be seen as characterizing "at-risk high schools." Frequently absent from this list are school characteristics over which schools themselves, or individuals within the schools, have some control (e.g., the governance structures).

In this paper, we focus on the school side of the explanatory equation. In particular, we focus on characteristics of schools that may be influenced by policy interventions, above and beyond their

demographic makeup. Our focus is on three foundational elements of how high schools are organized: (1) *structure* (in particular, school size and sector); (2) *academic organization* (focusing on the curricula they offer); and (3) *social organization* (focusing on relationships between students and teachers). Our rationale for this focus centers on our belief that high schools, through their organizations, may either force out or hold in students whose personal characteristics would put them at risk of dropping out before they graduate.

Our research makes use of nationally representative samples of students and schools drawn from the High School Effectiveness Supplement (HSES) to the National Educational Longitudinal Study of 1988 (NELS:88). All students in our sample were in high school at the end of their sophomore year (in 1990), but some had left high school by the time they would have been seniors (in 1992). We use longitudinal data on 3,840 students, drawn from achievement test scores, high-school transcripts, and surveys collected in 1990 and 1992. Because information about students' school behaviors, performance, and achievement are measured more precisely in the HSES study in mathematics, we focus on this area of the curriculum to capture students' academic background and schools' curriculum structure.

Information about the 190 high schools these students attended was drawn from descriptive data about schools supplied in surveys of their principals, as well as from aggregate information from students. The high schools were located in the 30 largest metropolitan areas in the U.S. We limited our analysis to students attending public, Catholic, and independent schools that were part of the HSES and NELS samples. Because our analyses are multilevel in nature, we make use of the hierarchical linear modeling (HLM) methodology. The outcome variable on which we focus is whether students dropped out of high schools between 10th and 12th grades.

Background

Because students' experiences with, and progress in, schools play such an important role in their transition from childhood to adulthood, leaving school is particularly harmful for adolescents' life chances. This interruption cuts off those who leave school before graduation from potentially valuable information, developmental opportunities, and personal assistance. Although the dropout rate has declined substantially since the early 1940s (Rumberger 1987), the loss of students from the nation's high schools is still unacceptably high. Current estimates of the proportion of

adolescents who do not finish high school vary widely (from 7 to 16 percent), depending on how the rate is calculated (Rumberger 1987; Ekstrom, Goertz, Pollock, & Rock 1986; Kaufman, McMillen & Sweet 1996; National Center for Education Statistics [NCES] 1992). Dropout rates in urban areas are much higher; one-third of entering 9th graders in large cities fail to complete high school (Council of Great City Schools 1994).

The Individual Perspective on Dropping Out

Social risk factors. The construct of risk, a characteristic of individuals, is common in studies of school dropouts (Natriello McDill, & Pallas 1990; Pallas 1989). Authors often divide this construct into two categories: academic and social risk. Social risk includes demographic factors associated with a higher likelihood of school difficulties: race, age, language-minority status, gender, family income, parents' education, and family structure. Students who are members of racial and ethnic minority groups drop out at higher rates than white students, as do those from low-income families, from single-parent households, and from families in which one or both parents did not complete high school (Rumberger 1987; Natriello et al. 1990).

There is a difference between the exact moment when students leave school and the process of disengaging from school that often begins well before they arrive at the moment when they leave school. Some scholars suggest that the cumulative process of school disengagement may begin as early as the first grade (Entwistle, Alexander, & Olson 1997). However, most dropouts actually leave school sometime between the 10th and 12th grades (Frase 1989), in part because the legal age for school leaving is 16 in most states. Besides the cumulative nature of the school disengagement process, social risk factors themselves are seen as cumulative. That is, a student characterized by more of these factors is at a statistically greater risk of dropping out.

Academic risk factors. Academic risk, which refers to students' school behavior and performance, reflects the actual manifestation of school-related problems (Caterall 1998). For example, students who eventually drop out often have a history of absenteeism and grade retention (Lee & Burkam, 1992), academic trouble (Bryk & Thum, 1989), and more general disengagement from school life (Entwisle et al. 1997; Finn 1989; McNeal 1995). Leaving school may actually represent some students' final attempt to "resolve" such problems (Croninger & Lee, in press; Fine 1986). Even young children may be at academic risk of eventually dropping out if they manifest such early school behaviors as low grades, low educational expectations, special education

placement, early grade retention, and discipline problems (Alexander, Entwisle, & Horsey 1997). As is the case with social risk, academic risk factors are also cumulative.

Characteristics of individuals that define their academic and social risk are correlated; students at high social risk are more likely to manifest at-risk academic behaviors. Despite their statistical association, we suggest that these two sorts of risk factors are conceptually quite separate. Students and schools have very little control over factors that constitute social risk (SES, race/ethnicity, gender, family circumstances), whereas such academic risk factors as absenteeism, retention, special education placement, and low performance are amenable to personal and school interventions. Both social and academic risk factors defining individuals are also linked to the characteristics of schools that are associated with students dropping out.

The School Perspective on Dropping Out

Schools can push students out. Some interesting extant research has rejected the more common focus on individuals' risk of dropping out, turning away from the "blame the victim for the problem" orientation of research that highlights risk factors. Instead, these studies explore school factors that are associated with dropping out. Several qualitative or interpretative studies have considered how schools themselves engage in practices or create conditions that push certain types of students out of school, especially those who exhibit the social and academic risk factors discussed above (Delgado-Gaitan 1988; Fine 1991; Wehlage, Rutter, Smith, Lesko, & Fernandez 1989). These studies go well beyond the well-documented findings that dropout rates vary widely between high schools (Pallas 1986) and between student populations within high schools (Rumberger 1987). Large comprehensive high schools, especially in urban areas, report the highest dropout rates (Bryk & Thum, 1989), even exceeding half of 9th grade cohorts in some urban high schools (CGCS 1994).

Rumberger studies. A series of recent quantitative studies by Russell Rumberger and his colleagues that use longitudinal data from NELS:88, complex multivariate models, and multilevel analysis methods provide an important grounding for the current study. Rumberger's (1995) study was unusual, with its focus on early dropout behavior (between 8th and 10th grades) and the middle-school characteristics associated with the behavior. In middle schools with lower-SES compositions, dropout rates were related to school demographic composition (higher minority and poverty concentrations), school structure (larger schools, more students per teacher), and school

organization and climate (more homework and fairer discipline). In terms of SES differentiation in dropping out, he found that high-poverty and large schools were more differentiating environments, as were middle schools with K-8 grade spans and higher teacher/student ratios.

Another study was retrospective, in that it explored the individual and school factors associated with students not completing high school two years after their cohort had graduated (Rumberger & Larson, 1998). Most findings here focused on individuals' academic and social risk factors. One result, virtually absent from other studies on this topic, concerned mobility. Students who dropped out were considerably more likely to have changed schools, before or during high school, and sometimes more than once. Beyond the usual social risk factors associated with dropping out (minority status, single-parent family status, and low SES), the authors also identified academic risk factors (low expectations, grade retention, high absenteeism, and low school performance). Surprisingly, school factors were generally unrelated to dropping out in these complex models. The authors also investigated the factors associated with the dropouts having obtained a GED in the two years after they left school.

A third quantitative study used the HSES, which included augmented samples of students in a subset of NELS schools located in urban and suburban areas (the HSES) -- the same data used in this study (Rumberger & Thomas, 2000). Here the authors explored both dropout and turnover rates in urban and suburban high schools. They reported higher dropout rates in public (compared to Catholic and other private schools), in urban schools, and in larger schools. Findings about school resources were noteworthy: dropout rates were lower in schools with more excellent teachers (reported by students) and with lower student/teacher ratios. Unsurprisingly, dropout rates were higher in schools with low attendance and with more students who had been retained before high school.

Transferring and dropping out. Students who leave their high schools can either transfer to another school (and thus stay in school) or leave school altogether. Two studies examined these alternatives to staying in high school. Rumberger and Thomas (2000) used multilevel methods and the HSES data. Some school factors were associated with both higher dropout and school transfer rates (higher proportions of retained students, lower quality teachers), and some factors were related to higher transfer but not dropout rates (high minority enrollment, lower teacher salaries). It was interesting that non-Catholic private (compared to public) schools had lower dropout rates but higher transfer rates.

Lee and Burkam (1992) also conceptualized school transfer as an alternative to dropping out, and considered demographic, family, and school factors associated with either staying in school, transferring, or dropping out. Using data from High School and Beyond (HS&B), they explored separate but identical multinomial logistic models in public and Catholic schools. Black and Hispanic students were more likely to transfer in both sectors, as were students from larger families and those engaging in more at-risk academic behaviors. In both sectors, being overage (undoubtedly reflecting a history of school retention) and being in a stepfamily were associated with dropping out. Although the factors linked to transferring and dropping out (both compared to staying in the same school) were quite similar in public schools, they were dissimilar in Catholic schools. The authors concluded that transferring schools (probably to a public school) represented a viable alternative to dropping out for disaffected students in Catholic schools, whereas this option was a less viable alternative for public school students. They suggested that low dropout rates in Catholic school might be explained by the fact that such students have the "drop down" alternative.

The School Perspective on Other Outcomes

School social organization. We characterize the schools in this study along three dimensions: social organization, academic organization, and school structure. In this section we discuss the social organization of schools. Although the construct is known by different names (e.g., teacher/ student relationships, social capital, social support, personalism, and communal relationships), the ideas behind them are quite similar. Both qualitative and quantitative studies suggest that students who leave high school before graduating often cite lack of social support as one reason for doing so. Students who are disaffected from school report being unconnected with teachers, even after having made efforts to gain assistance from school personnel (Croninger & Lee, in press). Unengaged students claim that teachers don't care about them, are not interested in how well they do in school, and are not willing to help them with problems (Fine 1986; Lee, Ready, & Ross, 1999; MacLeod 1987). Interviews with dropouts as they left school revealed that half said they were quitting because they didn't get along with teachers or other students (Caterall 1998).

Qualitative studies have also shown that positive social relationships can create powerful incentives for students to come to school, even those who report that school work is difficult and expectations are hard to meet (Fine, 1991; LeCompte & Dworkin 1991; Lee et al., 1999; Wehlage et al., 1989). Two recent quantitative studies provide evidence for the importance of social contact.

One showed that social capital (measured as relationships between students and teachers and whether teachers reported talking with students outside of class) was strongly related to dropping out, even after taking students' social and academic risk factors into account (Croninger & Lee in press). Another study focused on one-year achievement gains for middle-grade students in Chicago (Lee & Smith, 1999). Although students' reports of social support from teachers, parents, peers, and neighborhood were positively but modestly related to learning, the effect of support on learning was contingent on the school's academic press. Students with strong social support who attended schools with low academic press learned almost nothing, whereas students who reported considerable support from these sources learned quite a lot if they also attended schools where they were pushed academically.

Several studies have defined social support as an aggregate feature of schools' social organization. Examples of this work are represented in the comparisons made by Bryk, Lee, and Holland (1993) between Catholic and public schools. Communal school organization, which is how social capital was defined in that research, was a major factor explaining away the considerable differences between Catholic and public schools in students' academic engagement and teachers' commitment. That book provides consider-able conceptualization of the notion of communal school organization, as well as both qualitative and quantitative empirical evidence to supports its saliency in school life.

School academic organization. Although this construct also includes schools' tracking structure, here we restrict our discussion to the structure of the high-school curriculum. A growing both of research demonstrates that students learn more, and learning is distributed more equitably, in schools with a constrained curriculum, consisting largely of academic courses and with few low-level courses. In such "constrained curriculum" schools, students typically are required to complete many of these courses to graduate. Most studies on this topic have focused on the curriculum in mathematics. The "constrained curriculum" structure represents a major explanatory factor for why students learn more, and why learning is more equitably distributed, in Catholic than public schools (Bryk et al., 1993; Lee & Bryk, 1989).

A recent study has shown similar positive effects (i.e., higher and more equitably distributed learning) for such a curriculum structure in public high schools as well (Lee, Burkam, Chow-Hoy, Smerdon, & Geverdt, 1998). Another study showed stronger curriculum structure effects in Catholic, compared to both elite private and public schools, in how far students get in the

mathematics curriculum. Moreover, Catholic schools also demonstrated more social equity than students in schools in the other two sectors in this regard, in that their students' progress in the math curriculum was less dependent on students' mathematical ability (Lee, Chow-Hoy, Burkam, Geverdt, & Smerdon (1998). However, these studies that estimated curriculum structure effects centered entirely on achievement outcomes. Whether there are curriculum structure effects on students' dropout behavior is heretofore virtually uninvestigated.

School structure. Beyond schools' demographic compositions and organizational properties, they are characterized by their structural features: enrollment size, school sector, and urban location. Although many studies have shown that dropout rates are higher in urban schools, the high proportions of minority and low-SES students attending such schools probably explain this. Some studies cited above have investigated sector differences in dropout and transfer behavior, demonstrating that dropout rates are lower in Catholic than public schools (Bryk et al., 1993; Lee & Burkam, 1992; Rumberger & Thomas, 2000), after taking account of demographic and academic features of students attending each type of school.

An important aspect of school structure in this study is school size. Rumberger and Thomas (2000) demonstrated that the structural features mentioned here—sector, urbanicity, and size—are all related to dropping out. Once school demographic composition, resources, and attendance are accounted for (as well as many measures of social and academic risk of students), dropout rates were higher in urban schools, in private schools, and in large schools. Although size was not a factor for dropping out in the Rumberger and Larson (1998) study, Rumberger's (1995) study showed that students left high school during their first two years if they had attended larger middle schools.

Several studies by Lee and her colleagues have shown the importance of school size on student outcomes. A review of the effects of school size on students' well being also explores how size influences other organizational properties of schools (Lee, 1999). A multilevel study focusing on school size and achievement gains by Lee and Smith (1997) demonstrated that students learned more, and learning was more equitably distributed by student SES, in high schools that enrolled 600-900 students (i.e., small but not too small). Although the same size range was effective in schools with different social and racial/ethnic compositions, size influenced learning more strongly in low-SES schools. Another recent multilevel study of school size focused on middle-grade students in Chicago (Lee & Loeb, 2000). Again, smaller schools (in this case, K-8 schools with 400

or fewer students) were more favorable educational environments, not just for students' learning in mathematics and reading, but also on teachers' attitudes toward their students. Specifically, teachers in smaller schools took more personal responsibility for their students' learning than in larger schools. The authors concluded that size has both a direct and an indirect effect on learning, by influencing teachers' attitudes that are also associated with more learning.

Summary. Although the major focus of research about students dropping out of high schools focuses on students' social and academic risk factors, there is a growing interest in how schools influence these behaviors. Specifically, how schools are organized in terms of social relations among school members has been shown to influence students' engagement with school and also the ultimate act of disengagement: dropping out. Although a growing body of research demonstrates the importance of how schools structure their curricula, all of this research investigates curriculum structure effects on student learning. The small but growing body of research that focuses on schools influence students' decision to drop out has suggested that school structure—urbanicity, sector, and size—may influence this important decision. This research is meant to build on, and expand, the small but growing body of research that focuses on how the organization and structure of high schools links to students' decisions to drop out.

Research Focus

Research Questions

We organize our investigation around three related research questions. Our investigation is focused on students dropping out during their last two years of high school, but we suggest that the questions and the conceptual model that drives our investigation of the questions is relevant to students who drop out before this time. The particular relevance of this study, which focuses on school factors that influence students' decisions to drop out, is perhaps more relevant for students who have been in high school for at least two years. That is to say, these students know their high schools well by the time the decision to leave has been made, and they have accumulated an academic record on which they (and schools) may rely.

Question 1: Student background and dropping out. Although our primary focus is not on the characteristics of students who do and do not drop out of high school between 10th and 12th grade, it is important to identify these factors. Here, we focus on students' social

and academic background. We ask, "*Within the students' high schools, which background factors are associated with the decision to drop out?*"

Question 2: School organization and dropping out. Here we focus on characteristics of the high schools students attend that are associated with their decision to drop out or stay in school. The influence of relevant school organizational factors is estimated after students' individual characteristics are taken into account. We ask, *"What features of high schools' structure, curriculum, and social organization are associated with dropping out, once personal background and school demographics are accounted for?"*

Question 3: The contingent nature of organizational factors associated with dropping out. The analyses that address Research Question 2 assume that school factors associated with dropping out are either unrelated to one another, or that that these influences are independent of one another. Here we explore interactions among school structure, curriculum, and social organization. Here we ask, *"Is the influence of school social organization on dropout decisions contingent on school structure, and if so, what is the nature of these contingencies?"*

Conceptual Model

A school effects study. Our analyses to address these three research questions are organized around a conceptual model, displayed in Figure 1. Both the model and the questions fall within a type of inquiry called "school effects research." Studies of this type investigate how characteristics of schools (in this case, structure and organization) influence school members' attitudes and behaviors (in this case, the decision to drop out or stay in school). Because we investigate school effects on students, we formulate a multilevel model wherein students are "nested" in schools. School organization, the central construct in this study, is located squarely in the middle of our heuristic model. The major outcome, whether or not students drop out, is located at the right. We underscore the importance of these two constructs to our research by the heavy lines around the boxes that represent these constructs.

Insert Figure 1 about here

Student background. The boxes at the left of the model characterize two types of important background characteristics related to dropping out of high school. Under the heading of *social background,* we include students' gender, their race/ethnicity, and their family SES). Under the heading of academic *background*, we investigate whether students are overage for their grade (which would suggest they had repeated a grade earlier in school), their coursetaking behavior in

mathematics in the first two years of high school, their achievement in mathematics at 10th grade (a proxy for their mathematical ability at that point), and their GPA in mathematics in the first two years of high school (which captures their school performance and effort in this subject). We expect that academic and social background characteristics are related to one another, a set of relationships captured by the double-headed Arrow A. Our multilevel analyses investigate the direct relationship of both background constructs on dropping out, captured by Arrows D and E. However, our multilevel analyses also take into account how student background is associated with school organization, mostly through a series of statistical controls (captured by Arrows B and C).

School organization. Three major constructs characterize school organization in our conceptual model: *structure*, *academic organization*, and *social organization*. School structure we capture with two measures: school size (small, medium, large, and very large) and school sector (whether the school is public, Catholic, or an elite private school – we call the latter "independent" schools). We also operationalize the construct of the high school academic organization in two ways: by the number of mathematics courses offered that are basic or remedial (i.e., below the level of beginning Algebra) and by whether or not the school offers Calculus. School social organization is captured by student reports of their relationships with teachers. The direct association between school organization and dropping out of school is captured, in our conceptual model, by Arrow G. Because dropping out is hypothesized to be influenced by students' academic background, in our analyses we investigate whether this relationship (specifically the relationship between dropping out and school performance) varies systematically between schools. If it does, then we explore whether school organizational factors are related to this relationship, which is captured on our conceptual model by Arrow F.

In recognition of the multilevel nature of our research questions, the constructs illustrated in Figure 1 are measured at two levels. Both sets of background measures, and the outcome, are measured on *individual students*, which are represented on our conceptual model in striped boxes. School organization is, of course, measured on *schools*, illustrated in Figure 1 in a gray box. The major relationships in this model, the ones that drive this study, are captured in Arrows F and G.

Method

Sample and Data

The data used in this study come from the High School Effectiveness Study, which is a supplementary data collection to NELS:88 (Scott, Ingels, Sehra, Taylor, & Jergovic, 1996). The original design for NELS:88 selected about 25 8th-grade students in each of 1,000 middle-grade schools in 1988 (i.e., in schools that had 8th grades in them). These students were surveyed and tested two years later, in whatever high schools they had moved to. Because the National Center for Education Statistics (NCES), which designed NELS:88, recognized that students did not necessarily move from middle-grade to high schools in blocks, the within-school sample sizes of original NELS students in high school (specifically, at 10th grade) were relatively small. In order to facilitate research designed to explore school effects (such as this study), NCES selected a sub-sample of high schools where the original NELS:88 students were enrolled in which to collect more data on additional students. Focusing on the 30 largest metropolitan areas, they selected high schools in urban and suburban areas (i.e., rural schools were eliminated) which enrolled at least 5 original NELS:88 students. In those high schools, the 10th grade student sample was augmented. Most of the original NELS:88 students, as well as the augmented sample, completed the NELS:88 achievement tests and surveys in the spring of both their 10th and 12th grade years.

The sample we use for this study includes 190 schools and 3,840 students (with an average of 20.2 students/school). Students were selected who had data on race/ethnicity, gender, and SES at 10th grade, as well as test-scores, transcript information, and dropout status. All schools in our sample had data on the constructs of interest to this study, specifically school size, school sector, information about the curriculum, and demographic composition. An additional advantage of using HSES (compared to the smaller NELS:88 sample of students) is that all schools in the HSES sample were given school weights by NCES. Because the original sampling design involved considerable oversampling of particular schools (especially private schools and schools with high minority enrollments), the use of school-level design weights is required. Lee et al. (1998) provide considerable detail about the HSES sample, as well as the results of imposing sampling restrictions similar to those described here.

Measures

Student measures. Our outcome variable is a dichotomous measure of whether the student dropped out of school between 10th and 12th grade. That is, all students were in the original HSES sample of in-school students at the 10th grade, and some were also reported as having dropped out by the end of 12th grade, when other in-school students were surveyed and tested. Students who transferred to another high school or graduated early were not included in our sample.

Students' demographic background was captured by several measures: gender (female = 1, male = 0), race/ethnicity (a series of dummy variables that captured whether the student was Asian, Hispanic, or Black, with the uncoded category for white students), and SES (a z-score, with mean [M] = 0, standard deviation [SD]= 1). *Students' academic background* was captured by a dummy variable for whether the student was old for his/her grade (coded 1) or not (coded 0), by another dummy variable for whether the student had taken no academic (Algebra I or higher) mathematics courses by the end of 10th grade (coded 1) or not (coded 0), by the student's score on a standardized mathematics test administered at the end of 10th grade, and by the student's grade point average (GPA) in mathematics courses in the first two years of high school, taken from his or her transcript. More detail about the construction and coding of all variables used in this study are available in the Appendix.

School measures. We captured *school demographic composition* with several measures: school average SES, high-minority enrollment (which we converted to a dummy variable because of its bimodal distribution), average achievement, and average 9th-grade GPA. The latter measures captured the academic composition of the school as the sampled students began high school. *School structure* was captured by a series of dummy variables. We divided school size into four categories (small = 600 or less; medium = 601-1,500; large = 1,501-2500; very large = over 2,500 students). In our analyses, small, large, and very large schools were treated as dummy variables (coded 1), each of which was compared to the medium schools (coded 0). School sector was captured by two dummy variables capturing Catholic and independent schools (each coded 1), compared to public schools (coded 0). Independent schools are elite private schools that are members of the National Association of Independent Schools. Other small private schools, some of which had religious sponsorship, were dropped from our analyses because their numbers were small and their missions quite varied.

We captured the school's *academic organization* with two measures. One, a dummy variable indicating whether or not the school offered Calculus, focused on the high end of the mathematics curriculum. A second measure, focusing on the low end of the curriculum, captured the number of courses the school offered below Algebra I. One of the major constructs in this study, school *social organization*, is student/teacher relations, which we use as a measure of school-based social capital. This measure was constructed from a series of survey items directed to students, in which they indicated how much the school's teachers cared about them, were interested in them, and responded positively to them. The composite measure was first constructed with factor analysis of the student items, and it was then aggregated to the school level. More detail about this measure is presented in the Appendix. In our multivariate analyses, all variables were used either as dummies (coded 1 and 0) or as z-scored continuous variables (with M = 0, SD = 1). This decision was made to simply the interpretation of coefficients, and enable comparisons of the relative magnitudes.

Analytic Approach

Multilevel questions and methods. The three research questions around which we organized this study are multilevel, consistent with other school effects studies. Addressing these questions involves estimating the effects of student background on dropping out within each school (Question 1) and the effects of school organization on dropping out (Questions 2 and 3). We use a multilevel analysis strategy, HLM (Bryk & Raudenbush, 1992), in particular its special application to dichotomous outcomes (Raudenbush, Bryk, Cheong, & Congdon, 2000).

In general, HLM used in a school-effects context involves three steps. The first step typically involves partitioning the variance in the outcome into its within- and between-school components. For example, HLM would allow a researcher to estimate the proportion of the variation in 12th grade mathematics achievement that may be attributed to between-school differences. It is only this between-school component of the variance (the intra-class correlation, or ICC) that can be modeled as a function of school factors. However, in this instance, because the outcome measure is dichotomous, this step is not appropriate.[1]

A two-step model. Thus, HLM in this application involves two meaningful steps (or levels). In Level 1 we estimate, separately within each school, the relationship between academic and personal background and the log-odds that a student would drop out of school. At this level, the researcher must decide whether the independent variables are to be estimated as *fixed* effects or *random*

effects. In our analyses presented here, all independent variables at Level 1 were estimated as fixed effects. That means that the between-school variances of their relationships to the outcome are fixed to zero (i.e., all slopes were kept constant across schools). We were quite interested in estimating at least one of these relationships—the slope of GPA (or school performance) on dropping out—as a random effect. However, we found that this relationship did not vary systematically between schools. Thus, we fixed the effect. The implication of this was that we were unable to estimate the relationship captured by Arrow F in the conceptual model shown in Figure 1.

Presentation of results. Our results are of two sorts: descriptive and analytic. Descriptive results are of two types. One type presents group means on students' background measures between two groups of students: those who dropped out and those who stayed in school until graduation. These group mean differences were tested for statistical significance. Continuous variables were tested with t-tests (both Ms and SDs were tested); categorical variables, all of which are dummy variables, were tested with contingency tables. Because school size is an important consideration in this study, we present descriptive results for school-level variables as group means for small, medium, large, and very large schools. These differences were tested for statistical significance with one-way analysis of variance (ANOVA) and a series of contrasts. Group means on each variable for each size group (small, large, and very large schools) were compared separately to medium-sized schools.

Our HLM results are presented in two steps, as described earlier. In both steps, dropping out is the dependent measure. Step 1, our within-school (or Level 1) HLM model, explored relation- ships between background variables, in a multivariate and multilevel context, and dropping out. These results were estimated separately in each school and then pooled across schools. As would be typical in any logistic regression, the results are presented in a log-odds metric. Although this metric is not easily interpretable, we frequently translate the log-odds metric into the odds metric (permitting an estimate of the percent increase/decrease in the odds of dropping out). Our Level-2 results report the relationships between the several measures of school organization described earlier and the school-level estimate of the proportion of students who dropped out (i.e., the dropout rate in each school). The outcome was, of course, adjusted for all student-level measures in the Level-1 model. The results of the full 2-level HLM model are also reported in the log-odds metric.

Testing for contingent relations. Our Level-2 HLM model includes a series of interaction terms between certain school categories and teacher-student relationships (these interactions test

Research Question 3). In order to investigate whether the effect of social organization was different in different types of schools (i.e., a contingent relationship), we computed the necessary product terms between student-teacher relationships and the other school organization measures. Exploratory models included all such interaction terms. The final model represents a more parsimonious (and statistically efficient) model wherein all non-significant interaction terms were removed. The effect of social organization is seen to be contingent upon school sector and school size, but not contingent upon school demographics or curriculum structure.

Results

Student Background and Dropping Out of High School

The (weighted) dropout rates for the HSES schools are quite varied, ranging from a low of 0 percent to a high of over 50 percent, with a mean of about 7 percent. To compute these descriptive drop out rates, we employed the full HSES student sample, regardless of whether they had any demographic information; all we knew was their drop out status. In our restricted sample of 3,840 students, 5 percent (179 students) dropped out between the end of 10th and 12th grades (see Table 1). Hence the sample dropout rate shown on Table 1 is somewhat lower, after we restricted our attention to cases with needed student-level information.

This dropout rate seems quite low, at least in comparison to what we read about America's urban high schools. We suggest several reasons for this low rate. First, many students had already dropped out of school, either before they began high school in 9th grade or between 9th and the end of 10th grade. There is considerable evidence that the end of 9th grade is particularly important in this regard. Thus, even our sample of eventual dropouts had "survived" several perilous points in their educational trajectory. Second, we remind readers that our school sample includes both Catholic and independent schools, two sectors in which the dropout rate is rather low.

Insert Table 1 about here

The descriptive comparisons of social background shown in Table 1 indicate that gender was not significantly related to dropping out. Race/ethnicity was associated with dropping out, with

Asian students more likely to stay in school and Black students more likely to drop out compared to White students. Hispanic ethnicity was unrelated to dropping out. SES was strongly associated with dropping out; the dropouts' SES was .6 SDs lower than the non-dropouts' SES, a large difference.

Academic background was also strongly associated with dropping out. Almost 18 percent of the dropouts took no academic courses in mathematics during the first two years of high school, compared to only 5 percent of non-dropouts. Mathematics achievement at the end of 10th grade also strongly favored the non-dropouts, with differences between the two groups of about 1 SD (a very large difference). Similarly, students who eventually dropped out of school had considerably lower GPAs in mathematics than non-dropouts. On the traditional 4-point GPA scale, the eventual dropouts had earned a GPA below a C average (which would be 2.0), where the non-dropouts' GPA in mathematics was about C+.

Although the proportions of both groups who were overage at the end of 10th grade were low, it appears that being overage was related to dropping out. Over twice as many non-dropouts (4 percent) are overage, compared to dropouts (1 percent). This result runs contrary to the bulk of previous research which generally finds "over-age" a characteristic of "at risk" students. We can only speculate that this discrepancy is due once again to the fact that we are looking at the "late" dropouts. Being over-age may be a predictor of "early" drop out behavior (i.e., dropping out before 10th grade), but here we see that over-age students who persist until 10th grade may be more likely to persist until graduation.

Of course, the various measures of student background considered here are likely to be strongly related to one another, but these descriptive comparisons do not take that into account. Nevertheless, we have evidence from Table 1 that dropping out of high school between 1990 and 1992 was strongly related to students' social and academic backgrounds.

School size and dropping out. Descriptive information about the 190 schools in this sample is presented in Table 2. Although the distribution of the high schools in this sample was not balanced across school size, there were substantial numbers of schools in each size category. We selected medium-sized schools as our comparison group in the multivariate analysis simply because there were more schools in this category. It is clear that dropping out is related to school size, although the relationship seems to be non-linear. That is, the large schools (enrolling between 1,500 and 2,500 students) had a higher proportion of students dropping out (12 percent) than either medium or very large schools (where the proportions were both about 7 percent). The smallest schools (with

600 or fewer students) had the smallest dropout rates, which may be explained by the fact that many private schools fell into this size range (about 40 percent of small schools were Catholic and 52 percent were independent schools). The apparent non-linear relationship between school size and the drop out rate may once again be a reflection of the fact that we are investigating drop out behavior late in the high school years (i.e., after 10th grade). It is possible that students dropped out of the very large schools earlier in their high school careers.

Insert Table 2 about here

School demographic characteristics are also related to school size. The highest average SES and lowest proportion of high-minority schools were found in small schools. Small schools also had the highest average mathematics achievement and students with the highest GPAs in mathematics. Small schools also offered the fewest number of below-Algebra mathematics courses, although the availability of calculus was statistically unrelated to size (most high schools offer this course).

Perhaps the most striking differences in Table 2 relate to school averages of teacher-student relations. The small schools averaged about .5 SD higher than schools of other sizes (all of which were quite similar). Because these differences are likely to also be associated with the fact that a large proportion of the small schools is private (either Catholic or independent), we investigated this possibility. Average student/teacher relations were indeed related to school sector (ignoring school size): the mean on this variable was -.09 SD in public schools, .27 SD in Catholic schools, and .69 SD in independent schools, large group mean differences.

Further descriptive information on schools can be found in the tables in Appendix B. Table B-1 displays school characteristics across low, low-middle, high-middle, and high SES schools. Most notably, the dropout rate in low SES schools is nearly six times that found in high SES schools. Table B-2 displays school characteristics across very low, low, moderate, and high dropout rate schools. The results here emphasize the dramatic differences in socioeconomic status, racial composition, average achievement, and student/teacher relations between schools with low and high dropout rates. Finally, Table B-3 displays school characteristics across school sector (public, Catholic, and independent schools).

It is clear from examining descriptive differences among students and schools that the characteristics considered are associated with the probability that a student will drop out of high

school after 10th grade. Taken together, Tables 2 and B-1 through B-3, however, reinforce the need for multivariate investigations of the impact of school characteristics on the dropout problem. Because of the strong relations between school sector, size, racial and economic composition, and curriculum, the bivariate relationships can be misleading, if not completely spurious. We suggest that the group mean differences observed in Tables 1, 2, and B-1 through B-3 indicate the importance of considering each of the factors in our multivariate and multilevel analyses, to which we now turn.

Multilevel Analyses of Students, Schools, and Dropping Out

Within-school HLM model. The results of the analysis investigating Research Question 1, where we explore the relationship between students' social and academic background and the likelihood of their dropping out of school, are shown in Table 1. Recall from our earlier discussion that we were anxious to investigate some of these relationships as social distribution parameters. However, because they did not vary between schools, none of these relationships could be successfully modeled as random variables. Therefore, all of the independent variables shown in Table 3 were estimated as fixed effects. In HLM, that means that we have centered each of these variables around the grand mean for the entire sample. Moreover, each continuous variable was z-scored (M = 0, SD = 1).

Because of these decisions, the intercept shown in Table 3, the adjusted log-odds of dropping out (-3.40) translates into an adjusted dropout rate of slightly over 3 percent.[2] In the multivariate analyses shown in Tables 3 and 4, characteristics of schools with positive coefficients are associated with a higher likelihood of dropping out, whereas negative coefficients suggest an association with a lower likelihood.

Insert Table 3 about here

The within-school HLM model that focuses on social background provides somewhat different results from the descriptive results shown in Table 1. Descriptive results suggest that gender is unrelated to dropping out, and in the multivariate analysis, gender remains unrelated to dropping out. However, certain race/ethnic differences persist. These multivariate results consistently support a 73 percent decrease in the odds of Asians dropping out as compared to whites, (log-odds = -1.31,

or odds ratio = $e^{-1.31}$ = .270, and 1.00 - .27 = .73), but the results for Hispanic and Black students are quite different. In the multivariate and multilevel context, after controlling for SES and prior performance, we find that Hispanics are considerably more likely to drop out (log-odds coefficient of -0.39, or a 32 percent decrease in the odds of dropping out, p<.01), but that Blacks are no more likely than whites to drop out. Strongly associated with dropping out is student SES (log-odds coefficient of -0.57, or a 1 SD increase in SES led to a 43 percent decrease in the odds, p<.001).

Perhaps more interesting are the results for students' academic background. As with the descriptive results, overage students are considerably less likely to drop out (coefficient of -1.20, or a 70 percent decrease in odds, p<.01). A moderately strong individual factor associated with dropping out is students' school performance, captured by their GPA in mathematics (a 1 SD increase in GPA is associated with a 33 percent decrease in the odds of dropping out, p<.001). Although descriptive results indicated very large differences between dropouts and non-dropouts in academic achievement, in the multivariate and multilevel model, mathematics achievement is unrelated to dropout behavior, once school performance and social background are accounted for. Students who took no academic mathematics courses in their first two years of high school were slightly more likely to drop out (coefficient of .75, or a 12 percent increase in the odds, p<.10). The adjusted intercept in each school, which represents the dropout rate after adjustments for social and academic background, becomes the dependent variable in our Level-2 HLM.

Between-school HLM model. The results of our Level-2 HLM model are displayed in Table 4. These results include adjustments for the entire set of within-school factors shown in Table 3, which the bottom of Table 4 shows have changed very little. The analysis includes variables that describe schools in terms of their demographic composition, structure (size and sector), academic organization, and school social organization. We discuss each of these sets of variables separately, although their effects were estimated simultaneously.

Insert Table 4 about here

School demographic composition. As entering math achievement increases, school drop out rates decline slightly (log-odds coefficient of -.38, p<.10). In other words, a 1 SD increase in the average mathematics achievement of entering students resulted in a 32 percent decrease in the odds of dropping out (odds ratio = $e^{-.38}$ = .68). Adjusted school dropout rates are statistically unrelated to

school average SES, high-minority concentration, or students' average GPA in mathematics at Grade 9.

Academic organization. Our results here focus on the structure of the high school curriculum. Schools that offer fewer mathematics courses below the level of Algebra I or offer Calculus have lower drop out rates. More specifically, students in schools that offer Calculus exhibited 55 percent lower odds ($e^{-.81} = .45$) of dropping out. Students attending schools which are 1 SD above the mean in the number of lower-level (i.e., below algebra) math courses offered experienced a 28 percent increase in the odds of dropping out ($e^{.25} = 1.28$).[3] Thus, we conclude that students are less likely to drop out in high schools with a more constrained and academic mathematics curriculum, above and beyond their own coursetaking behavior and school performance. This finding addresses Research Question 2.

School structure. The main effects of school structure, shown in Table 4, are straightforward. School dropout rates do not differ between public, Catholic, and independent schools in these multivariate analyses, once demographics, size, and organization are taken into account. More exactly, the presence of a significant interaction term involving sector implies that school sector has no significant effect on dropout rates *among schools of average student/teacher relations*. The main effects of school size are similar. Compared to medium-sized schools, large and very large schools have higher dropout rates, *among schools of average student/teacher relations*. This is particularly strong for large schools (coefficient of 1.32, or nearing a 300 percent increase in the odds of dropping out, $p<.001$). Small schools also have higher dropout rates than medium-sized schools (coefficient of .75, or more than a 100 percent increase in the odds, $p<.10$).

School social organization: a contingent relationship. Also related to Research Question 2, our findings seem clear in this regard. Students attending schools with more positive student-teacher relations are less likely to drop out than those who attend schools with less positive student-teacher relations (coefficient of -1.96, or a 1 SD increase in the quality of student/teacher relations led to an 86 percent decrease in the odds of dropping out, $p < .01$). However, this effect occurs only in certain schools (as indicated by the presence of significant interaction terms shown in Table 4). That is, our findings about the effect of school social organization are contingent on school structure, both school size and school sector (Research Question 3). The impact of student-teacher relations on dropping out differs by the size and sector (public, Catholic, or independent) of the school is among the most important findings of this study.

In public or Catholic schools, of small or medium size, a 1 SD increase in positive student-teacher relations led to an 86 percent decrease in the odds of dropping out ($e^{-1.96} = .14$). In independent schools of small or medium size, however, there is no significant impact of student-teacher relations on dropping out (difference in log-odds = -1.96 + 2.07 = .11, a non-significant difference). This lack of an effect here is most likely due to the fact that student-teacher relationships are especially high in these schools in the first place, as we reported earlier in the paper. As school size increases, the impact of positive student-teacher relations also disappears (for large schools: -1.96 + 2.50 = .54, a non-significant difference; for very large schools: -1.96 + 2.65 = .69, also a non-significant difference).

We conclude that positive teacher-student relationships in school – a measure of school-based social capital – may indeed reduce the probability that students will drop out of school. However, these positive relationships benefit students only under certain circumstances. Specifically, positive social capital has an effect in public and Catholic schools only (where there is far more variability in social capital), and its effect is also felt in schools without large enrollments. Positive teacher-student relationships are not shown to be important in reducing student dropout rates in independent schools for two reasons: (1) the dropout rates in such schools are already so low that there is little "room" to drop; and (2) teacher-student relationships are universally high in such school (i.e., there is little variability).

That student-teacher relationships do not influence dropout behavior in large and very large schools may be due to the fact that the large sizes (with the typical depersonalized environments) undermine any personalizing nature of good student-teacher relations. Even at average levels of student-teacher relations, large and very large schools exhibit higher dropout rates than medium-sized schools. Indeed, even small schools with average student-teacher relations (admittedly a rare occurrence as small schools, in general have rather high student-teacher relations as seen in Table 2) exhibit higher dropout rates than medium sized schools.

Discussion

Individual Explanations Are Incomplete

Our results suggest that explanations for students dropping out of school before graduation that rely solely on students' social background and school behaviors are incomplete. Although our

research has demonstrated that both students' social and academic background are associated with the likelihood of students dropping out of high school, the story doesn't (and shouldn't) end there. The results of this study suggest that schools can exert important organizational effects on dropping out, above and beyond individual students' behaviors and backgrounds.

Clearly, there are important school effects on dropout behavior, even after taking students' risk factors into account. However, U.S. society continues to lend strong support to the individualistic model, whereby students and their families are held responsible for dropout behavior. Acceptance of the individual model, we argue, tends to let schools off the hook; they are not seen as having any responsibility for holding students in school who are not learning, who are not working hard in school, and who come from families where support for education is not strong. This is a mistake — one more example of blaming the victim for the problem.

What Could High Schools Do to Hold All Their Students in School?

Some important non-findings. A remarkable result in this study is that several features of schools that they are unable to change — specifically, their demographic composition and their sector — are almost completely unrelated to school dropout rates, *once students' background and behavior are taken into account*. Although many policymakers interested in the dropout phenomenon explain it by invoking individual characteristics, others refer to the prevalence of this phenomenon in schools that enroll large proportions of low-SES students, high proportions of minorities, and many low-scoring students. Although the presence of low-achieving students has a marginal influence on school dropout rates, neither average SES nor minority concentration is uniquely related to this outcome after controlling for the other school characteristics (from Table 4). Moreover, although observed dropout rates are lower in Catholic and independent schools than in public schools, there is no direct *residual* effect of school sector on dropping out. These non-findings we consider to be very important. They should be seen in light of the fact that several organizational features — specifically, size, curriculum and social organization — are important.

School academic organization. We conclude that the structure of the high school curriculum is associated with holding students in high school until graduation. Regardless of students' own academic background and school performance, schools with what we have called in other settings "a constrained academic curriculum" – more challenging courses, fewer remedial or non-academic courses – hold students in school (Lee, Burkam, Chow-Hoy, Smerdon, & Geverdt, 1998). This

finding flies in the face of those who say that high schools must offer a large number of non-demanding courses in order to keep uncommitted students in school. Although other research has shown the positive effects of this constrained curriculum structure on academic learning and its socially equitable distribution (e.g., Bryk et al., 1993; Lee et al., 1998), here those findings about the constrained academic curriculum are extended to show positive benefits on keeping students from dropping out.

School size. Much has been written in recent years about the importance of the size of secondary schools (Lee, 1999; Lee & Loeb, 2000; Lee & Smith, 1997). In general, this research has supported making high schools smaller than they are, but not so small that they cannot offer a reasonable curriculum to their students. Although these studies have focused primarily on the direct relationship between school size and student achievement (and its equitable distribution), the authors have argued in these writings that school size is unlikely to have a direct relationship on many of these outcomes. Similar findings accrue in this study: students are more likely to drop out of larger high schools, although actual size categories are slightly different.

However, we make the same argument here has been made elsewhere. School size, per se, is unlikely to directly influence the probability that students will drop out of high school. Rather, there are likely to be other organizational features that accrue to students and staff in smaller high schools. One of those organizational features is how school members — particularly teachers and students —relate to one another. It is noteworthy that there are residual direct effects for school size here, even when school social organization is taken into account. These findings suggest the importance of school size on dropping out. We also suggest that such findings indicate that there may be other social features that accompany smaller size — including organizational trust, members' commitment to a common purpose, more frequent contact with people with whom members' share their difficulties, uncertainties, and ambitions. These measures, unfortunately, are not part of this analysis, as they are unavailable in the HSES data. Our results here show that school size is quite important, and that students in medium-size schools are least likely to drop out. As such, the findings here are quite consistent with other recent studies that show that the size of secondary schools influences important school outcomes, and that smaller (but not too small) size is generally better.

School social organization. We consider our findings that students are less likely to drop out of high schools where the average relationships between teachers and students (as perceived by the

students) are more positive as the most important in this study. Although schools themselves have little ability to influence who attends them, we believe that the adults who work in schools (teachers and administrators) have the ability to consciously alter how they interact with their students. Quite clearly, students stay in school when social relations with their teachers are positive. This association persists even when students' background, school demographics, and school sector are accounted for.

However, our analyses have provided some insight into particular organizational settings where this relationship is salient. In large and very large schools (that is, schools that enroll more than 1,500 students), positive relationships no longer hold students in school. Developing and sustaining such relationships, at the organizational level, is surely much more difficult in larger and more anonymous settings. Thus, the influence of positive social relationships on dropping out is restricted to high schools that enroll fewer than 1,500 students. Similarly, the effect of positive relations on keeping students from dropping out is restricted to public and Catholic high schools; it does not apply in independent schools. Why? Our results suggest that relationships are uniformly quite positive, and dropping out quite rare, in independent schools.

The Importance of Using the Appropriate Analytic Approach

Data and methods coincide well with questions. The data used for this study, the High School Effectiveness Supplement to NELS:88, have provided us with an opportunity to explore a school organizational explanation for the dropout phenomenon. That the data are multilevel in design, that they are longitudinal, and that they include large and random samples of secondary schools in America's cities and suburbs — these design elements have made this study possible. The HSES design has allowed us to make use of the multilevel research methods that are critical in examining school effects on individual behaviors.

Two caveats. On the other hand, we suggest that the findings reported here probably represent a lower bound for possible organizational influences on students' academic behaviors. One reason is that we were able to explore dropping out only in students' last two years of high school, and we know that many students leave high school well before the end of 10th grade. A second reason that our results may not reflect the full breadth and depth of the relationships is tied to the HSES design. Within-school sample sizes in HSES are rather modest (averaging 20 students), and we suggest that our ability to find social distribution outcomes may be limited by this design constraint. We were

especially interested in exploring the organizational factors that might be associated with the relationship between dropping out and school performance, what might be called "cross-unit interactions." That is, we were anxious to identify features of schools that allowed them to hold even low-performing (and possibly uncommitted) students in school. We admit that we were unable to explore this relationship with these data. However, whether such a relationship really doesn't vary systematically between schools, or whether such variation was impossible to detect with the design of HSES, is unclear. Thus, our results would likely be both stronger and richer with a more complete data structure.

Interactions are important. Our final words focus on a common analytic oversight. The large majority of quantitative research ignores potential interactions, and instead concentrates on main effects only. In this study, a very important finding is the contingency of the influence of school social organization on dropout behavior. Only in some settings is this relationship important; in others it is not. We would not know this had we not investigated interactions among the school factors we considered in this study. We argue that researchers should be considerably more aware of possible interaction effects, and that these should be tested systematically. Many studies may have drawn incomplete or incorrect conclusions by this oversight. In some instances, main effects are seen as non-significant (and conclusions are drawn— incorrectly—that they are not important) mainly because researchers have failed to explore interactions. Our findings here reinforce the importance of exploring interaction effects and not relying entirely on main effects.

Technical Notes

1. The variance for a binomial variable is the simple product of the proportion of those coded 1 and those coded 0. In other words, the variance of a binomial variable is not independent from the mean (unlike a continuous measure where the mean and variance are separate parameters). Consequently, partitioning (or explaining) variance is not a statistical goal.

2. The intercept can be used to estimate the drop out rate, adjusted for the social and academic background of the students. More exactly, it can estimate the probability of dropping out for a group of students with an average gender and racial/ethnic background (i.e., average percent female, average percent Black, etc.), average SES, average achievement and grades, and an average proportion of over-age students.

3. To make more practical sense of this finding, we remind readers that a 1 SD increase in the number of low-level math courses translates into about 1.75 courses. Thus, for every two additional courses offered below the level of Algebra, students experience more than a 30 percent increase in the odds of dropping out.

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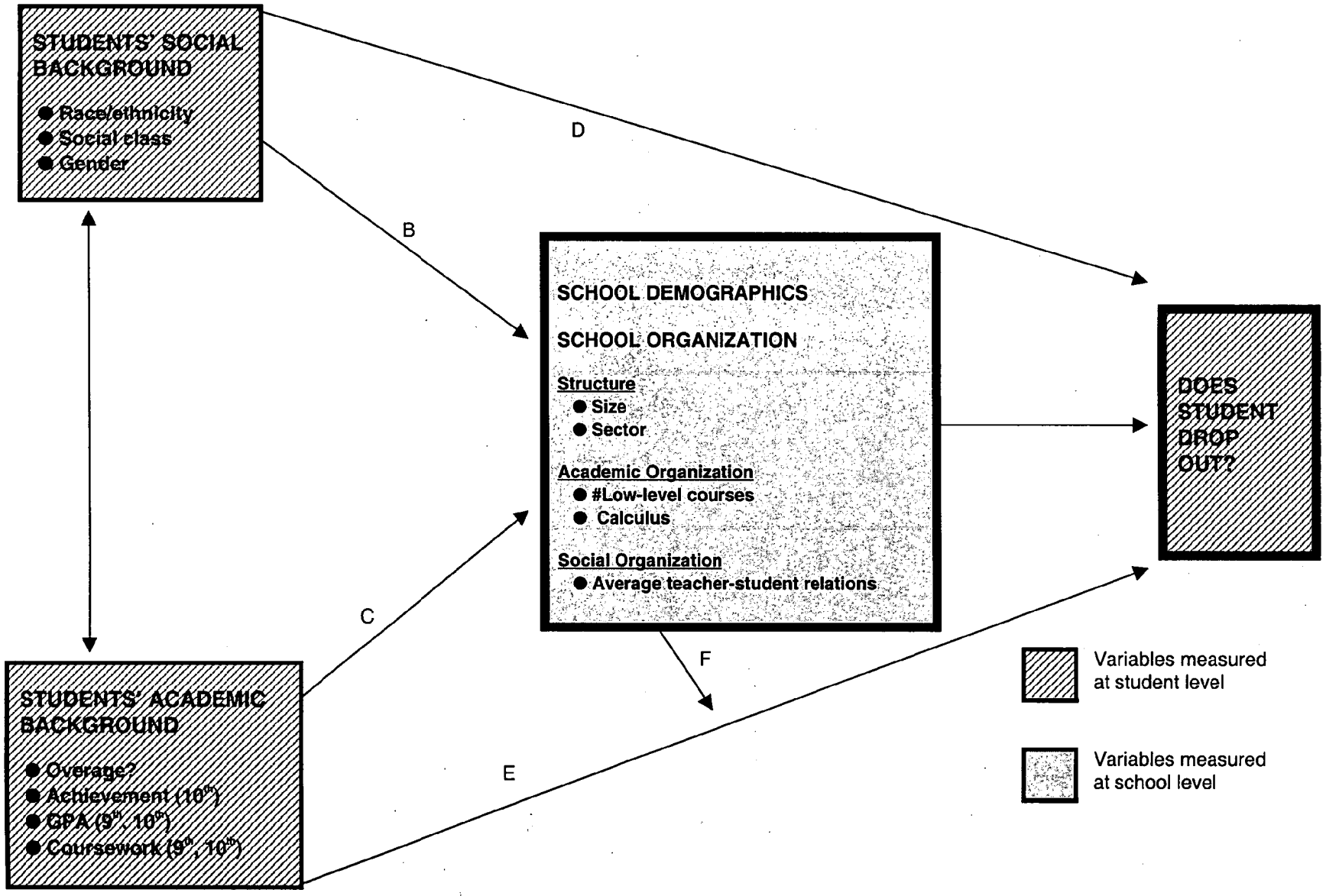

Figure 1: **Multilevel Heuristic Model for Investigating School Effects on the Probability of Students Dropping Out of High School**

Table 1. Student Characteristics by Drop Out Status
[unweighted n = 3840 students]

	Drop Out[a]	In School
(Unweighted sample size)	(179)	(3661)
Weighted percentages	5.4	94.6
% Female	49.4	47.3
% Asian	0.7	6.1***
% Hispanic	13.7	11.8
% Black	22.6***	3.6
SES, mean	-0.57	0.03***
(SD)	(1.01)	(0.99)
% Overage	1.2	3.8*
% No Academic Math Courses, Grades 9 & 10	17.5***	4.9
Math Achievement, Grade 10, mean	33.8	45.3***
(SD)	(11.9)	(14.0***)
Math GPA, Grades 9 & 10, mean	1.86	2.39***
(SD)	(0.97)	(0.88)

~ $p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

[a] Differences in percentages and means tested for significance. Significance levels are indicated on the larger of the two numbers.

Table 2. School Characteristics by School Size[a]
[N = 190 schools]

	Small[b]	Medium	Large	Very Large
Unweighted sample size	(36)	(67)	(58)	(29)
Weighted percentages	40.6	30.3	21.8	7.3
% Drop Out	5.3	7.0	11.8**	7.5
Average SES	0.61***	0.22	0.13	-0.23***
% Black	4.8***	20.8	19.9	28.2
% Hispanic	2.3*	6.1	14.8**	40.5***
% Asian	3.0	2.7	4.4	7.2
% High Minority[c]	9.3*	25.0	37.1	77.3***
Average Math Achievement, Grade 8	41.4***	37.0	35.4	30.4***
Average Math GPA, Grade 9	2.86***	2.34	2.35	1.93**
% Urban	29.0	32.3	28.9	78.0***
% Catholic	40.0***	18.7	8.1	0.0
% Independent	51.7***	6.3	0.5	0.0
% Offering Calculus	56.7	66.6	77.7	48.2
Number of Below-Algebra Math Courses	2.7***	4.1	4.2	4.7
Student-Teacher Relations	0.53**	-0.05	-0.03	-0.13

~ $p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

[a] School size is defined as follows – small schools: 0 - 600, medium schools: 601 - 1500, large schools: 1501 – 2500, and very large schools: above 2500.

[b] Differences in percentages and means across school size are tested for significance with pairwise contrasts, comparing small, large and very large schools to medium-sized school. Significance levels indictate whether a particular percentage or mean is significantly different from the percentage or mean from medium-sized school.

[c] High minority schools are defined as schools with 40 percent or more minority student enrollment.

Table 3. Within-School Model of School Drop Out between 10th and 12th Grade [unweighted n = 3840 students, unweighted N = 190 schools]

Adjusted Log-Odds of Dropping Out:	
Intercept	-3.40
Fixed Effects:	
Female	0.12
Asian	-1.31*
Hispanic	-0.39**
Black	0.33
SES	-0.57***
Overage	-1.20**
No Academic Math Courses	0.75~
Math Achievement, Grade 10	-0.04
Math GPA, Grades 9 & 10	-0.39***

~ $p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

Table 4. Between-School Model of School Drop Out – How School Characteristics Affect Drop Out Rates [unweighted n = 3840 students, unweighted N = 190 schools]

Adjusted Log-Odds of Dropping Out:	
Intercept	-3.75
School Demographics:	
Average SES	0.66
High Minority	-0.32
Average Math Achievement, Grade 8	-0.38~
Average Math GPA, Grade 9	-0.22
School Academic Organization:	
Offers Calculus	-0.81**
Number of Below-Algebra Courses	0.25~
School Sector:	
Catholic[a]	-0.56
Independent[a]	-1.09
School Size:	
Small[b]	0.75~
Large[b]	1.32***
Very Large[b]	0.76*
School Social Organization:	
Student/Teacher Relations	-1.96**
Interactions:	
S-T Relations by Independent	2.07**
S-T Relations by Large	2.50**
S-T Relations by Very Large	2.65**
Fixed Effects:	
Female	0.14
Asian	-1.34*
Hispanic	-0.36~
Black	0.40
Overage	-1.17**
SES	-0.54***
No Academic Math Courses	0.61
Math Achievement, Grade 10	-0.04
Math GPA, Grades 9 & 10	-0.36***

~ $p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

[a] As compared to public schools.
[b] As compared to medium-sized schools (601-1500 students).

APPENDIX A

Student-Level Variables:

Female – Dummy coded gender variable, 1 = Female, 0 = Male.
Asian – Dummy coded race variable, 1 = Asian, 0 = Other.
Hispanic – Dummy coded race variable, 1 = Hispanic, 0 = Other.
Black – Dummy coded race variable, 1 = Black, 0 = Other.
SES – Standardized composite measure of socioeconomic status including parental education, parental occupational prestige, and household income, mean = 0, SD = 1.
Overage – Dummy coded age variable, 1 = Over 16, 0 = 16 or younger.
No Academic Math Courses – Dummy coded coursetaking variable, 1 = no courses at or above the level of algebra, grades 9 & 10, 0 = only courses below the level of algebra, grades 9 & 10.
Math Achievement, Grade 10 – Standardized test of math achievement, grade 10.
Math GPA, Grades 9 & 10 – Grade point average in math courses, grades 9 & 10, from school transcript.

School-Level Variables:

Average SES – Aggregate measure of school-average SES.
High Minority – Dummy coded school demographic variable, 1 = 40 percent or higher minority students, 0 = less than 40 percent.
Average Math Achievement, Grade 8 – Aggregate measure of school-average entering math achievement.
Average Math GPA, Grade 9 – Aggregate measure of school-average math course performance (GPA), grade 9.
School Offers Calculus? – Dummy coded curriculum measure, 1 = school offers calculus, 0 = school does not offer calculus.
Number of Below-Algebra Courses – Continuous curriculum measure, number of math courses offered below the level of high school algebra (1 Carnegie unit = 1 course).
Catholic – Dummy coded school sector variable, 1 = Catholic school, 0 = Other.
Independent – Dummy coded school sector variable, 1 = Independent school, 0 = Other.
Small – Dummy coded school size variable, 1 = 0 – 600 student, 0 = Other.
Large – Dummy coded school size variable, 1 = 1501-2500 students, 0 = Other.
Very Large – Dummy coded school size variable, 1 = over 2500 students, 0 = Other.
Student/Teacher Relations – Aggregate measure of school social organization based on student-level standardized composite score. Student-level items were on a four-level agree/disagree scale, and include: Teachers are interested in students, teaching is good at this school, most teachers listen to me, when I work hard teachers praise my effort, student get along well with teachers, and discipline is fair at school.

APPENDIX B

Additional Descriptive Statistics on Schools

Table B-1. School Characteristics by School SES[a] [unweighted N = 190 schools]

	Low[b]	Low Middle	High Middle	High
(Unweighted sample size)	(56)	(61)	(39)	(34)
Weighted percentages	15.2	29.1	46.1	9.7
% Drop Out	15.3***	8.2*	5.3	2.7~
% Black	37.1***	17.7*	6.8	8.5
% Hispanic	30.7***	9.2**	2.2	6.0*
% Asian	4.5	2.9	3.1	5.9~
% High Minority[c]	81.0***	28.4**	9.1	6.8
Average Math Achievement, Grade 8	29.1***	35.4***	40.8	45.5***
Average Math GPA, Grade 9	1.94***	2.28***	2.82	2.75
% Urban	65.4**	21.5	32.9	25.0
% Catholic	2.3***	14.9**	38.4	12.4**
% Independent	0.0***	7.3***	36.6	39.5
School Size	1904***	1241***	615	1198**
% Offering Calculus	63.4	54.0	64.4	89.3*
Number of Below-Algebra Math Courses	4.6***	4.2***	3.1	3.0
Student-Teacher Relations	-0.11**	-0.09***	0.40	0.40

~ $p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

[a] School SES is defined as follows – low (more than 1 SD below the mean), low-middle (no more than 1 SD below the mean), high-middle (no more than 1 SD above the mean), and high (more than 1 SD above the mean).

[b] Differences in percentages and means across school SES are tested for significance with pairwise contrasts, comparing low, low-middle and high SES schools to high-middle SES schools. Significance levels indicate whether a particular percentage or mean is significantly different from the percentage or mean from high-middle SES schools.

[c] High minority schools are defined as schools with 40 percent or more minority student enrollment.

Table B-2. School Characteristics by School DropOut Rates[a]
[unweighted N = 190 schools]

	Very Low[b]	Low	Moderate	High
(Unweighted sample size)	(64)	(43)	(51)	(32)
Weighted percentages	37.8	20.6	33.3	8.5
Average SES	0.50***	0.26	0.33	-0.26***
% Black	12.6***	4.7	15.4**	49.3***
% Hispanic	9.9	4.8	8.2	23.1**
% Asian	5.0**	1.9	3.3	3.5
% High Minority[c]	19.8	9.5	23.6~	91.8***
Average Math Achievement, Grade 8	40.6***	36.0	38.3*	29.5***
Average Math GPA, Grade 9	2.55	2.48	2.62	2.13**
% Urban	42.8	38.7	18.9*	39.7
% Catholic	51.2***	5.3	10.2	0.0
% Independent	15.1	27.5	34.6	0.0***
School Size	949	903	1103	1624**
% Offering Calculus	63.1*	36.6	75.3***	85.1***
Number of Below-Algebra Math Courses	2.6***	4.7***	3.8**	4.7
Student-Teacher Relations	0.35**	0.09***	0.14	-0.12*

~ $p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

[a] School Drop Out rate is defined as follows – very low (less than 2 percent), low (2 to 7.5 percent), moderate (7.5 to 17.2 percent), and high (above 17.2 percent).

[b] Differences in percentages and means across school Drop Out rate are tested for significance with pairwise contrasts, comparing very low, moderate and high Drop Out schools to low Drop Out schools. Significance levels indicate whether a particular percentage or mean is significantly different from the percentage or mean from low Drop Out schools.

[c] High minority schools are defined as schools with 40 percent or more minority student enrollment.

Table B-3. School Characteristics by School Sector
[N = 190 schools]

	Public	Catholic	Independent
(Unweighted sample size)	(131)	(31)	(28)
Weighted percentages	53.6	23.5	22.9
% Drop Out	10.2	2.7***	5.7***
Average SES	0.05	0.54***	0.75***
% Black	22.4	10.4***	1.8***
% Hispanic	13.3	6.1*	2.6***
% Asian	3.6	5.7~	1.9*
% High Minority[b]	37.0	18.3**	5.1***
Average Math Achievement, Grade 8	34.8	41.7***	41.2***
Average Math GPA, Grade 9	2.24	2.57***	3.14***
% Urban	27.0	56.5**	26.2
School Size	1620	514***	264***
% Offering Calculus	67.3	46.0*	73.4
Number of Below-Algebra Math Courses	4.6	1.7***	3.4***
Student-Teacher Relations	-0.12	0.45***	0.62***

~ $p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

[a] Differences in percentages and means across school sector are tested for significance with pairwise contrasts, comparing Catholic and independent schools to public schools. Significance levels indicate whether a particular percentage or mean is significantly different from the percentage or mean from public schools.

[b] High minority schools are defined as schools with 40 percent or more minority student enrollment.

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