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Climates for Learning

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I. Introduction

Many of the school and student characteristics that have been shown in multiple studies to be related to student achievement—including students' socioeconomic status (SES) and race/ethnicity, as well as school contextual factors such as size, location, and sector (public/parochial/other private)—cannot be directly controlled by administrators and teachers associated with any individual school. One area that individual administrators and teachers are able to influence is the climate within a school and the extent to which that climate supports an atmosphere conductive to student learning. In this paper, we use data from the National Assessment of Educational Progress (NAEP) 2000 mathematics assessment to examine three aspects of school climate—schoolwide student behavior, schoolwide parental involvement, and schoolwide morale—and their relationship to student achievement. The data presented in this paper show that while these aspects of school climate are related to other student and school characteristics they constitute separate and distinct attributes of schools. They also have an independent relationship to student achievement after controlling for other school and student factors.

II. Background

Defining and measuring school climate. The idea that each school has a distinct measurable climate originated approximately 40 years ago (Halpin and Croft, 1963). School climate is usually defined as an aggregate measure of school characteristics that parents, teachers, administrators, and policymakers consider desirable, but the set of characteristics varies among studies. Despite the lack of a uniform definition, the issue of whether or not a school has a "good" climate continues to be raised both in popular

discourse and in the education research literature. This interest suggests that many people think that school climate is an important school characteristic that influences students' educational experience and academic achievement.

The extant research literature suggests that school climate is indeed a measurable property of schools that transcends the differences in the way individuals experience the environment in a school. In a study using NELS:88 data, Nusser and Haller (1995) found correlations among the ways students, teachers, and principals rated a their school on issues of safety and discipline—schools that were ranked highly by one group tended to be ranked highly by the other two—but found that principals, on average, gave schools more favorable ratings than teachers; and teachers, on average, gave schools more favorable ratings that students. Nusser and Haller stress the differences among the ratings assigned by the three groups and suggest that because of the differences in the way the three groups report perceived school climate, a given school may in fact not have a single measurable climate that is experienced in similar ways by all members of the school community, and therefore school climate may not be a viable concept for further research. However, the fact that they found that the three groups within any given school—students, teachers, and principal—tended to agree in their orderings of different dimensions of the school climate suggests to us that, despite these differences in rating intensity, school climate may indeed be a viable theoretical concept. We would be concerned if the three groups ordered the lists of school problems differently, but this was not the case. The fact that principals and teachers were somewhat less extreme in their ratings of different dimensions of school climate than students, should not come as a

surprise to anyone who regularly interacts with adolescents: adolescents frequently have stronger reactions than adults in many different situations.

In a similar study, Van Horn (2003) used survey data collected from parents, teachers, and principals at 378 schools as part of the National Head Start Transition Demonstration Project and compared their responses to various measures of school climate. He showed that, although there were differences in how each of these three groups rated the climate in a given school, there was some consistency between the ratings the different groups assigned to the same school. This agreement in rank ordering suggests that schools do have an underlying measurable climate, although there are differences in the intensity with which different members of the school community experience that climate (one group may rate a problem as severe while another group rates it as moderate).

If we accept the fact that school climate is a measurable characteristic of schools, the issue becomes whether school climate is a uni- or multi-dimensional characteristic of schools. Most studies support the view that school climate is multi-dimensional. However, the number of dimensions identified, and the way they are measured, varies among studies. A 2003 review by Schindler et al identified almost 50 different school climate inventories.

Ma and Klinger (2000) reviewed the school climate literature and found that the elements of school climate identified in various studies can be classified into five categories: teacher satisfaction, principal leadership, disciplinary climate, academic press (expectations), and parental involvement. Other studies emphasize the importance of a

having a sense of community within the school (Bryk and Driscoll 1988) and the importance of collegiality among teachers and administrators (Peterson 1997).

The relationship between school climate and student achievement. While it can be argued that having a positive school climate is a good thing in and of itself, even if it is not associated with higher student achievement, the concept of school climate is primarily of interest to the education research community because of its potential relationship with student achievement. Many of the studies looking at the relationship between school climate and student achievement are based upon very small samples, so at best their results can only suggest a relationship. For example, Gaziel (1997) surveyed 20 public secondary schools in Israel with populations composed primarily of disadvantaged and found that the schools that exceeded academic expectations based on student demographics had more favorable climates. Brookover et al (1968) used data from the Michigan Assessment Program of the Michigan State Department of Education to examine the relationship between school climate and student achievement among students in 68 schools. Their study also found a relationship between school climate and student achievement.

Other small studies failed to find a relationship between school climate and student achievement. Montoya and Brown (1990) analyzed the relationship between school climate and student achievement as measured by scores on the California Test of Basic Skills among students in eight 6^{th}-grade classrooms. They did not find any relationship between school climate and academic achievement.

Most of the school climate studies based upon large, nationally representative samples of students and schools have been done using longitudinal data sets from the

National Center for Education Statistics of the U.S. Department of Education, including the National Educational Longitudinal Study of 1988 (NELS:88) and High School and Beyond (HS&B). Most of these studies found that favorable schools climates were positively related to student academic achievement. Lee et al (1996) analyzed NELS:88 data and found a positive relationship between a more favorable academic climate and achievement levels of both boys and girls in grade 8. Bryk and Thum (1989) analyzed HS&B data and found that a favorable high school climate reduced the likelihood that students would drop out of school before graduating. Completing high school can be viewed as a measure of academic achievement. Rumberger (1995) reported a similar positive relationship between school climate and the propensity of students to stay in middle school .

III. Data

The measures of school climate used in this study are based on the responses of a school official, usually the principal, to the school questionnaire that accompanied the NAEP 2000 mathematics assessment for grades 4, 8, and 12. We used survey items from three separate sections of the questionnaire to define our school climate measures. We combined data this school-level data with data from the student background questionnaire, and the NAEP mathematics assessment, in our analyses. NAEP does not ask students to report their perceptions of school climate. However, our review of the literature (discussed above), gives us some confidence that students would probably rank different aspects of school climate in roughly the same order as principals, but differ with the principals in the intensity associated with a problem (reporting a problem is serious rather than moderate, or moderate rather than minor).

The first section of the school survey that we utilized asked school officials to indicate the extent to which 13 possible problems were an issue in their school. For each potential problem, administrators indicated whether that issue was "serious," "moderate," "minor," or "not a problem" at their school. Specifically, the questionnaire asked about the following:

- Student absenteeism
- Student tardiness
- Physical conflicts among students
- Racial or cultural conflicts
- Student health problems
- Gang activities
- Cheating
- Physical conflicts between students and teachers
- Vandalism
- Student use of alcohol
- Student use of tobacco
- Student use of drugs
- Teacher absenteeism

As we explain in the "Results" section below, the teacher absenteeism question was not included in our final *student behavior* measure. Also note that we did not include the three items that address student use of alcohol, tobacco, and drugs in the 4th grade analyses, because the very rare reports of these problems in schools serving 4th graders were not associated with reports of other problems at this grade level.

The second section of the survey contained items that measured parental involvement. This section of the questionnaire asked school administrators to indicate what percentage of parents participated in the following activities:

- A parent-teacher organization
- Open houses or back-to school nights
- Parent-teacher conferences
- Volunteer programs
- School curriculum decisions

As we explain in the "Results" section below, the school curriculum decisions item was not included in our *parental involvement* measure.

The third and final questionnaire section asked questions regarding the school administrator's assessment of the morale, attitudes, and expectations of teachers, parents, and students. These questions roughly correspond to the areas of collegiality, community, and teacher satisfaction identified in other studies, although they do not comprehensively cover those constructs. For each question, school officials were asked to characterize that element of morale as "very positive," "somewhat positive," " somewhat negative," or "very negative." Specifically, the questions asked about the following elements:

- Morale of teachers
- Students' attitudes toward academic achievement
- Parental support for student achievement
- Teachers' expectations for student achievement
- Regard for school property

As we explain in the "Results" section below, all five of these items were included in our *school morale* measure.

Schools that responded to at least 75 percent of the questions associated with a given school-climate measure were included in the data set used for the analysis of that school-climate measure in this study. The percentage of schools that met this criterion ranged from 90 to 93 percent, depending on the specific measure and grade level in question. Among the schools that were excluded from this analysis, the vast majority (at least 92 percent) failed to respond to even a single item used to calculate a given school-climate measure. For schools that met the 75 percent criterion, we computed the average response across all the questions answered for a given school-climate measure.

Before analyzing these measures of school climate, we recoded response values so that a higher numeric response always indicated a more positive school climate. Responses indicating fewer school-wide behavior problems, greater levels of parental involvement, and higher morale were all assigned higher numeric values. Thus, for the remainder of this paper, higher values on our school climate measures always reflect "better" school climates.

We created three school climate measures, corresponding to the three sets of questions discussed above, separately for each grade. Responses to the questions measuring each aspect of school climate were averaged for each school at a given grade level and then standardized to have a mean of 0 and a standard deviation of 1 for each aspect of school climate across schools at each grade level. The "Results" section includes a more detailed description of the procedures we followed to create and validate the school climate measures. By standardizing these measures with a mean of 0 and a

standard deviation of 1, we were able to focus on differences in ranking across schools with different characteristics, rather than on nominal meaning of the scores principals assigned various school attributes. As we mentioned in our review of the literature, the intensity of ratings appears to differ much more among different types of school informants (administrators, teachers, and students) than the ranking of problems does. Our use of standardized values compensates to some extent for the fact that we lack student or teacher ratings for any of these aspects of school climate.

In addition to the school climate information provided on the school survey, we used information collected on the school questionnaire to classify schools in terms of the number of students enrolled, the proportion of students eligible for the Free/Reduced Price Lunch Program, and school sector (public, Catholic Private, or Non-Catholic Private).

In examining the relationship between our school climate measures and mathematics achievement we controlled for student characteristics that other research has found to be associated with student achievement. These factors include gender, race/ethnicity, the types of reading materials in a student's home, and parental education level.

IV. Methodology

We used principal component analysis to determine which survey items could be combined to measure distinct elements of school climate. The empirical results of these analyses are present in the "Results" section of this paper.

We performed difference of means tests to determine whether or not any relationships between school climate measures and other school characteristics observed in the sample data were statistically significant.

We also assessed the association between our school climate measures and student mathematics achievement using ordinary least square regression models to control for the other school and student factors known to be associated with student achievement. Because NAEP data are cross sectional, these analyses will not be able to address questions of causality, but will be able to determine if a relationship between school climate and student achievement exists, net of other factors.

In making statistical inferences from the NAEP sample data to the U.S. 4^{th}-, 8^{th}-, and 12^{th}-grade populations we needed to account for two distinct sources of variability. The first is the familiar sampling variability, present any time researchers make inferences based on sample data. Because of the complex sampling procedures used in collecting NAEP data, conventional formulas for sampling variability, which assume simple random samples, underestimate the variance attributable to sampling. To account for this, NAEP assigns each student a series of replicate weights that take into account variability based on sampling procedures and weight the sample so that it is representative of the respective school populations.[1]

[1] For information on how replicate weights are calculated, see NAEP 2000 *Technical Report*.

The second source of variability arises from the design of the NAEP mathematics assessment—specifically, the fact that individual students complete only a subset of the assessment questions. This introduces a second type of uncertainty into our population estimates of student achievement. To address this issue NAEP assigns each student participating in the assessment five plausible values. These values represent five separate estimates of the NAEP score the student would have obtained if he or she had completed the entire assessment. All achievement results reported here are based on the average of the five plausible values. By incorporating the variation we observed between the five plausible value estimates into our standard error estimation, we were able to account for the variability introduced by individual students only completing a subset of assessment questions.

Therefore, when making comparative statements about subgroups of students or schools and about the percentage of students or schools possessing certain characteristics, we used statistical procedures that take into account *only* the degree of uncertainty associated with the sampling, or sampling variability. When making comparative statements about student achievement, we took into account *both* sampling variability and variability based on the fact that each student answered only a subset of the mathematics questions.

To adjust the standard errors for all other population estimates and for the coefficients in regression models, we used a Taylor Series linearization procedure to account for the complex sample design.[2] In the regression model we accounted for the estimation of NAEP scores by estimating five separate regression models predicting each

[2] For further details, see Johnson, E. G. and Rust, K.F. "Population Inferences and Variance for NAEP Data," *Journal of Educational Statistics* 17 (2) (1992): 175–190.

of the five plausible values. The results reported reflect the average coefficient across the five models and the standard error estimates reflect the variance observed between the five coefficient estimates as well as the average of the standard errors across the five models. All statistical estimation was carried out within the STATA® statistical software package.

We used a multiple regression model to estimate the relationship between our measures of school climate and mathematics achievement controlling for other factors. The model assumes that mathematics achievement can be modeled as a linear function of school climate (C) as well as student and school (S) characteristics, with a normally distributed random error term (ε):

$$Y = \beta C + \gamma S + \varepsilon .$$

In this model, β estimates the influence of school climate measures and γ indicates the contribution of individual school and student background factors on achievement. Specifically, we controlled for differences in the following school factors: school size (number of students), school poverty level (measured by eligibility for the free and reduced price lunch program), urbanicity, and school sector (public, Catholic, other private). We also controlled for student gender, race/ethnicity, number of reading materials in the student's home, and parental education. This type of model allowed us to statistically estimate the independent effect of each school climate measure on mathematics achievement, net of other factors included in the model.

We used school weights for all analyses done at the school level and student weights for all analyses done at the student level. These weights are assigned by the

NAEP program to take into account probabilities of selection into the sample and also to adjust for non-response.

V. Results

As explained above, we used data collected in support of the 2000 NAEP mathematics assessment to carry out the following three types of analyses. First, we used principal components analysis to determined which items on the school questionnaire measured distinct aspects of a school's climate. Second, we examined how values on our school climate scale varied with school characteristics. Finally, we examined the relationship between school wide climate scores and individual student achievement in mathematics. More formally we organized our analyses of NAEP data to answer the following three research questions:

1. Can school climate be measured using a uni-dimensional scale or do the measures of school climate collected on the NAEP school questionnaire fall into more than one dimension ?
2. How does school climate vary across schools with different characteristics?
3. What is the relationship between school wide climate measures and mathematics achievement?

Below we address each of these research questions in turn.

Measuring School Climate with NAEP Data

We used exploratory factor analysis to examine whether the items on the NAEP School Questionnaires clustered together in a manner that would allow us to construct one or more valid measures of school climate. That is, were there consistencies in how principals from the same school responded to groups of survey items that suggested

common underlying factors? And how many school climate factors could we detect with the data supplied by the school questionnaire?

Our exploratory factor analyses found three distinct factors in the pattern of correlations among all of the school survey items we examined. These three factors closely mirrored the three sections of the school questionnaire discussed in the data section above. For example, responses of school officials concerning their perceptions of various behavior problems were more similar to each other than they were to their reports of percentages of parents involved in various activities and or their assessments of morale levels within the school.

Our factor analysis did, however, reveal a handful of survey items that did not seem to be measuring the same common underlying factor as the other questions in their section.

Looking first at the factor defined by the principal perception of school problems, we found that teacher absenteeism was not associated with perceptions of other problems for any grade. Therefore, teacher absenteeism was not included in our school climate measure of problematic behavior. As all the remaining behavior items concerned students we labeled this construct *student behavior*. While principal perceptions about problems with drugs, alcohol, and tobacco were related to the common *student behavior* factor in schools serving 8^{th}- and 12^{th}-grade students, such problems were extremely rare at schools serving 4^{th} graders. More importantly when drugs were perceived to be a problem at grade 4, they were not associated in any systematic way with other problems at that grade level. Therefore we include drugs, alcohol, and tobacco in the *student behavior* factor at 8^{th} and 12^{th} grade, but excluded these measures from the analysis of 4^{th}

grade data. Table 1 indicates the final specifications and factor loadings for the *student behavior* factor. We provide Cronbach's Alpha, in addition to the Omega reliability and validity statistics developed by Heise and Borhrnstedt.[3]

TABLE 1: Student Behavior Factor Analysis Results

TO WHAT DEGREE IS THIS A PROBLEM IN YOUR SCHOOL?	Factor Loadings		
	GRADE 4	GRADE 8	GRADE 12
Student Absenteeism	0.767	0.521	0.729
Student Tardiness	0.760	0.455	0.668
Physical Conflicts	0.650	0.420	0.720
Racial Conflicts	0.509	0.485	0.564
Student Health	0.650	0.414	0.556
Gang Activities	0.407	0.520	0.532
Misbehavior in Class	0.701	0.464	0.667
Cheating	0.451	0.477	0.574
Student-Teacher Physical Conflict	0.484	0.305	0.429
Vandalism	0.444	0.451	0.487
Student Use of Alcohol		0.839	0.577
Student Use of Tobacco		0.880	0.601
Student Use of Drugs		0.872	0.690
Cronbach Alpha	0.830	0.877	0.848
Omega Reliability	0.875	0.904	0.925
Validity	0.940	0.849	0.995

We turn next to the second factor identified by our analyses: principal reports about the percentage of parents who were involved in various school activities. Initial

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Heise, D. R., & Bohrnstedt, G. W. (1970). The validity, invalidity, and reliability of a composite score. In *Sociological Methodology* ( ), 104-129.

factor analysis showed that the percentage of parents involved in making curriculum decisions was not closely tied to other parental involvement in other activities. Therefore, we omitted the item that measured parental involvement in making curriculum decisions in all three grades. The lack of association between parents setting the curriculum of a school with the other measures of *parental involvement* made some substantive sense, as this activity may be beyond the control of individual schools. Schools vary across districts and across states in their ability to set their own curriculum; therefore there is unequal opportunity to involve parents in such decisions across schools even if the principal is eager to obtain parental participation and parents are willing participate. Furthermore, a high percentage of parents participating in current curriculum decisions may reflect both positive and negative relationships between schools and parents: positive if parents are constructively partnering with schools and negative if parents are participating because they are displeased with the status quo. Table 2 provides the final specifications, factor loadings, and reliability statistics for the *parental involvement* factor.

TABLE 2: Parental Involvement Factor Analysis Results

WHAT PERCENT OF PARENTS PARTICIPATE IN THESE ACTIVITIES?	Factor Loadings		
	GRADE 4	GRADE 8	GRADE 12
Parent-Teacher Organization	0.701	0.499	0.741
Open House	0.545	0.792	0.599
Parent Teacher Conference	0.425	0.695	0.469
Volunteer Activities	0.705	0.550	0.806
Cronbach Alpha	0.689	0.731	0.736
Omega Reliability	0.711	0.733	0.737
Validity	0.838	0.848	0.854

The third and final school factor suggested by our analysis was measured by school officials' perceptions of the overall morale of students and teachers. All five of the morale measures available from the school questionnaire loaded consistently high on the common factor across all three grades. Table 3 provides the final specifications, factor loadings, and reliability statistics for the *school morale* factor.

TABLE 3: School Morale Factor Analysis Results

HOW WOULD YOU CHARACTERIZE EACH OF THE FOLLOWING IN YOUR SCHOOL?	Factor Loadings		
	GRADE 4	GRADE 8	GRADE 12
Teacher Morale	0.555	0.544	0.615
Student Attitude Toward Achievement	0.714	0.807	0.796
Parent Support for Achievement	0.710	0.760	0.775
Teacher Expectations	0.692	0.634	0.752
Regard for School Property	0.579	0.519	0.624
Cronbach Alpha	0.784	0.783	0.834
Omega Reliability	0.787	0.789	0.837
Validity	0.887	0.889	0.917

The results of the factor analysis confirmed three distinct school climate measures. In exploring the relationships between these factors and other school characteristics, we did not use the factor loadings – which varied across grades – but simply calculated the average response across the items that measured an underlying factor.[4] To simplify our presentation across the three school climate measures and three grade levels, as well as to remove the direct connection to nominal labels expressing the intensity of opinions (which, as discussed above, probably varies by respondent) from the scales, we standardized all resulting averages to have a mean of 0.0 and a standard deviation of 1.0. Table 4 provides the correlations among the school climate measures for

[4] In the process of deciding on how to measure school climate in our analysis we performed simplex analysis to determine whether an Item Response Theory (IRT) specification would be more appropriate than the simple average of responses used in this report. An IRT specification would assume that items that had a lower percentage of schools indicating the preferable school climate answer were better measures of the underlying school climate factor. However, the correlations between the individual questions making up each school climate measure did not show a pattern that indicated that IRT analysis would be appropriate. That is, items with low averages did not have higher correlations than items with high averages.

each of three grade levels we will examine. Note that the correlations range from 0.38 to 0.59, indicating that the three factors are related, but are measuring separate components of school climate.

TABLE 4: Correlation Among School Climate Measures

	STUDENT BEHAVIOR	PARENTAL INVOLVEMENT	SCHOOL MORALE
4TH GRADE			
Student behavior	1.00		
Parental involvement	0.44	1.00	
School morale	0.59	0.48	1.00
8TH GRADE			
Student behavior	1.00		
Parental involvement	0.46	1.00	
School morale	0.56	0.47	1.00
12TH GRADE			
Student behavior	1.00		
Parental involvement	0.40	1.00	
School morale	0.38	0.46	1.00

The Relationship Between School Climate and Other School Characteristics

The factor analysis in the previous section demonstrated the technical reliability and validity of our three school climate measures. Next, we turn to the relationship between school climate and other school characteristics that have been shown to be related to both climate and student achievement in previous studies. If our three measures are actually capturing the types of differences between schools that people care about, then our measures should be associated with the school characteristics people use

as informal signals for a school's climate. However, if our school climate measures are merely functions of the school characteristics readily available to gauge the quality of school's environment, then they will add nothing to our measures of these other school characteristics.

In this section we will look first at the relationship between the three school climate measure and school characteristics. Following this analysis, we will use regression analysis to determine how much of the variation in the school climate measures is independent of these school characteristics.

We will focus on the relationships between the three school climate measures and three school characteristics[5]:

- Size[6] – For grades 4 and 8: Small = 0 – 300 students, Medium = 30 – 700 students, Large = more than 700 students; in Grade 12: Small = 0 – 600 students, Medium = 601 – 1,000 students, large = more than 1,000 student

- Poverty level[7] – Low poverty = 0 – 5% students eligible for free or reduced–price lunch, Medium poverty = 6 – 50% students eligible for free or reduced–price lunch, High poverty = more than 50% students eligible for free or reduced–price lunch

- Sector[8] – Public, Private Catholic, and Private Non-Catholic

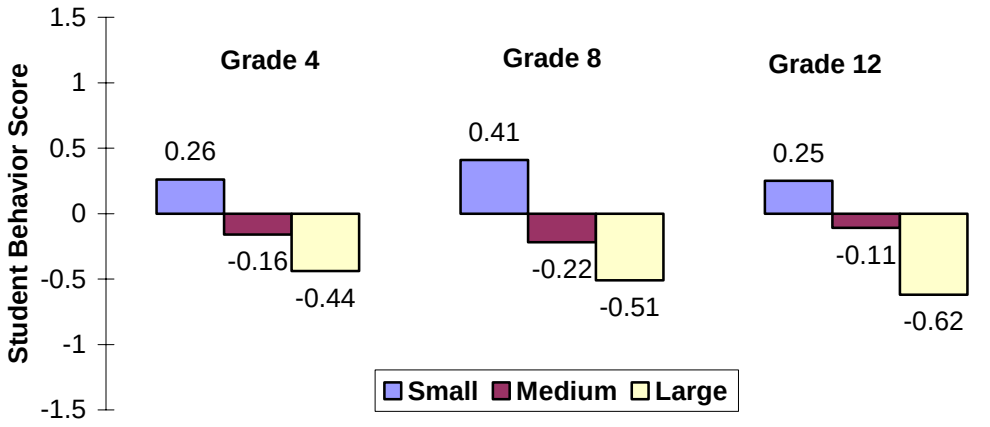
Because we constructed the school climate measures separately for each grade, comparisons across grades are not meaningful. The reader is reminded that one standard deviation below the 4th-grade, 8th-grade, or 12th-grade mean may reflect quite different

[5] We also examined the relationship between type of location (urban, suburban, rural) and school climate. However, there were very few statistically significant differences in school climate among schools in different types of location. Therefore, we do not report those results here.
[6] Studies that have shown a relationship between school size and school climate include Lee and Smith (1994), Bryk and Easton (1993), and Howley (1989).
[7] For a discussion of how school poverty level is related to school climate, see Kozol (1991).
[8] For a discussion of the relationship between school sector and school climate, see Lee et al (1998).

levels of disparity. Consequently, we only make comparisons within a single grade in our discussion below

School Size and School Climate. Larger schools had lower scores on each of our three school climate dimensions, but not all of these relationships were statistically significant within each grade. Figures 1 through 3 illustrate the relationship between school size and each of the three dimensions of a school's climate. The most consistent impact of school size was on the student behavior measure. For all grade levels, small schools and medium-size schools reported better student behavior than large schools (Figure 1). The negative impact of large schools on the parental involvement measure was limited to middle school. Among schools serving 8th graders, reports of parental involvement were significantly higher at small schools than at large schools (Figure 2). For grades 4 and 8, small schools had higher school morale scores than large schools, but school size was not associated with any statistically significant difference in school morale at grade 12 (Figure 3).

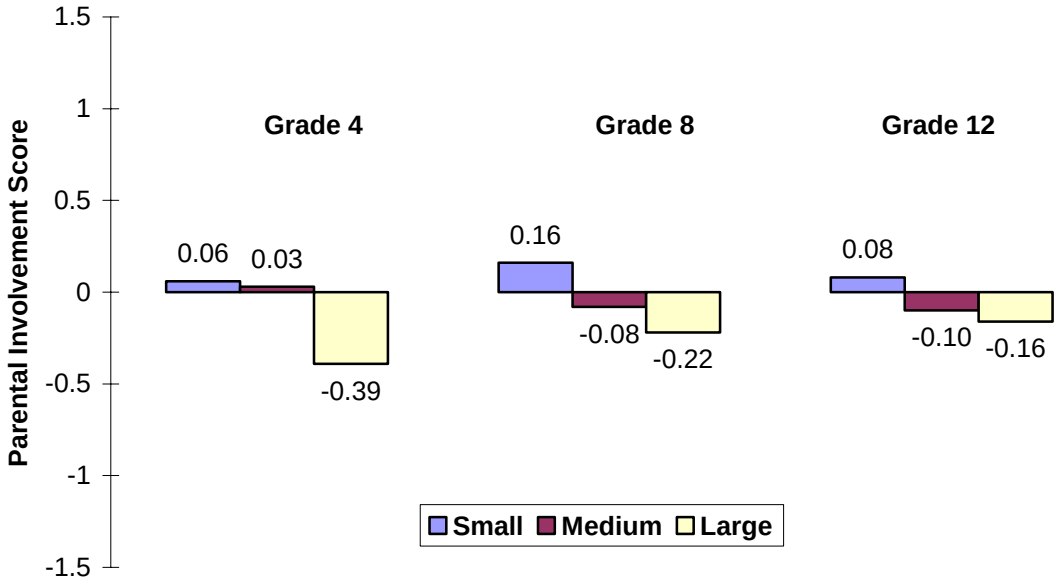
Figure 1: Average Student Behavior Score by School Size



Grades 4 and 8: Small = 1 – 300 students, Medium = 301 – 700 students, Large = more than 700 students
Grade 12: Small = 1 – 600 students, Medium = 601 – 1,000 students, large = more than 1,000 students

Source: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Mathematics Assessment.

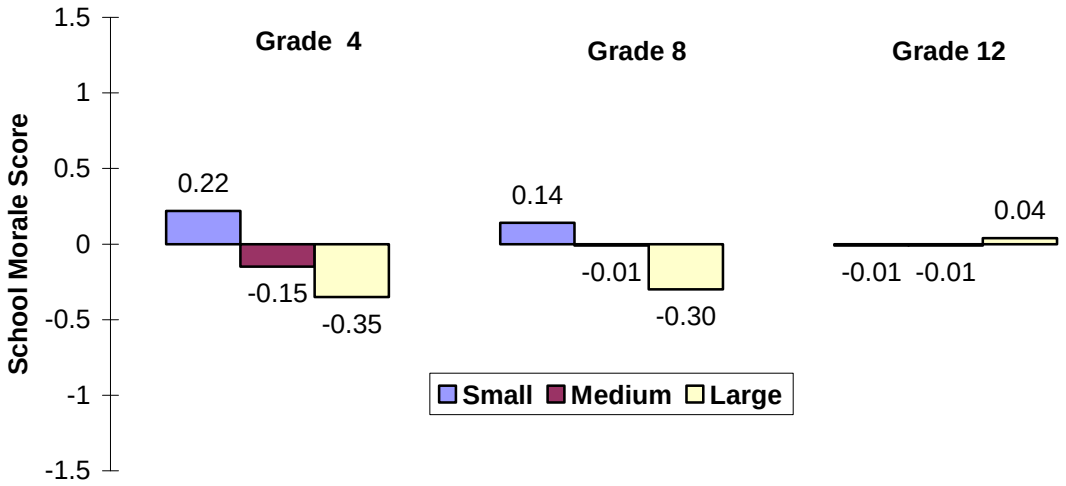
Figure 2: Average Parental Involvement Score by School Size



Grades 4 and 8: Small = 1 – 300 students, Medium = 301 – 700 students, Large = more than 700 students
Grade 12: Small = 1 – 600 students, Medium = 601 – 1,000 students, large = more than 1,000 students

Source: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Mathematics Assessment.

Figure 3: Average School Morale Score by School Size

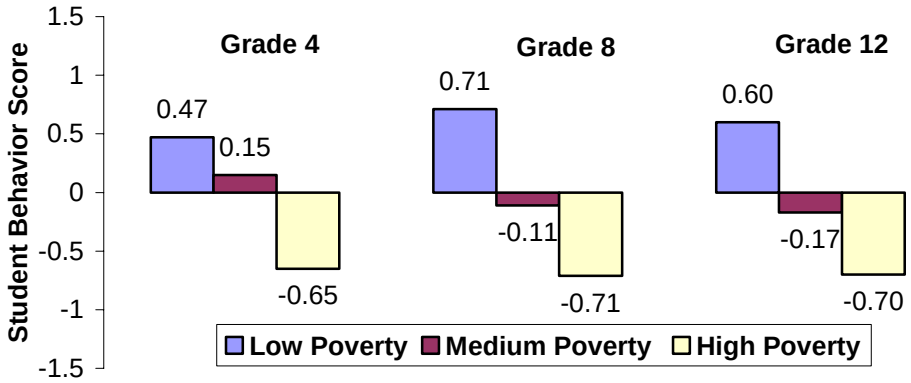


Grades 4 and 8: Small = 1 – 300 students, Medium = 301 – 700 students, Large = more than 700 students
Grade 12: Small = 1 – 600 students, Medium = 601 – 1,000 students, large = more than 1,000 students

Source: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Mathematics Assessment.

School Poverty Level and School Climate. Schools serving more affluent students —as measured by participation in the free and reduced-price lunch program—generally reported more positive school climates than those serving predominately poor students. Figures 4 through 6 depict the relationship between student participation in the free and reduced-price lunch program and our school climate measures. For all grade levels, low-poverty schools had higher scores than high-poverty schools on the student behavior, parental involvement, and school morale measures; medium-poverty schools also had higher scores than high-poverty schools on the student behavior and school morale factors. At grades 4 and 8, medium-poverty schools reported higher levels of parental involvement than high-poverty schools, but the difference between medium-poverty and high-poverty schools was not statistically significant at grade 12.

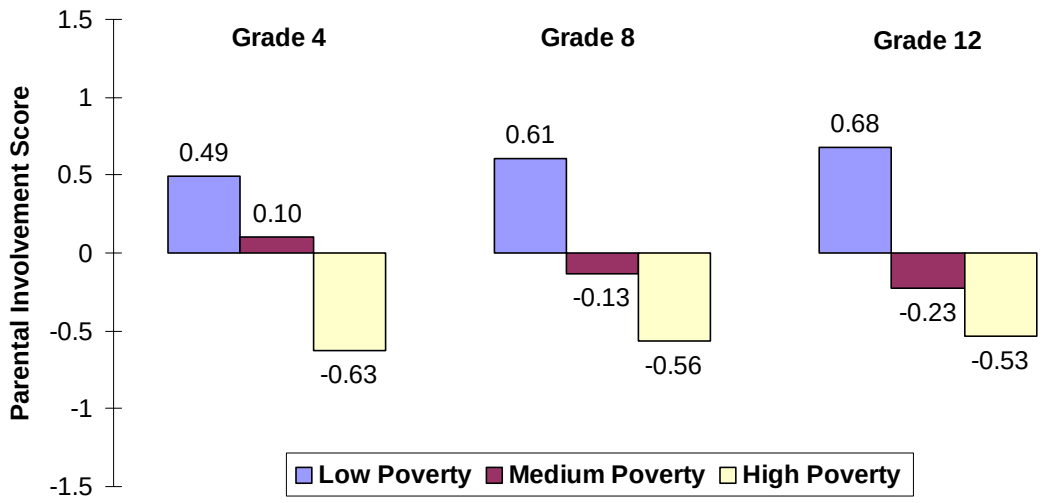
Figure 4: Average Student Behavior by School Poverty Level



Low poverty = 0 – 5% students eligible for free or reduced-price lunch, Medium poverty = 6 – 50% students eligible for free or reduced-price lunch, High poverty = more than 50% students eligible for free or reduced-price lunch

Source: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Mathematics Assessment.

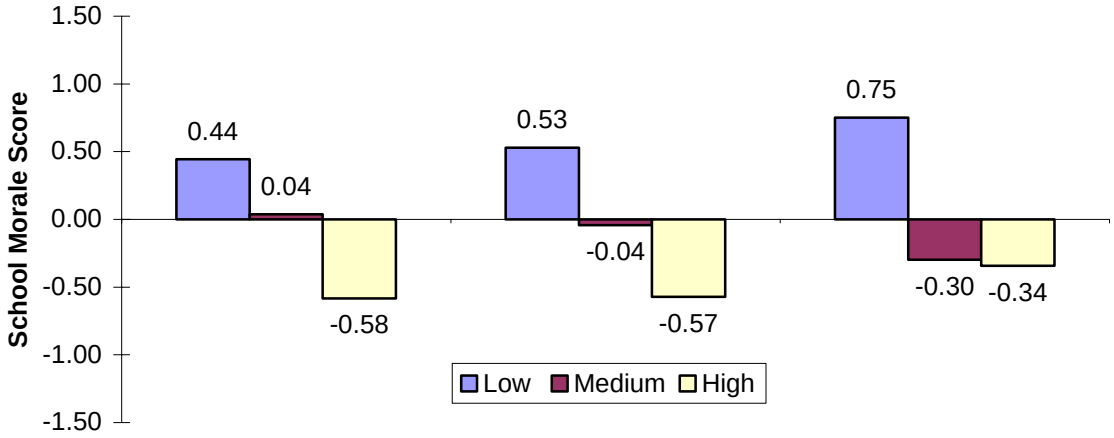
Figure 5: Average Parental Involvement by School Poverty Level



Low poverty = 0 – 5% students eligible for free or reduced-price lunch, Medium poverty = 6 – 50% students eligible for free or reduced-price lunch, High poverty = more than 50% students eligible for free or reduced-price lunch

Source: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Mathematics Assessment

Figure 6: Average School Morale by School Poverty Level



Low poverty = 0 – 5% students eligible for free or reduced-price lunch, Medium poverty = 6 – 50% students eligible for free or reduced-price lunch, High poverty = more than 50% students eligible for free or reduced-price lunch

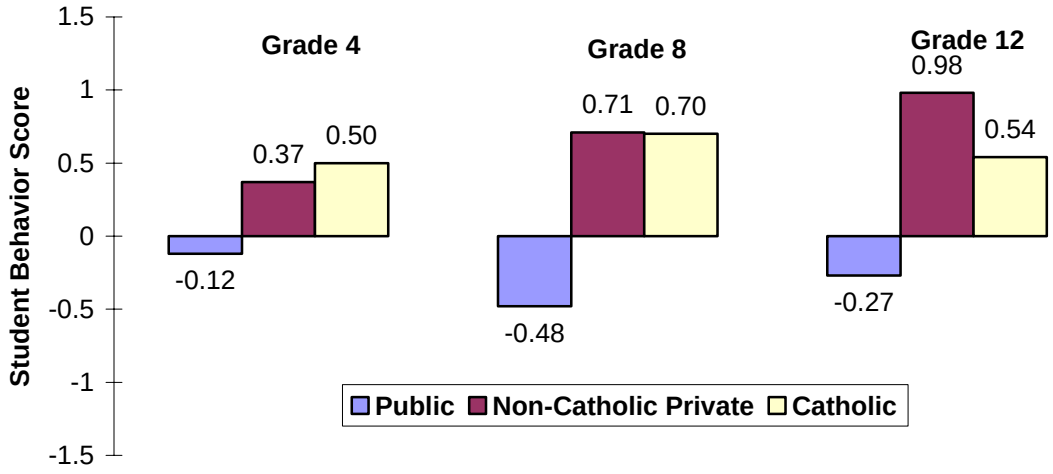
Source: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Mathematics Assessment

School Sector and School Climate. Private schools (Catholic and Non-Catholic) generally reported more positive school climates than public schools. Figures 7 through 9 illustrate the relationship between school sector (public, Catholic private, non-Catholic private) and the three school climate measures. Across all grades, Catholic schools had higher scores on all three factors than public schools. Similarly, non-Catholic private schools had higher student behavior scores than public schools in all grades and also reported higher parental involvement and school morale than public schools in grades 8 and 12.

Comparing the school climates in the two types of private schools revealed several significant differences. Among schools serving 12th graders, non-Catholic private schools had higher student behavior scores than Catholic schools (Figure 7). However among schools serving 4th- and 8th-grade students, Catholic schools had higher levels of parental involvement than non-Catholic private schools (Figure 8). Only at schools serving 4th graders, was school morale higher at Catholic than non-Catholic private schools (Figures 9).

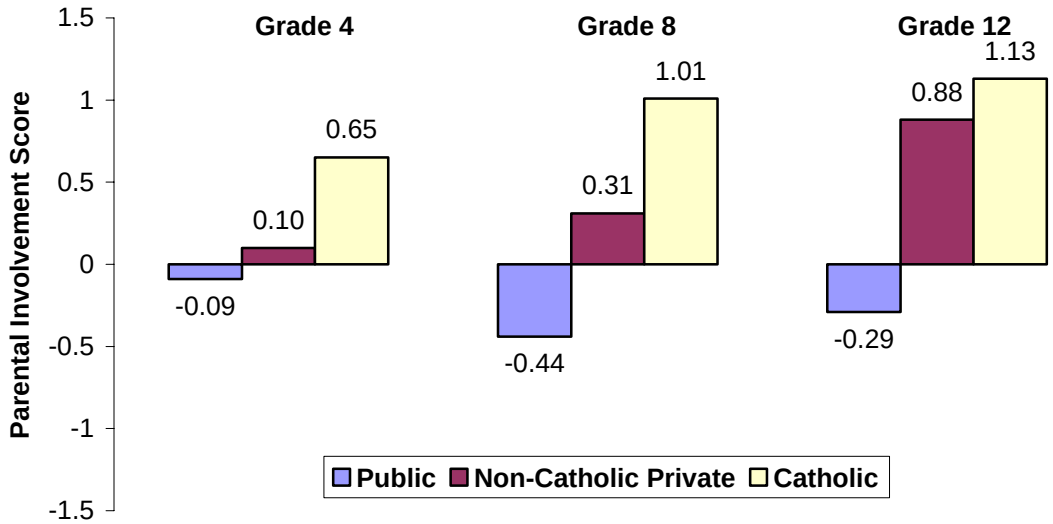
It is important to point out that none of these differences imply causation. Families and children who are able to choose private schools differ in many ways from families and children who attend public schools. Unlike public schools, private schools are able to choose which children and families they will accept, and often reject children whose behavior is problematic or whose parents who are unable or unwilling to participate in school-related activities. These differences undoubtedly contribute to differences in school climate observed between public and private schools.

Figure 7: Average Student Behavior by School Type



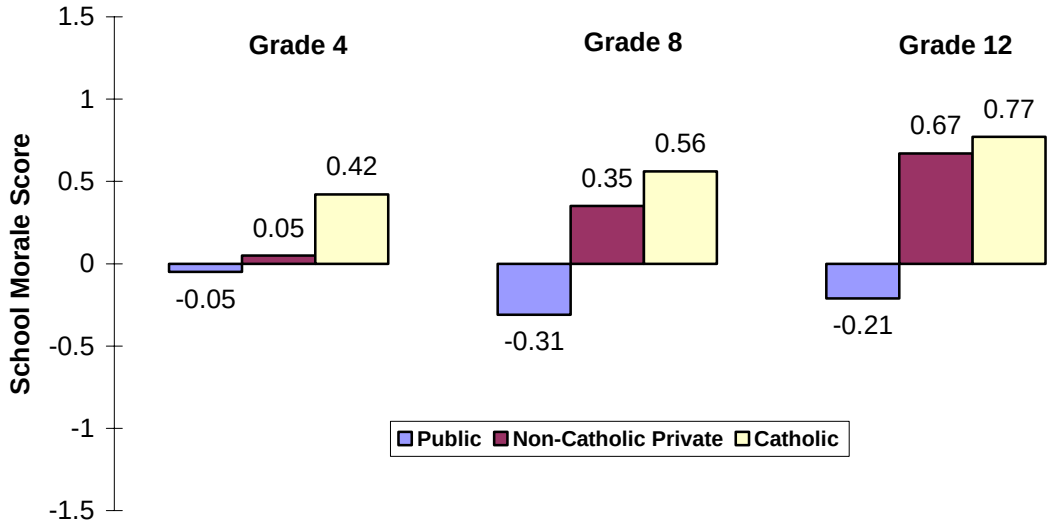
Source: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Mathematics Assessment

Figure 8: Average Parental Involvement by School Type



Source: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Mathematics Assessment

Figure 9: Average School Morale by School Type



Source: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Mathematics Assessment

Percentage of Variance in School Climate Accounted For by School Characteristics. Figures 1 through 9 indicated that relationships existed between the three school climate measures and the other school characteristics. However, if school climate is simply a function of these school demographics, then making the effort to explicitly measure school climate would be a waste of time. Furthermore, it would be very difficult for educators and others interested in improving school climate in existing schools to be successful.

To determine to what degree school climate was independent of these "given" school conditions, we estimated nine OLS regressions models separately for each school climate measure and grade level. These statistical models predicted school climate as a function of school size, school poverty level, type of school, and urbanicity of the community in which the school is located. Table 5 shows the percentage of variance in each school climate measure that can be accounted for by these school demographics.

The percentage of variance explained by these nine regression models ranged from a low of 21 percent for the 8th grade model predicting school morale to a high of 41 percent for the 8th grade model predicting student behavior. The average of the nine values in Table 4 was 30 percent.

Restating these findings in terms of unexplained variance reveals just how much relying just on school characteristics to measure school climate would miss. The proportion of variance unrelated to school characteristics ranged from 79 to 59 percent and averaged 70 percent. The fact that so little of the differences in school climate scores between schools can be accounted for by school characteristics suggests that directly measuring school climate is worthwhile and efforts to improve school climate in existing schools are not doomed to failure.

TABLE 5
Percentage of Variance in School Climate Measures Accounted For by School Characteristics

	Student Behavior	Parental Involvement	School Morale
GRADE 4	**26%**	**25%**	**22%**
GRADE 8	**41%**	**40%**	**21%**
GRADE 12	**35%**	**32%**	**25%**

School characteristics controlled for in this model include school size, school poverty level, type of school, and urbanicity of the community in which the school is located.

Source: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Mathematics Assessment.

The Relationship Between School Climate and Mathematics Achievement

Our final research question concerns the relationship between school climate and student achievement in mathematics. The NAEP assessment data we analyzed were cross-sectional and did not include measures of student achievement prior to the surveyed year that we could use as controls for this analysis. Therefore, we are not able to address the issue of causality. We are able to explore whether or not the schools with higher values on our school climate measures have higher NAEP mathematics scores.

Table 6 presents the average NAEP mathematics scores for schools with the highest 25 percent, middle 50 percent, and lowest 25 percent values on each of our three school climate measures.[9] The distributions of school climate scores were calculated separately for each measure of school climate at each of the three grades.

[9] In some instances, the 25th or 75th percentile fell among a cluster of schools with the same score. When this occurred, we assigned all school with the same score to the same category in such a way as to leave the percentage of schools in the highest or bottom category as close to 25 percent as possible.

Table 6: Average NAEP Mathematics Scores by School Ranking on Each of Three School Climate Measures

	Grade 4		Grade 8		Grade 12	
School Climate Measure Distributions	Mean NAEP Math Score	Standard Error	Mean NAEP Math Score	Standard Error	Mean NAEP Math Score	Standard Error
Student Behavior						
Highest 25 %	240	1.4	283	1.7	307	1.8
Middle 50%	227	1.2	276	1.6	301	1.4
Bottom 25%	217	1.7	267	1.9	295	2.9
Parental Involvement						
Highest 25 %	241	1.7	288	1.6	308	1.6
Middle 50%	227	1.1	276	1.3	302	1.9
Bottom 25%	214	1.9	265	1.9	292	2.3
School Morale						
Highest 25 %	239	1.5	286	1.9	310	1.8
Middle 50%	226	1.2	278	1.5	301	1.3
Bottom 25%	219	1.5	266	1.6	293	3.2

Source: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Mathematics Assessment.

At all three grade levels, students in schools with the highest student behavior values had higher mean mathematics scores than students in schools in the middle or at the bottom of the student behavior distribution. In addition, at grades 4 and 8, students in schools in the middle of the behavioral distribution had higher mean mathematics scores than students in schools with the lowest student behavior values. However, at grade 12, this difference was not statistically significant.

Similar relationships existed between parental involvement and mathematics achievement and between school morale and mathematics achievement. At all three grade levels, schools with the highest 25 percent of these two school climate measures had higher mean NAEP mathematics scores than schools falling in the middle or at the bottom of the respective distributions. Additionally, at all three grade levels, schools in

the middle of the distribution of the two school climate distributions had higher mean NAEP mathematics scores than schools with the lowest values on our parental involvement and school morale measures.

Student achievement is, of course, related to a variety of other school and student characteristics, including a student's socioeconomic background. Therefore, we estimated nine regression models that examined the independent relationship between school climate measures and mathematics achievement holding constant a variety of other school and student characteristics. Specifically, we examined the effect of each of the school climate measures on student achievement when controlling for school size, percentage of students eligible for free or reduced-price lunch, school urbanicity, school type, student gender, student race/ethnicity, and parental socioeconomic status (number of reading materials in the home and, for 8^{th} and 12^{th} grade, parental education). We excluded parental education measures from the 4^{th} grade analysis because children that young are not reliable informants for this information.

The coefficient estimates, standard errors, and R^2 statistics for the nine regression models are provided in Tables 7 through 9. Eight of nine regression models (excluding student behavior for grade 8) found a statistically significant independent relationship between the school climate scale and mathematics achievement. Table 7 presents the regression models that predict mathematics scale scores by the student behavior measure, holding other school and student characteristics constant. Schools serving 4^{th} and 12 graders with higher student behavior scores also had significantly higher NAEP mathematics scores. The regression results for 8^{th}-grade schools suggested a positive relationship, but this result was not statistically significant. Because our student behavior

measure was standardized, one unit change in this measure reflects the change in NAEP mathematics scores associated with a one standard deviation increase on the student behavior measure. The size of the regression coefficients in the 4th and 12th grade models indicates that a standard deviation change in our student behavior measure has roughly the same impact as the independent difference between boys and girls in mathematics.

Table 7: NAEP Mathematics Scores and Student Behavior Regression Analysis

	Grade 4		Grade 8		Grade 12	
Independent Variable	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
Behavior Measure	2.06*	0.59	1.34	0.73	2.00*	0.83
Large School	-1.59	1.61	-0.27	1.55	0.95	2.25
Small School	-3.26	2.40	-0.97	2.55	-1.05	2.55
Low Poverty	9.27*	1.97	5.81*	2.37	5.55*	2.52
High Poverty	-10.89*	1.89	-8.84*	1.93	-7.37*	1.98
Urban	1.26	1.56	2.04	1.59	3.51*	1.58
Rural	-0.07	1.93	-0.18	1.90	-2.15	2.96
Non-Catholic Private	-1.45	2.15	-2.96	2.73	1.52	3.27
Catholic Private	-2.88	1.67	-4.69*	2.15	0.79	2.90
Female	-2.03*	0.75	-1.88*	0.68	-2.80*	0.75
Black	-20.61*	1.71	-29.75*	1.49	-27.81*	1.69
Hispanic	-15.77*	1.61	-19.51*	1.58	-15.64*	2.07
Three Types of Reading Materials in the Home	6.67*	1.09	5.12*	1.39	2.94*	1.39
Four Types of Reading Materials in the Home	11.59*	0.97	11.26*	1.29	6.66*	1.35
Parent education. < H.S.			-2.20	1.73	-3.92	2.13
Parent education: HS+, not BA			11.99*	1.32	10.12*	1.34
Parent education: BA or more			15.50*	1.07	17.18*	1.33
Intercept	231.92*	1.51	270.29*	1.92	293.10*	2.73
R^2	0.26		0.27		.024	

Grades 4 and 8: Small = 1 – 300 students, Medium = 301 – 700 students, Large = more than 700 students
Grade 12: Small = 1 – 600 students, Medium = 601 – 1,000 students, large = more than 1,000 students

Low poverty = 0 – 5% students eligible for free or reduced-price lunch, Medium poverty = 6 – 50% students eligible for free or reduced-price lunch, High poverty = more than 50% students eligible for free or reduced-price lunch

Source: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Mathematics Assessment

Table 8 presents the regression results for parental involvement. These models suggest an even stronger relationship between parental involvement and achievement than we saw for student behavior. The independent relationship between the level of parental involvement at a school and NAEP mathematics scores was significant for all three grades. Holding other school and student characteristics constant, the models

estimated a three point increase in NAEP mathematics scores for each standard deviation increase in the parental involvement measure.

Table 8: NAEP Mathematics Scores and Parental Involvement Regression Analysis

	Grade 4		Grade 8		Grade 12	
Independent Variable	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
Parental Involvement Measure	3.38*	0.87	3.13*	0.88	3.04*	0.99
Large School	-0.68	1.56	-0.81	1.53	-0.60	2.34
Small School	-2.45	2.40	-0.77	2.46	-1.00	2.86
Low Poverty	8.16*	2.04	4.78	2.40	5.01	2.61
High Poverty	-9.87*	2.06	-8.39*	1.91	-7.42*	1.92
Urban	1.21	1.60	1.98	1.50	3.31*	1.52
Rural	1.15	1.84	0.07	1.92	-1.93	3.22
Non-Catholic Private	0.09	2.17	-3.15	2.93	0.73	3.42
Catholic Private	-3.18*	1.57	-7.48*	2.40	-1.09	3.02
Female	-2.20*	0.77	-1.84*	0.68	-3.18*	0.77
Black	-20.58*	1.73	-29.66*	1.46	-27.95*	1.75
Hispanic	-15.65*	1.63	-19.35*	1.54	-15.07*	2.07
Three Types of Reading Materials in the Home	6.44*	1.11	4.98*	1.38	2.79	1.41
Four Types of Reading Materials in the Home	11.39*	0.98	11.17*	1.29	6.45*	1.38
Parent education. < H.S.			-2.03	1.71	-3.04	1.92
Parent education: HS+, not BA			12.04*	1.34	10.36*	1.19
Parent education: BA or more			15.39*	1.07	16.81*	1.30
Intercept	231.13*	1.51	271.21*	1.94	294.14*	2.78
R^2	0.26		0.27		0.24	

Grades 4 and 8: Small = 1 – 300 students, Medium = 301 – 700 students, Large = more than 700 students
Grade 12: Small = 1 – 600 students, Medium = 601 – 1,000 students, large = more than 1,000 students

Low poverty = 0 – 5% students eligible for free or reduced-price lunch, Medium poverty = 6 – 50% students eligible for free or reduced-price lunch, High poverty = more than 50% students eligible for free or reduced-price lunch

Source: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Mathematics Assessment

Table 9 presents the regression results for school morale. The independent relationship between positive school moral and higher NAEP math scores was significant for all three grades. Holding other school and student characteristics constant, the models

estimated an increase of approximately two NAEP points on the mathematics scale for each standard deviation increase in the school morale measure.

Table 9: NAEP Mathematics Scores and Parental Involvement Regression Analysis

	Grade 4		Grade 8		Grade 12	
Independent Variable	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
School Morale Measure	2.21*	0.66	2.30*	0.69	2.02*	0.81
Large School	-1.50	1.61	-0.27	1.54	-0.46	2.33
Small School	-3.03	2.33	-0.36	2.52	-0.34	2.68
Low Poverty	9.10*	1.98	5.82*	2.45	5.40*	2.54
High Poverty	-10.82*	2.05	-7.91*	1.91	-7.70*	1.92
Urban	1.48	1.60	1.73	1.52	3.18*	1.54
Rural	0.02	1.90	-0.23	1.91	-2.25	3.08
Non-Catholic Private	-1.08	2.16	-3.23	2.82	1.38	3.69
Catholic Private	-2.80	1.64	-5.16*	2.16	0.12	3.17
Female	-2.08*	0.76	-1.89*	0.69	-2.82*	0.76
Black	-20.73*	1.75	-29.11*	1.47	-27.65*	1.74
Hispanic	-15.78*	1.62	-19.14*	1.58	-15.46*	2.02
Three Types of Reading Materials in the Home	6.74*	1.10	4.87*	1.39	3.07*	1.36
Four Types of Reading Materials in the Home	11.71*	0.95	10.97*	1.30	6.75*	1.35
Parent education. < H.S.			-2.05	1.74	-3.97	2.15
Parent education: HS+, not BA			11.81*	1.32	9.89*	1.33
Parent education: BA or more			15.39*	1.07	16.89*	1.33
Intercept	231.75*	1.50	270.25*	1.92	293.27*	2.67
R^2	0.26		0.27		0.24	

Grades 4 and 8: Small = 1 – 300 students, Medium = 301 – 700 students, Large = more than 700 students
Grade 12: Small = 1 – 600 students, Medium = 601 – 1,000 students, large = more than 1,000 students

Low poverty = 0 – 5% students eligible for free or reduced-price lunch, Medium poverty = 6 – 50% students eligible for free or reduced-price lunch, High poverty = more than 50% students eligible for free or reduced-price lunch

Source: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Mathematics Assessment.

CONCLUSION

The results presented in this paper support previous studies which found that school climate is multi-dimensional rather than uni-dimensional Using principle

component analysis, we identified three distinct school climate factors based on school administrators' responses to the NAEP 2000 school background survey. The questions on the NAEP school survey did not allow us to measure other factors that might influence school climate, such as the leadership style of the principal or the manner in which adults in the school interact with students and with each other. We suspect that many of these factors may be important aspects of school climate as well. Therefore, there may be additional independent components of school climate that were not identified in this study.

The findings presented in this paper suggest that school climate cannot be dismissed as simply being the product of fixed school conditions. The school characteristics we were able to measure —school size, school poverty level, type of school, and urbanicity of the community in which the school was located—accounted for less than half the variation in school climate among the schools in our sample. If school climate is to some extent independent of school characteristics, it may indeed be possible for administrators and teachers in an individual school to positively influence the climate in that school.

The findings in this paper also suggest that further study on the relationship between school climate and student achievement is merited. Because the data used in this paper are cross-sectional and do not include any baseline measure of student achievement, we cannot attribute causality to any of our findings. The connection between student achievement and school climate may run in either direction: higher achievement levels may lead to a better school climate or a better school climate may

lead to higher achievement letters. The data used in this paper do not allow us to distinguish between these two very different scenarios.

However, the fact that better student behavior, increased parental involvement, and higher school morale are positively associated with student achievement in mathematics, even after controlling for other school and student characteristics that are known to be related to student achievement, suggests that there is at least some possibility that improving school climate may result in an increase in student achievement. Confirming the direction of this relationship would require conducting additional studies that start with a baseline measure of student achievement and then relate improvements in achievement to differences in school climate.