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School Structural Characteristics, Student Effort, Peer Associations, and Parental Involvement

The Influence of School- and Individual-Level Factors on Academic Achievement

Endya B. Stewart

Florida State University

This research examines the extent to which individual-level and school structural variables are predictors of academic achievement among a sample of 10th-grade students abstracted from the National Educational Longitudinal Study database. A secondary analysis of the data produced the following findings. The study results show that individual-level predictors, such as student effort, parent-child discussion, and associations with positive peers, play a substantial role in increasing students' achievement. Furthermore, the results also suggest that school climate—in particular, the sense of school cohesion felt by students, teachers, and administrators—is important to successful student outcomes. In total, school structural characteristics were found to have relatively small effects on student achievement when compared with individual-level characteristics. Given these results, interventions aimed at improving academic achievement need take into consideration the impact of individual-level and school structural factors on students and their ability to succeed.

Keywords: *academic achievement; student characteristics; school structure*

Education researchers have long studied the impact of individual-level and school structural characteristics on student outcomes such as academic achievement. These researchers have observed that a variety of

Author's Note: The author is grateful to Eric Stewart, Patricia Boyer, Victor Battistich, and Ann Thompson for their helpful comments on drafts of this article. All errors and omissions are those of the author. Please address correspondence to Endya B. Stewart, Florida State University, Center for Criminology & Public Policy Research, 325 John Knox Road, Building L, Suite 102, Tallahassee, Florida 32303; e-mail: endyas@aol.com

individual-level and school structural variables are consistently linked to academic achievement, including school commitment (Battistich, Solomon, Kim, Watson, & Schaps, 1995; Marsh, 1992), school involvement (R. Brown & Evans, 2002; McNeal, 1995), school attachment (Crosnoe, Johnson, & Elder, 2004; Johnson, Crosnoe, & Elder, 2001), and school climate (Dupper & Meyer-Adams, 2002; Goldsmith, 2004; Lee & Bryk, 1989). Through analyses of students' individual behaviors and schools' structural characteristics, these studies have identified elements shown to positively affect academic achievement. Although it seems evident from the research that both individual-level and school structural variables affect academic achievement, the process by which this effect occurs is often described as complex (Feuerstein, 2000).

To address the complex effect of the school context on students' academic achievement, researchers have advocated a multilevel approach that focuses on the distinct effects of both individual- and school-level characteristics in explaining academic achievement (Battistich et al., 1995; Catsambis & Beveridge, 2001; Lee & Bryk, 1989; Pong, 1997). Although the investigation of single-level factors (individual or structural) is important, a multilevel, multifactor model possesses a distinct advantage over single-level models because it allows for the complex examination of multilevel characteristics associated with achievement (Schreiber, 2002).

Accordingly, this study sought to investigate the individual-level influences and school structural characteristics associated with academic achievement by using a multilevel framework among a national sample of 10th-grade students. Investigating individual-level and school structural characteristics that influence academic achievement is important because children spend a great deal of time in school, and therefore schools and school-related activities play key roles in the socialization of children and serve as the primary social setting for students (R. Brown & Evans, 2002; Voelkl, Welte, & Wieczorek, 1999). Furthermore, this study moves beyond the individual- and family-level factors typically studied to incorporate school-level factors that affect academic achievement. As Coleman (1990) argued, it is possible that the school's context can promote or reduce students' academic achievement. Multilevel modeling techniques were used with data from the National Educational Longitudinal Study (NELS) to explore how school structural characteristics (proportion non-White, school size, school poverty, school location, school social problems, and school cohesion) and individual-level covariates (school attachment, school motivation, school involvement, peer attachments, and parental school involvement) influence academic achievement among a national sample of 11,999 students from 715 high schools.

Review of the Empirical Literature

Individual-Level Characteristics and Student Achievement

Student effort and academic achievement. Student effort toward educational achievement or attainment is characterized by the level of school attachment, involvement, and commitment displayed by students. Measuring the effect of the effort that students devote to education is important in that such effort contributes to their educational achievement and attainment. A number of researchers have shown that the amount of effort that students put into their schooling affects their academic outcomes (Johnson, Crosnoe, & Elder, 2001; Marks, 2000; Natriello & McDill, 1986; Smerden, 1999). In a recent study, Carbonaro (2005) concluded that students' efforts had a significant, positive effect on math gains. Furthermore, research has shown that school attachment, which refers to students' feelings about or embedment in their school, is positively related to academic achievement (Johnson et al., 2001; Roscigno & Ainsworth-Darnell, 1999).

A number of studies have demonstrated an association between students' involvement with extracurricular activities and their grades (Broh, 2002; Fejgin, 1994; Guest & Schneider, 2003; Marsh, 1992; McNeal, 1995). In a study of high school students' extracurricular involvement, Guest and Schneider (2003) found that participation in extracurricular activities, such as sports, drama, and journalism clubs, was associated with increased levels of achievement. Furthermore, in a test of the effect of participation in extracurricular activities on high school achievement, Broh concluded that participation in interscholastic sports showed consistent benefits for students' grades, in particular, grades on math tests. Last, as Johnson et al. (2001) pointed out, students who feel more attached or embedded in their school exert more effort, and those who participate in extracurricular activities develop increased positive feelings toward school (p. 320). Thus, according to the literature, student effort as it relates to increased school involvement, school attachment, and school commitment should positively affect academic achievement.

Peer associations and student achievement. Peer groups have been cited as important to adolescent development (Nichols & White, 2001). In fact, as Nichols and White pointed out, there is a recognized need to account for peer group context as an important factor in adolescent socialization, motivation, and achievement. Research has shown that peer groups wield a great

deal of influence over the outlook students adopt toward achievement (Duncan, Boisjoly, & Harris, 2001; Horvat & Lewis, 2003; Kurdek, Fine, & Sinclair, 1995; Phelan, Davidson, & Ya, 1998; Wentzel & Caldwell, 1997). Furthermore, it is possible that peers yield more influence when they are close friends or acquaintances (Goldsmith, 2004; Hallinan & Williams, 1990).

Meaningful (or positive) relationships with peers are assumed to promote psychological and life skills for children and may be related to academic achievement and motivation (Cauce, 1986; Connell & Wellborn, 1991; Cotterell, 1992; Gonzales, Cauce, Friedman, & Mason, 1996; Greenberg, Siegel, & Leitch, 1983; Nichols & White, 2001). Duncan et al. (2001) discovered a high correlation between having best friends (i.e., peer relationships) and verbal achievement. Furthermore, in their study on the impact of peer networks on the academic achievement of algebra students in two high schools, Nichols and White found supportive evidence for the positive influence of student peer groups on achievement.

However, some peer groups apply negative peer pressure to those who excel academically (Cauce, Felner, & Primavera, 1982; Fordham & Ogbu, 1986; Gonzales et al. 1996; Horvat & Lewis, 2003; Steinberg, Dornbusch, & Brown, 1992). Researchers have argued that negative peer pressure has served to discourage students from conforming to values, attitudes, beliefs, and behaviors that raise achievement (Goldsmith, 2004; Ogbu, 1995a, 1995b). For example, the social disapproval or negative peer pressure experienced by some students might lead to dropping out of school (Nichols & White, 2001).

From these studies, it is apparent that the findings related to peer relationships and academic achievement are varied and complex. In their study of friendships, peer acceptance, and group membership, Wentzel and Caldwell (1997) concluded that "peer relationships serve varied functions in the academic lives of young adolescents" (p. 1206). Furthermore, they suggested that such relationships "might be particularly influential in promoting and enforcing sets of norms and values that can either undermine or facilitate academic achievement" (p. 1206). In addition, adolescents who associate with positive peers are more likely to take into consideration the negative reactions of peers before they act and are less likely to engage in behaviors that do not promote academic success (Kurdek et al., 1995; Nichols & White, 2001; Wentzel & Caldwell, 1997). Thus, according to the literature, having relationships with positive peers who support academic achievement should positively influence student achievement.

Parental school involvement and student achievement. A growing body of research has shown that students perform better academically when

parents are involved with their child's schooling (see, e.g., Astone & McLanahan, 1991; Catsambis & Beveridge, 2001; Christenson, Rounds, & Gorney, 1992; Coleman, 1990; Epstein, 1991; Fehrman, Keith, & Reimers, 1987; Feuerstein, 2000; Jeynes, 2003; Keith et al., 1993; Levine & Lezotte, 1990; Rumberger & Palardy, 2005; Sui-Chu & Willms, 1996; Thompson, 2002). In a recent study evaluating the effects of family and school capital on students' classroom achievement, Parcel and Dufur (2001) found that parental involvement in school activities had a positive impact on children's mathematics achievement. Overall, the research has shown that parents are instrumental to their children's academic success and that parental involvement has a positive impact on student achievement.

Typically, parental involvement includes attendance at teacher conferences and involvement in school activities, such as open houses and social activities. Intermittent contact with teachers and direct involvement with their child outside of the school setting also serve a monitoring function that allows parents to receive feedback about their child's academic performance and self-regulatory skills (Coleman, 1990; Hara, 1998; Jeynes, 2003). Furthermore, parents may also establish relationships with school administrators through involvement in parent-school organizations to influence school policy and monitor the performance of their child, teachers, and administrators. Through such participation, parents demonstrate the importance they attach to schooling and academic achievement. Parental involvement may thereby become a powerful influence on school and academic policies that may have a direct influence on their child's in-school activities and academic success. Thus, according to the literature, parental involvement should positively influence student achievement.

School Structural Characteristics and Student Achievement

Schools influence the academic and social development of their students, in particular their academic achievement, through their structure, staffing, organization, resources, and climate. Numerous educational researchers have studied school characteristics—such as type of school (public or private), size, student body demographics, and teacher qualifications—and their relationship to students' academic outcomes (Carbonaro, 2005; Coleman, 1990; Parcel & Dufur, 2001; Rumberger & Palardy, 2005). Schools exert their influence on their students' attachment, commitment, involvement, and, most important, academic achievement through their resources and climate (Freiberg, 1999).

Freiberg and Stein (1999) stated that "school climate is the heart and soul of a school" (p. 11). It is the school climate that either facilitates or constrains classroom instruction and student learning (Shields, 1991). School climate reflects students' perceptions of the impact of the school environment on their own well-being (S. P. Brown & Leigh, 1996; Crosnoe et al., 2004; Dupper & Meyer-Adams, 2002; Glisson, 2000). Lee and Bryk (1989) found that a safe and orderly school climate is associated with more equitable academic achievement between White students and students of color or non-White students. Furthermore, Rumberger and Palardy (2005) concluded that student reports of class disruptions (one of their measures of school climate) had a negative impact on student learning. They further mentioned that schools in which students felt that discipline was fair had lower attrition rates, yet the proportion of students who felt unsafe had a positive effect on both school dropout and attrition rates (i.e., the school dropout and attrition rates were higher).

The present investigation focuses on three dimensions of school climate: school culture, school organizational structure, and school social milieu. School culture focuses on the unwritten beliefs, values, attitudes, and various forms of interaction among students, teachers, and administrators (Anderson, 1982; Welsh, Jenkins, & Greene, 2001). A school's culture is important because it can affect students' learning and behavior (Dupper & Meyer-Adams, 2002; Wang, Haertel, & Walberg, 1997). Furthermore, school culture can also affect students' sense of belonging. As defined by Goodenow and Grady (1993), sense of belonging is the extent to which students feel accepted, respected, and supported in schools. Research has shown that students' sense of belonging influences academic achievement (Ma, 2003).

Another aspect of school climate is school organization. School organizational structure, which has largely been measured by class and school size, is another school characteristic thought to affect student outcomes. Several researchers have hypothesized that smaller school size, which is often associated with more personal attention, more opportunities for involvement, less anonymity for students, and a more caring academic environment, leads to positive behavioral and academic outcomes for students (Finn, 1989; Holland & Andre, 1987; Johnson et al., 2001; McMillen, 2004; Rumberger & Palardy, 2005). Moreover, varied studies have shown that large schools have lower test scores than midsized or small schools (Lee & Burkam, 2003; Lee & Smith, 1997). Larger schools are reported to have more problems with drop outs and expulsions, truancy, robbery, vandalism, alcohol and drug use, sale of drugs on school grounds, and behavioral issues (including disorderliness, physical or verbal conflicts among

students, physical or verbal abuse of teachers, and gangs) (Fetler, 1989; Fowler & Walberg, 1991; Haller, 1992; Heaviside, Rowand, Williams, & Farris, 1998; Lindsay, 1982; McMillen, 2004; Page, 1991; Pittman & Haughwout, 1987; Schoggen & Schoggen, 1988).

The third dimension of school climate under investigation is the social milieu of the school (Anderson, 1982; Gottfredson & Gottfredson, 1985; Welsh, 2000). The social milieu of a school refers to the background characteristics of the students, teachers, and administrators, including ethnicity, gender, socioeconomic status, and teachers' experience and training. These factors are believed to shape students' values, beliefs, attitudes, and behaviors regarding educational achievement and attainment (Alwin & Otto, 1977; Gamoran, 1992; Goldsmith, 2004). Furthermore, a number of studies have found lower achievement in predominantly minority schools (Bankston & Caldas, 2002; Crain & Mahard, 1983; Goldsmith, 2004; Orfield & Eaton, 1996; Pong, 1997).

Of further importance is the school's physical location. School location (urban, suburban, or rural) has been associated with student achievement (Rumberger & Palardy, 2005). Because most schools tend to be neighborhood schools, they typically reflect larger community-level processes (Gottfredson, 2001; Hellman & Beaton, 1986; National Institute of Education, 1978; Welsh, Greene, & Jenkins, 1999). Schools in urban, poor, and disorganized communities experience more school problems than schools in rural or suburban, affluent, and organized communities (Gottfredson, 2001). Research has shown that students attending schools in school districts that are large, urban, or both are often subject to conditions of school violence, high dropout rates, vandalism, inadequate equipment and facilities, greater numbers of inexperienced teachers, student and teacher alienation, and academic failure (Boyd, 1991; Montgomery & Rossi, 1994; Parham & Parham, 1989). Thus, according to the literature, urban schools should negatively influence student achievement.

Last, the socioeconomic status of the school's student body has been linked to academic achievement (Johnson et al., 2001). A school's socioeconomic status affects the levels of human, physical, and fiscal resources available to educate students. Several studies have suggested a relationship between low academic achievement and school poverty (Myers, Kim, & Mandala, 2004). According to Myers et al., school poverty can serve to "reduce the effectiveness of teacher resources" and, when used as a "proxy for social capital," lends itself to declining test scores when the social capital declines (p. 83). Thus, according to the literature, school poverty should negatively influence student achievement.

Hypotheses

A review of the literature has illustrated that academic achievement can be analyzed from two important levels—the individual and the school—and that achievement is affected by a number of factors at each level. The present study goes beyond an investigation of the individual-level factors that affect achievement and includes an investigation of the school structural characteristics that affect a change in students' achievement. Therefore, this study addresses a number of hypotheses linking individual-level and school structural characteristics to academic achievement. The following hypotheses drawn from the empirical literature are examined:

Hypothesis 1: Higher levels of student effort (as characterized by school involvement, school attachment, and school commitment) are associated with higher levels of academic achievement.

Hypothesis 2: Positive peer associations are associated with higher levels of academic achievement.

Hypothesis 3: Higher levels of parental involvement (as characterized by parent-child discussion and parental school involvement) are associated with higher levels of academic achievement.

Hypothesis 4: Schools characterized by many social problems (e.g., a disruptive school climate) have lower levels of academic achievement.

Hypothesis 5: Schools characterized by high levels of school cohesion (e.g., students' sense of belonging and social milieu) have higher levels of academic achievement.

Hypothesis 6: Schools with large student enrollments have lower levels of academic achievement.

Hypothesis 7: Schools with a higher proportion of non-White students have lower levels of academic achievement.

Hypothesis 8: Schools located in urban areas have lower levels of academic achievement.

Hypothesis 9: School poverty is associated with lower levels of academic achievement.

Method and Procedures

Data and Sample

To test these hypotheses, data were abstracted from the second wave (1990) of the NELS, a comprehensive national probability study of students, teachers, schools, and families designed and funded by the National Center for Education Statistics (NCES). Students, teachers, school

administrators, and families were interviewed every 2 years. During the first wave of data collection in 1988, the NCES drew random samples of about 25 eighth-graders in each of about 1,000 schools. During the second wave of data collection, a subsample of the original group was interviewed in Spring 1990 when most of the original sample was enrolled in the 10th grade. The sample was freshened to generate a representative sample of 10th-grade students in the United States in 1990 (Ingles, Scott, Taylor, Owings, & Quinn, 1998). The retention rate from Wave 1 to Wave 2 was 74%, with a response rate of more than 90% for both students and school administrators (and 87% for teachers). Details of the NELS sample design and procedures are provided in the NCES reports (see Ingles et al., 1998).

In the current study, analyses are based on 11,999 students nested within 715 high schools. Within the 715 schools, the number of students sampled ranged from a low of 15 students per school to a high of 65 students per school, with an average of 17 students per school. Moreover, African Americans were the largest minority group in the sample (12.0%), followed by Latinos (9.6%), Asians (7.2%), and Native Americans (1.2%). White students made up 70% of the sample. Fifty-three percent of the sample was female. Data collected about individual-level characteristics were based on student reports. Also, school officials (administrators and teachers) and students provided information about school characteristics. Finally, unlike the initial survey (1988) undertaken when the students were in eighth grade, the second-wave survey (1990) provided a variety of peer influence and teacher expectation measures.

Dependent Variable

Students reported their current grades in math, English, history, and science. The construct was coded on a 5-point scale, on which 4 represents an A in most classes and 0 represents a grade below D in most classes. The values range from 0 to 16, with higher values on this construct indicating a higher grade point average. The coefficient alpha for the construct was .73.

Level 1 (Within-School) Measures

Student effort. Student effort was measured by the following three variables: school attachment, school involvement, and school commitment. These variables are described in detail below.

1. *School attachment.* The students indicated the extent to which they care about and have positive feelings for school. The seven-item scale used to

measure school attachment included the following items: "My teachers are interested in students," "Most of my teachers care about me," "My teachers praise my effort," "In class I often feel 'put down' by my teachers" (reverse-scored), "In school I often feel 'put down' by other students" (reverse-scored), "There is real school spirit," and "Discipline is fair." The response format for the items ranged along a 4-point continuum from 1 (*strongly disagree*) to 4 (*strongly agree*). The items were summed to create an index of school attachment. The values range from 7 to 28, with higher values indicating higher levels of attachment to school. The coefficient alpha was .74.

2. *School involvement.* The students were asked whether they participated in a specified activity during the current school year. An index of school involvement was created from the summed total of the students' affirmative responses to 16 school activities. An example of the questions is "Do you participate in band, student government, sports, service clubs, honor clubs, etc.?" The response format for the items was binary (1 = *did not participate* and 2 = *participate*). Scores on the composite index range from 16 to 32, with higher values representing more involvement. Because the scale is composed of dichotomous items, the Kuder-Richardson Formula 20 (KR_{20}) is the appropriate reliability coefficient (Kuder & Richardson, 1937). The KR_{20} coefficient was .82.
3. *School commitment.* The students were asked to indicate their commitment to education on a scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). A four-item scale used to measure this construct included the following: "I get a feeling of satisfaction from doing what I'm supposed to do in class," "I think the subjects I'm taking are interesting and challenging," "Education is important for getting a job later," and "It is important to work hard for good grades." The items were summed to create an index of school commitment. The values range from 4 to 16, with higher values representing greater commitment. The coefficient alpha for the scale was .79.

Association with positive peers. The students were asked to indicate how important it is for them to engage in positive education-oriented behaviors among their peers or the friends they hang out with on a scale ranging from 1 (*not important*) to 3 (*very important*). The three-item scale used to measure association with positive peers included "Among the friends you hang out with, how important is it for you to study; get good grades; and finish high school?" The items were summed to create an index of association with positive peers. The values range from 3 to 9, with higher values indicating greater association with positive peers. The coefficient alpha for the scale was .75.

Parental school involvement. The students were asked to indicate the extent to which their parents or guardians engaged in a variety of school activities such as attending school meetings and acting as a school volunteer on a scale ranging from 1 (*never*) to 3 (*more than twice*). The six items used to measure this construct were summed to create an index of parental school involvement. The values range from 6 to 18, with higher values representing higher levels of parental involvement. The coefficient alpha for the scale was .83.

Parent-child discussion. The students were asked to indicate the extent to which they engaged in discussion with their parents on issues such as “selecting courses or programs at school,” “school activities or events of particular interest,” and “things studied in class” on a scale ranging from 1 (*never*) to 3 (*often*). The three items used to measure this construct were summed to create an index of parent-child discussion. The values range from 3 to 9, with higher values representing higher levels of discussion. The coefficient alpha for the scale was .98.

Demographic control variables. In the current study, family structure, gender, ethnicity, and family socioeconomic status (SES) were controlled for because these demographic factors have been shown to be associated with academic achievement (Astone & McLanahan, 1991; Battle & Coates, 2004; Christenson et al., 1992; Johnson et al., 2001; Noguera, 2003; Roscigno & Ainsworth-Darnell, 1999; Schreiber, 2002). Family structure is a dichotomous variable denoting households in which there are two parents in the home, in comparison with single-parent homes (0 = single-parent family, 1 = two-parent family). Gender is a dichotomous variable with female gender (0) as the reference group. Ethnicity is measured by a dichotomous variable on which 1 indicates non-White (i.e., African American, Asian, Hispanic, or Native American) and White (0) is the reference group. Family SES was formed by two measures: parents' highest level of education and family income. Parents reported the highest level of education they had completed and the amount of money they earned during the previous year. These two measures were standardized and summed to form a composite measure of family SES.

Level 2 (Between-Schools) Measures

All of the school-level variables were based on the school administrators', teachers', and students' reports of selected school characteristics.

School size represents the total student enrollment of the school and ranged from 500 to 2,500. Proportion non-White represents the proportion of non-White students in each of the schools. School poverty represents the proportion of students within each school who are receiving free or reduced price lunch. School location represents whether the school is located in an urban (1) or nonurban (0) geographic area.¹

School social problems. School administrators and students provided information regarding school social problems. This construct assesses whether the school is experiencing a range of student behavioral problems. Administrators answered 13 items that indicated the degree to which each of the following was a problem with students in their school: tardiness, absenteeism, class cutting, physical conflicts, gang activity, robbery or theft, vandalism, use of alcohol, use of illegal drugs, possession of weapons, physical abuse of teachers, verbal abuse of teachers, and racial or ethnic conflict. The response format ranged from 1 (*not a problem*) to 4 (*a serious problem*).

Students answered three items that asked them to indicate the number of times they had experienced social problems while at school on a scale ranging from 0 (*never*) to 2 (*more than twice*). The items were “I had something stolen from me at school,” “Someone offered to sell me drugs at school,” and “Someone threatened to hurt me at school.” To create a composite measure of school social problems, school administrator and student responses were standardized and summed. The values of this measure range from -2.37 to 5.21 , and higher scores indicate more social problems at school. The coefficient alpha for the measure was $.84$.

School cohesion. Teachers and students provided information regarding school cohesion. This construct is a global measure that assesses the extent to which there is trust, shared expectations, and positive interactions among students, teachers, and administrators. Teachers responded to 18 items. Teachers were asked to indicate the extent to which they agreed or disagreed with the following various statements about their school environment: “You can count on most staff members to help out anywhere, anytime—even though it may not be part of their official assignment,” “There is a great deal of cooperative effort among staff members,” “There is broad agreement among the entire school faculty about the central mission of the school,” “I usually look forward to each working day at this school,” “This school seems like a big family; everyone is so close and cordial,” “If I try really hard, I can get through even to the most difficult or

unmotivated students,” “I feel that it’s part of my responsibility to keep students from dropping out of school,” “If some students in my class are not doing well, I feel that I should change my approach to the subject,” and “I am certain I am making a difference in the lives of my students.” The response format ranged from 1 (*strongly disagree*) to 6 (*strongly agree*).

Students were asked to indicate whether they felt there was cohesion in their school on a scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). There were five items, including “My teachers care about me and expect me to succeed in school,” “Students make friends with students of other racial and ethnic groups,” “Students get along well with teachers,” “My teachers care about me and expect me to succeed in school,” “Most teachers really listen to what students have to say,” and “Students help other students with their schoolwork.” The teacher and student responses were standardized and summed to form a composite measure of school cohesion. The values on this measure range from -2.91 to 4.95 , and higher scores indicate greater school cohesion. The coefficient alpha for the scale was $.79$.²

Analytic Strategy

In the NELS data used for this study, the students are nested within schools. A statistical model must be able to account for nested data, as well as the individual-level and school structural effects on students’ GPA, to test a comprehensive model of these influences. Therefore, hierarchical linear modeling (HLM) was used to analyze the data. Over the past two decades, HLM methods have been created to address statistical problems related to the analysis of nested (or multilevel) data (Raudenbush & Bryk, 2002). One of the advantages of HLM is that it allows simultaneous estimation of relationships within a particular hierarchical level, as well as relationships between or across hierarchical levels (Bryk & Raudenbush, 1992).

These models explicitly recognize that individuals within a particular school may be more similar to one another than individuals in another school and, therefore, may not provide independent observations. HLM models avoid violating the assumption of independence of observations that traditional ordinary least squares analysis commits in analyzing hierarchical data (Bryk & Raudenbush, 1992). Furthermore, HLM also allows for simultaneous estimation of both individual-level and school structural variance components on the outcome variable of interest (e.g., GPA), while still maintaining the appropriate level of analysis for the independent variables.

HLM models adopt a two-level approach to multilevel investigations in which the Level 1 (within-school) model estimates the average association

of individual-level predictors to the outcome variables among schools in the sample. These effects are then statistically controlled for in analyses of between-school relationships. In the present study, the Level 1 model takes the form of the following regression-based equation:

$$(GPA)_{ij} = \beta_{0j} + \beta_{1j}(X_{ij} - X_{.j}) + r_{ij},$$

where β_{0j} is the intercept for each j th school, β_{1j} is the slope for each j th school, $(X_{ij} - X_{.j})$ is each individual's score on the Level 1 predictor (e.g., school attachment) after subtracting the average score for the individual's school, and r_{ij} is the residual.

The Level 2 analysis for this study uses the intercept from the Level 1 analysis as a dependent variable.³ The Level 2 model takes the following form:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{proportion non-White}) + \gamma_{02}(\text{school size}) + \gamma_{03}(\text{school poverty}) + \gamma_{04}(\text{school location}) + \gamma_{05}(\text{school social problems}) + \gamma_{06}(\text{school cohesion}) + U_{0j},$$

where γ_{00} is the average GPA score across schools, γ_{01} through γ_{06} are the Level 2 regression coefficients (school effects) on GPA, and U_{0j} is the between-unit error or the unique effect of school j th on mean GPA. HLM is typically defined by this two-level modeling (Bryk & Raudenbush, 1992).

Three models were estimated for this study. First, an unconditional, random analysis of variance (ANOVA) model (i.e., a model with no predictors or control variables) was estimated. This model, also known as the null model, estimates the overall between-school variance for the outcome measure, GPA, and provides a baseline for comparison with later models. Second, an individual-level model was estimated to control for student characteristics in each school. Last, a full model with school structural effects was estimated. This model allows for comparison of various school structural measures on GPA. Furthermore, it is important to note that individual-level predictors are controlled in the estimation of school structural effects. Therefore, the individual-level and structural models are statistically independent (i.e., estimates of school contextual effects are not confounded by individual-level effects).

Results

Table 1 provides the descriptive statistics and correlations with GPA of all the study variables. The table shows support for several of the hypotheses. For example, two of the student effort measures, school attachment and

Table 1
Descriptive Statistics and Correlations With Grade Point
Average (GPA) for the Study Variables

Variable	<i>M</i>	<i>SD</i>	GPA
Individual level			
School attachment	17.8	2.4	.15*
School commitment	8.4	1.9	.15*
School involvement	17.7	2.9	.02
Positive peers	4.7	1.3	.06*
Parent-child discussion	5.8	1.6	.07*
Parental school involvement	11.9	2.2	.04*
Gender (1 = male)	0.47	0.50	.02
Family structure (1 = two parent)	0.68	0.45	.08*
Ethnicity (1 = non-White)	0.30	0.46	.07*
Family socioeconomic status	3.2	1.4	.08*
School context			
School poverty	39.5	11.4	-.03
Proportion non-White	43.2	22.2	-.05*
School location (1 = urban)	0.59	0.39	-.03
School size	1,539.7	685.8	-.05*
School social problems	2.9	1.2	-.06*
School cohesion	1.9	1.5	.14*
Dependent variable			
GPA	5.64	2.26	—

Note: $N = 11,999$ students; $N = 715$ schools.

* $p < .05$.

school commitment, are significant and positively associated with GPA. The zero-order correlations between both school attachment and school commitment with GPA are both .15. Also, as expected, positive peer associations, parent-child discussion, and parental school involvement are significantly and positively associated with student GPA. Moreover, three of the school-level variables show significant and negative zero-order correlations with GPA: proportion non-White, school size, and school social problems. School cohesion shows a significant and positive relationship (.14) with GPA. Next, the multilevel multivariate results are presented.

Multilevel Analyses

The first step in the multilevel analyses was to estimate a random ANOVA model for the dependent variable, GPA. Although the ANOVA model contains no predictors, it provides a base model for comparison with

subsequent models. Most important, it provides an estimate of how much of the variance in the dependent variable is within schools (Level 1) and between schools (Level 2). The results of the ANOVA test are presented in Model 1 of Table 2. As the data in Table 2 show, the total variance in the dependent variable, GPA, was 5.17. The amount of variance within schools was 3.84. The between schools variance was 1.33. This implies that about 74.3% of the variance in GPA lay within schools, and the remaining 25.7% occurred between schools.

Furthermore, the null hypothesis of no variation in the average GPA between the schools was rejected, $\chi^2(1, N = 714) = 4,487, p < .01$. This finding means that although most of the variance in GPA is within schools (74.3%) rather than between schools (25.7%), there is significant between-schools variance that can be modeled.

Level 1 (Within-School Analyses)

The second step in the multilevel analyses was to build a Level 1 regression model using individual-level variables as predictors of GPA. The Level 1 model included the following individual-level predictors of GPA and control variables: school attachment, school commitment, school involvement, positive peers, parent-child discussion, parental school involvement, gender, family structure, ethnicity, and family SES. Each effect is adjusted for all other effects in the model. The results of the within-school tests are presented in Model 2 of Table 2.

Of the 10 Level 1 covariates, 7 were significantly related to GPA. Two of the school effort measures, school attachment and school commitment, were significantly and positively related to GPA. This indicates that students who display higher levels of effort in their schooling, as measured by school attachment (.15) and school commitment (.19), have higher GPAs. Furthermore, associations with positive peers (.09) and parent-child discussion (.08) were significant predictors. The direction of the effect suggests that frequent associations with positive peers and parent-child discussions are associated with higher GPA. Family SES (.06) was also significantly and positively related to self-reported GPA. There were two significant inverse relationships with GPA: family structure (-.08) and ethnicity (-.07). This suggests that (a) students from single-parent families have lower GPAs than students from two-parent families and (b) non-White students have lower GPAs than White students. Contrary to expectations, school involvement was not significantly related to GPA. Also, parental school involvement was not significantly related to GPA. Collectively, these

Table 2
Multilevel Regressions of Individual-Level and School Structural Variables on Grade Point Average

Variable	Model 1: Unconditional			Model 2: Individual			Model 3: School		
	<i>b</i>	<i>SE</i>	<i>t</i>	<i>b</i>	<i>SE</i>	<i>t</i>	<i>b</i>	<i>SE</i>	<i>t</i>
Intercept, γ_{00}	5.73	.04	143.25**	5.76	.04	144.00**	5.70	.04	142.50**
Individual level									
School attachment	—	—	—	.15	.02	7.50**	.15	.02	7.50**
School commitment	—	—	—	.19	.02	9.50**	.18	.02	9.00**
School involvement	—	—	—	.003	.03	0.10	.003	.03	0.10
Positive peers	—	—	—	.09	.03	3.00**	.08	.03	2.67**
Parent-child discussion	—	—	—	.08	.03	2.67*	.06	.03	2.00*
Parental school involvement	—	—	—	.02	.02	1.00	.02	.02	1.00
Gender (1 = male)	—	—	—	.02	.02	-1.00	.02	.02	-1.00
Family structure (1 = two parent)	—	—	—	-.08	.03	2.67**	-.08	.03	2.67**
Ethnicity (1 = non-White)	—	—	—	-.07	.03	-2.33*	-.07	.03	-2.33*
Family socioeconomic status	—	—	—	.06	.03	2.00*	.06	.03	2.00*
School structural									
School poverty	—	—	—	—	—	—	.007	.06	.12
Proportion non-White	—	—	—	—	—	—	.003	.06	.05
School location (1 = urban)	—	—	—	—	—	—	.05	.04	1.25
School size	—	—	—	—	—	—	-.05	.04	-1.25
School social problems	—	—	—	—	—	—	.09	.07	1.29
School cohesion	—	—	—	—	—	—	.22	.02	11.00**
Random effects									
Between schools (τ_{00})	1.33				1.31			0.98	
Within schools (<i>r</i>)	3.84				2.01			2.01	
Total	5.17				3.32			2.99	
χ^2	4,487**				4,251**			4,208**	

Note: $N = 11,999$ students; $N = 715$ schools.

* $p < .05$. ** $p < .01$.

findings indicate that students who are attached and committed to school, associate with positive peers, engage in parent-child discussion, live in high-SES two-parent families, and are nonminority have higher GPAs. Individual-level characteristics accounted for about 47.6%⁴ of the within-school variance in GPA.

Level 2 (Between-School Analyses)

In the Level 2 analyses, the extent to which the adjusted variations in the average level of GPA (the intercept) are explained by the combined effects of the Level 2 and Level 1 predictors was examined. Six between-school (Level 2) predictors of GPA were examined: school size, proportion non-White, school poverty, school location, school social problems, and school cohesion. As in the within-school model, each effect is adjusted for all other effects in the model. Thus, the 10 Level 1 variables shown in Table 2 are controlled in these analyses.

Model 3 of Table 2 shows that after controlling for individual-level variables, only one of the six school structural variables had a significant effect on GPA: school cohesion (.22). Schools with greater cohesion (i.e., more positive interactions and trust among students and teachers) had higher average student GPAs. Surprisingly, school poverty, proportion non-White, school location, school size, and school social problems were not significantly associated with average GPA when school cohesion and individual-level predictors were taken into account.

Recall from Model 1 (the unconditional model) that the initial variance for GPA between schools was estimated as 1.33. In Model 3, the between-school variables accounted for a reduction of 26.3%⁵ in the variance of the dependent variable. This translates to about 26.3% of the variance in GPA being explained by school structural-level predictors. In Model 1, the percentage was 25.7.

Discussion and Conclusion

The present study used a sample of U.S. 10th-grade students to investigate the relationships between academic achievement and individual-level and school structural predictors. Overall, the general conclusion from the analyses is that there are substantial associations between the individual-level predictors and students' academic achievement. It was determined from the results that school structural factors have relatively small effects

on student achievement in comparison with individual-level student characteristics. Support was also found for the hypothesized relationship between school cohesion and academic achievement.

The Level 1 results were consistent with several of the hypothesized relationships. First, school attachment and school commitment were significantly associated with academic achievement, which suggests that as students feel a sense of attachment and show signs of commitment to school and schoolwork, they have higher GPAs. In other words, those students who care about and feel supported by their teachers and friends are more likely to develop affective ties to school and display socially acceptable behavior. Furthermore, students with well-defined educational goals who invest greater effort and display higher aspirations for status attainment may be more committed to the overall educational process (Carbonaro, 2005).

Second, the hypothesized relationship between student involvement in school and academic achievement was not supported. Research on the relationships between student school or extracurricular involvement and academic achievement reported both significant and nonsignificant relationships (Broh, 2002; R. Brown & Evans, 2002; Marsh, 1993; Schreiber & Chambers, 2002). For example, research has found that student participation in selected fine arts activities, intramural or high school sports, and vocational clubs had no significant relationships to academic success (Broh, 2002; R. Brown & Evans, 2002; Marsh, 1993). In explaining this nonsignificant finding, it is possible that students' participation in extracurricular activities diverts time and energy away from valuable academic time or activities designed to increase students' achievement (Schreiber & Chambers, 2002). Because there are different types of extracurricular activities, not all forms of participation in these activities are consequentially equal, and students, therefore, do not gain the same advantages from participation (Broh, 2002). Nevertheless, it is important to mention that although the current study does not find a significant relationship between student involvement and academic achievement, schools should not abandon or reduce efforts to encourage student involvement in extracurricular activities. In addition to the benefit to students' grades, participation in extracurricular sports may foster a sense of belonging or community and a sense of self-pride in students.

Third, positive peer associations were significantly associated with academic achievement. As adolescents associate with friends who value education and are committed to academic pursuits, they create attachments to school and conform to the ideals associated with it. Furthermore, positive peers provide important reference points for students and help them invest

in their education (Horvat & Lewis, 2003; Nichols & White, 2001; Wentzel & Caldwell, 1997).

Fourth, parent-child discussion was found to be significantly associated with academic achievement, thereby suggesting that parental engagement in education-related discussion with their children was an effective tool for increasing students' academic achievement. This form of parental involvement in students' academic lives is crucial in promoting achievement (Catsambis & Beveridge, 2001; Desimone, 1999; Hara, 1998; Muller, 1998; Rumberger & Palardy, 2005; Sanders, 1998; Shaver & Walls, 1998).

Moreover, although academically relevant parent-student discussion was found to be influential, the expected relationship between parental school involvement and students' academic achievement was not corroborated by the analyses. This, however, does not necessarily negate the importance of parents' involvement in their children's school activities. The present finding might be interpreted as follows: Many more forms of parental educational activities occur at home with the children than in school (Catsambis & Beveridge, 2001; Desimone, 1999; Fine & Cook, 1993; Jeynes, 2003); therefore, parental involvement occurring in the school was possibly considered less effective than that at home.

Among the control variables, family SES, family structure, and ethnicity were found to be significantly associated with academic achievement. Specifically, students from higher SES and two-parent families had higher levels of academic achievement than students from low-SES and single-parent families. Also, students who were classified as minority had lower achievement levels than their White counterparts. Gender was not significantly related to academic achievement.

Turning to the school structural predictors, school cohesion was found to be significantly related to academic achievement. Students who attend schools with a supportive and inviting environment have significantly higher academic achievement, as believed by students, their parents, teachers, and school administrators (Anderson, 1982; Freiberg, 1999; Shields, 1991; Welsh et al., 2001). Furthermore, once individual-level predictors such as ethnicity and SES are taken into account, the concentration of social problems, proportion non-White, and poverty in a school, as well as the school's location and size, do not significantly relate to average achievement. This study suggests that the educational ills commonly associated with large, urban, minority schools are mitigated by a cohesive school environment. In other words, school contexts in which there was a great deal of cooperation among teachers and administrators, support for students, and clear expectations about the school's mission appeared to translate into higher levels of

achievement, irrespective of school social ills. The current findings, coupled with other findings, suggest that the school's climate is extremely important to successful student outcomes (Anderson, 1982; Carbonaro, 2005; Johnson et al., 2001; Shields, 1991; Welsh et al., 2001).

This study has attempted to address the individual-level and school structural predictors that significantly affect students' academic achievement. In short, the results of the current study suggest that individual-level predictors, such as student effort, parent-child discussion, and associations with positive peers, are substantially associated with a student's achievement level. Policy aimed at the improvement of students' achievement needs to consider the impact of individual and school factors on achievement to reach desired outcomes.

Notes

1. Urban schools were defined as central city schools, whereas nonurban schools consisted of schools that were located in suburban and rural areas. In the current study, 59% of the schools were defined as urban, 22% were defined as suburban, and 19% were defined as rural. Because suburban and rural schools did not differ significantly on key variables, they were combined to represent nonurban schools.

2. To assess multicollinearity among the predictor variables, I estimated regression models and examined the variance inflation factor (VIF). The VIF statistics measure the extent to which standard errors in ordinary least squares parameter estimates are inflated because of the presence of collinearities (Fisher & Mason, 1981). A commonly accepted practice regards VIFs greater than 4.0 to be an indicator of multicollinearity. In the present study, multicollinearity does not appear to be a problem, as none of the VIFs was greater than 2.4.

3. HLM techniques for the Level 2 variables also use the slopes from the Level 1 analysis as a dependent variable. However, based on preliminary analyses, I constrained all within-school slopes to be fixed across schools because they did not significantly vary.

4. Using the within-school variance totals for Models 1 (unconditional) and 2 (individual), the percentage that individual-level characteristics accounted for was calculated as follows: $3.84 - 2.01 = 1.83 / 3.84 = 0.476 * 100 = 47.6$.

5. Using the between-school variance totals for Models 1 (unconditional) and 3 (school), the percentage that between-school variables accounted for was calculated as follows: $1.33 - 0.98 = 0.35 / 1.33 = 0.263 * 100 = 26.3$.

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Endya B. Stewart received her PhD in Education from Iowa State University. She is currently an associate in research at the Criminology and Public Policy Research Center at Florida State University. Her research interests include the predictors of academic achievement, the effective integration of technology into teaching and learning, and teacher quality.