

# The Role of Single-Sex Education in the Academic Engagement of College-Bound Women: A Multilevel Analysis

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**Background/Context:** *As opportunities for public and private single-sex education have expanded, the debate surrounding this issue has become more heated. Recent reviews of research on single-sex education have concluded that the evidence is mixed, due in large part to the difficulty of attributing differences between single-sex and coeducational students specifically to the single-sex nature of their experience, as opposed to other differences between single-sex and coeducational schools and their attendees. This study comes at a time of renewed national interest in the value and appropriateness of single-sex education, especially as changes to Title IX have expanded the opportunities to establish single-sex classes and activities, and contributes new data with a focus exclusively on the academic engagement of female students from single-sex and coeducational high schools.*

**Purpose/Objective/Research Question/Focus of Study:** *This study addresses whether levels of academic engagement differ between single-sex and coeducational settings.*

**Research Design:** *The study uses self-reported survey data and multilevel modeling to address secondary school-level effects in a national sample of women entering college.*

**Findings/Results:** *The analyses suggest that attendance at a single-sex high school remains a significant predictor of academic engagement even after controlling for the confounding*

role of student background characteristics, school-level features, and peer contexts within each school. Specifically, women attending all-girls high schools report higher levels of academic engagement across numerous fronts: studying individually or in groups, interacting with teachers, tutoring other students, and getting involved in student organizations. However, these results may also be attributed to other features that differentiate single-sex from coeducational schools, such as smaller enrollments and racial/ethnic diversity of the schools in this study.

**Conclusions/Recommendations:** *Although the results of this study support the claims that all-female environments provide a unique opportunity for young women to thrive, these results should be interpreted with some caution. Because of the limitations of the study, it is difficult to make definitive inferences about the relationship between single-sex education and academic engagement, and we cannot assert with confidence that school gender alone is responsible for higher academic engagement. The study points the way for future research that further distinguishes the role of individual and school-level attributes and ideally examines this issue using longitudinal data. Finally, given the current expansion of single-sex education in the public schools, future research ought to employ these methodological advances in studies on single-sex public education and should consider the consequences of single-sex settings for both female and male students.*

Interest in single-sex education has been on the rise over the past two decades, first in the private sector and more recently in the public sector following the U.S. Department of Education's 2006 authorization of single-sex classes in public schools. As opportunities for public and private single-sex education have expanded, the debate surrounding this issue has become more heated. Sex-segregated schools and classrooms are viewed by many as possible antidotes to gender inequities that have been documented throughout education (as discussed in American Association of University Women, 1992; Sadker & Sadker, 1994; and Sadker, Sadker, & Zittleman, 2009). Others, however, raise concerns that single-sex settings run the risk of reinforcing sex-based stereotypes and exacerbating gender gaps in educational opportunity (Meece, Bower Glienke, & Burg, 2006; Morse, 1998). Furthermore, at a time of increasing educational attainment and academic success among women nationwide (Sax, 2008), one may ask whether the need for single-sex education has become obsolete.

The ongoing debate over single-sex education has led to greater demand for evidence of its effectiveness (Datnow & Hubbard, 2002; U.S. Department of Education, 2005). Researchers, educators, policy makers, and the public at large want to know whether single-sex education makes a difference and, if so, how and for whom. Recent reviews of research on single-sex education have concluded that the evidence is mixed, due in large part to the difficulty of attributing differences between single-sex

and coeducational students specifically to the *single-sex* nature of their experience, as opposed to other differences between single-sex and coeducational schools and their attendees (Morse, 1998; Salomone, 2006; Smithers & Robinson, 2006; U.S. Department of Education). All reviews emphasize the need for more research on single-sex education, especially research that examines a variety of outcomes, uses large and representative samples, and relies on sophisticated methodologies that can disentangle the effects of single-sex schooling from other confounding influences (Arms, 2007; Lee, 2000; Mael, 1998; U.S. Department of Education).

This study contributes new data to the debate over single-sex education with a focus exclusively on the academic engagement of female students from single-sex and coeducational high schools. Academic engagement can be broadly understood as physical and intellectual participation in activities related to school and is associated with social and cognitive development (Marks, 2000; Yazzie-Mintz, 2009), high school graduation, and college attendance (Marks). Advocates of single-sex education argue that without the distraction of men, all-female environments may promote greater academic engagement for female students (Karpiak, Buchanan, Hosey, & Smith, 2007; Lee & Marks, 1990; Monaco & Gaier, 1992). To provide context and new evidence to the single-sex debate, this study addresses whether levels of academic engagement (as reflected in self-reported time spent on academic tasks, interaction with teachers, participation in student groups, and interactions with other students) differ between women in single-sex and coeducational settings.

## BACKGROUND

Academic engagement can be understood as involvement in school activities generally, effort put into learning activities specifically, and motivation to learn (Marks, 2000). Marks defined academic engagement as a psychological construct, describing it as “the attention, interest, investment, and effort students expend in the work of learning” (p.155). The High School Survey of Student Engagement (HSSSE) includes specific behavior-related activities in its definition (e.g., class attendance and time spent on academic tasks) but measures two other dimensions as well, including extracurricular academic involvement and emotional engagement (how a student feels about his or her connection to school; Yazzie-Mintz, 2009). These definitions emphasize that academic engagement is not a unidimensional construct focusing on time-on-task alone, but rather includes behavioral, cognitive, and emotional elements (Yonezawa, Jones, & Joselowsky, 2009). In light of the definitions offered

here, and in light of the limitations of our data, this study focuses on the behavioral aspects of academic engagement, including time spent studying or tutoring peers, informal interactions with teachers, and participation in different student groups.

Academic engagement in high school is positively related to academic success (such as higher grades) and propensity to graduate (Cole & McCormick, 2009; Marks, 2000). Additionally, the cognitive aspect of engagement is linked to socialization toward concentration and attention to task skills (Marks). At the college level, academic engagement has been found to be an important element in college student success and in the retention of students from the first year into the second year and on to graduation (Pike & Kuh, 2005; Reason, Terenzini, & Domingo, 2006). However, a number of studies have found differences in levels of academic engagement based on key student characteristics, including gender, race/ethnicity, and class, as well as differences in how students in K–12 may be differently engaged based on whether they attend a single-sex school. The following sections elaborate on the need for research related to school context (e.g., school gender) and for research that considers student characteristics and identifies the ways in which the present study meets these needs.

## GENDER AND ACADEMIC ENGAGEMENT

In both high school and college, women appear to be more academically engaged than men (Cole & Gonyea, 2008; Sax, 2008; Yonezawa et al., 2009); women report significantly more time spent studying and talking with teachers in high school than their male classmates. Findings by Cole and Gonyea (2008), and supported by Sax, indicate that high-achieving high school women are more involved with cocurricular activities than are high-achieving men. Cole and Gonyea also found that women have higher levels of expected college engagement than men. The higher levels of academic engagement among women correspond to academic gains women have made in recent decades, including increased college attendance and degree attainment (King, 2006; Sax).

Despite women's gains on many academic fronts, recent research highlights the persistent nature of certain gender inequities, particularly in elementary and secondary school classrooms (Carlone, 2004; Karpiak et al., 2007; Meece et al., 2006; Sadker et al., 2009). In their review of research, Meece et al. emphasized the role of classroom context in perpetuating historical gender differences, noting that boys continue to be more encouraged to engage in science and math, whereas girls are more encouraged to read or be classroom caregivers (i.e., getting band-aids

when a fellow student has an injury). Carlone further identified instructional practices or attitudes that continue to disadvantage girls in the classroom. For example, she noted that the program she examined (“Active Physics”) persistently represented a predominantly male science identity. In particular, the teacher of the classroom consistently identified the boys in the classroom as having natural talent and valued these students more highly than the girls whom he more frequently identified as hard workers.

This emphasis on gender differences is echoed in Sadker et al.’s (2009) work on gender bias in schools. The girls in their study mentioned that they felt as though they had to balance academic pursuits and hostile classroom environments with pressures over appearance and popularity. Sadker et al. suggested that girls may experience these pressures more strongly and more frequently than boys and, as such, may at times be less able to engage with classroom material or succeed academically. Thus, despite research showing that women may be more engaged than men generally (Sax, 2008), concerns persist that women may be disadvantaged in coeducational environments (Carlone, 2004; Karpiak et al., 2007; Sadker et al.).

## SINGLE-SEX EDUCATION AND ACADEMIC ENGAGEMENT

Arguing that the increased demands on women in coeducational settings may serve to stifle their engagement and motivation to succeed, many advocates of single-sex education suggest that girls’ levels of academic engagement may be even higher in single-sex environments than in coeducational settings (Karpiak et al., 2007; Lee & Marks, 1990; Monaco & Gaier, 1992). Further, researchers suggest that high academic engagement may have uniquely beneficial effects for women in single-sex environments, including increased likelihood to choose sex-atypical majors (Karpiak et al.; Sullivan, 2009), assume leadership roles (Riordan, 1994), and participate in political and civic activities (Lee & Marks). Thus, advocates of all-girls schooling contend that without distraction or competition from male students, women in single-sex schools could become even more academically engaged, thereby forming a foundation for continued engagement in college.

A number of reviews have been compiled examining single-sex education research and the claims made by both sides of the rift (Salomone, 2006; Smithers & Robinson, 2006; U.S. Department of Education, 2005). The reviews provide helpful insight into some of the outcomes of single-sex education, while also offering insight into gaps in the research. In particular, the U.S. Department of Education reviewed over 40 studies

examining single-sex education, though only a few of the studies reviewed specifically looked at academic engagement.

Among studies that have investigated academic engagement, many are either insufficient, in that they do not encompass all elements of academic engagement, or have inconsistent findings. For example, Marsh (1991) studied time spent per week on homework and found no significant difference between single-sex and coeducational school students; however, he did not analyze any other aspects of academic engagement, such as talking with teachers or studying with others. Contrary to Marsh's findings, Lee and Bryk (1986) noted that girls from single-sex schools spent more time on homework and were more expressive about their interest in math than were their coeducational peers. In considering delinquency, an indicator of academic disengagement, Lee and Bryk found no differences in absence rates between girls from single-sex and coeducational environments.

More recent studies on academic aspirations and achievement are also inconsistent when comparing single-sex and coeducational environments. For example, in a longitudinal study by Sullivan, Joshi, and Leonard (2010), girls who attended single-sex schools achieved significantly more exam passes than their coeducational counterparts and were more likely to obtain a college degree, but the results were mitigated once school context (e.g., private vs. public) was controlled. These findings counter the results of earlier studies that did not find significant differences in achievement between girls at single-sex schools and their coeducational counterparts (Conway, 1996; Harker & Nash, 1997; Shmurak, 1998).

In explaining the mixed results, some researchers suggest that that academic engagement may be more strongly related to individual characteristics of the students themselves than to the school context (Chouinard, Vezeau, & Bouffard, 2008; Smithers & Robinson, 2006). To address this suggestion, the present study includes a number of individual student characteristics (e.g., race/ethnicity and socioeconomic status) to better isolate the unique relationship between school gender and academic engagement.

## RACE AND CLASS CONSIDERATIONS

Although the vast majority of research on single-sex education focuses on majority-White samples, researchers have repeatedly made the case for investigating the extent to which the impact of school gender is shaped by students' race and class (Buchmann, DiPrete, & McDaniel, 2008; Salomone, 2003, 2006; U.S. Department of Education, 2005). This

consideration is especially important when it comes to academic engagement, which has been shown to be particularly salient to the academic success of students from lower socioeconomic backgrounds (Pike & Kuh, 2005). Some research has addressed the nexus between race, class, and single-sex education and has documented particular achievement advantages for African American, Hispanic, and socioeconomically disadvantaged students (Riordan, 1990, 1994, 2002). A more recent investigation (Sax, Arms, Woodruff, Riggers, & Eagan, 2009) revealed unique benefits of single-sex education for Latina students when it came to developing scientific aspirations but did not find other conditional effects of race or class. With the exception of Riordan's research and the recent work by Sax et al., the moderating effects of socioeconomic factors have been largely ignored in research on single-sex education (U.S. Department of Education).

## METHODOLOGICAL CHALLENGES

Our ability to draw firm conclusions from the extant research on single-sex education is further complicated by a number of methodological challenges that are consistently present across studies (Arms, 2007; Mael, 1998; Smithers & Robinson, 2006; U.S. Department of Education, 2005). These challenges include generalizability of results, confounding variables, and selection bias, among others.

For example, as discussed by Arms (2007) and the Department of Education (2005), prior work on single-sex education often examined individual schools or classrooms, thus making the findings difficult to generalize to the population. Furthermore, results from religiously affiliated schools were frequently generalized to public or independent schools, or vice versa. The present study addresses this problem in two ways. First, the sample includes data gathered from a national sample of women who entered college in 2005. Additionally, the data set has been carefully disaggregated to separate religious and nonreligious schools in the analysis. The current study also considers preenrollment factors, such as student demographics, and other school context factors including size and location, which addresses the critique raised by Smithers and Robinson (2006) and the Department of Education, that previous research did not effectively control for individual and school characteristics.

School context factors also help to address the issue of confounding variables. Previous studies have had a tendency to draw conclusions based on the gender composition of the classroom or school without taking into account other conditional aspects that may contribute to the results

(as discussed in Bryk, Lee, & Holland, 1993; Haag, 1998, Hubbard & Datnow, 2005). In the present study, by considering other aspects of school context, including religious affiliation, selectivity, size, and location, we are able to draw more appropriate, albeit still cautious, conclusions about single-sex education.

In addition, selection bias is a key methodological challenge that is related to the issue of confounding variables and focuses most specifically on the demographic characteristics of the students who attend single-sex and coeducational institutions (Haag, 1998; Riordan, 1990; U.S. Department of Education, 2005). Thompson (2003), likewise, asserted that addressing issues of selection bias is a key consideration when conducting research on single-sex schooling. Like the issue of school context, student characteristics (such as family income, parental education, race/ethnicity, and academic performance) may be more predictive of student outcomes than the gender composition of the classroom or school. The voluntary nature of single-sex school attendance makes it difficult to understand the impact of the single-sex environment itself separate from the characteristics of students who chose to attend such schools (Riordan, 1990; U.S. Department of Education). The present study is able to identify and control for a wide variety of student characteristics, which helps to isolate the specific relationship between single-sex education and academic engagement; however, even with these additional controls, this study cannot fully account for issues of selection bias.

The methodological challenges described in the preceding paragraphs are evident across the body of literature on single-sex education, including the literature cited by major reviews conducted by the U.S. Department of Education (2005), Mael (1998), and others. Scholarship on the role of single-sex education has not advanced to a point where most of these methodological challenges can be easily addressed, though this study does aim to minimize several key limitations, including generalizability, self-selection bias, and the influence of confounding variables.

## OBJECTIVES

The study compares aspects of self-reported academic engagement between women graduates of single-sex high schools and women who graduated from coeducational high schools to determine if there is an advantage to either setting for women's academic engagement. Three primary research questions are addressed: (1) How do female graduates of private single-sex and coeducational high schools compare in terms of academic engagement experienced during high school? (2) To what extent do differences in academic engagement persist after controlling

for students' demographic background and other high school characteristics? (3) Does school gender mitigate or enhance the association between academic engagement and a student's race or socioeconomic status? For all questions, this study separately considers students from independent and Catholic school sectors and distinguishes the predictive power of single-sex schooling from the role played by other high school characteristics as well as the demographic backgrounds of students who attend all-girls schools. Because of its large, national sample and number of control variables, this study aims to make a notable contribution to the research on single-sex education.

## METHODOLOGY

### DATA AND SAMPLE

This study draws its sample from the 2005 Cooperative Institutional Research Program (CIRP) Freshman Survey, an instrument completed by 263,710 students at 385 colleges and universities nationwide (Pryor et al., 2006). Established in 1966 at the American Council on Education and currently housed at UCLA's Higher Education Research Institute, the CIRP is the oldest and largest longitudinal study of American higher education. Each fall, the CIRP collects data from approximately 350,000 first-year college students from over 600 institutions across the United States. Typically administered at new student orientation, the Freshman Survey requests detailed demographic information and asks students about their high school experiences, college expectations, self-concepts, values, and life goals, as well as their academic and career aspirations. This study uses data from the 2005 CIRP Freshman Survey, which is the only year in which the survey asked students to indicate the name, city, and state of the high school from which they graduated. Complete details on the 2005 CIRP study can be found in Pryor et al.

To identify which of the CIRP respondents' high schools were single-sex and which were coeducational, the Freshman Survey data file was merged with the 2000 College Board High School Data File and the Department of Education's 2003–2004 Private School Survey. The College Board file is thought to be the most current and comprehensive data set on public and private U.S. high schools, and it includes a high school gender variable identifying whether high schools in the data set are coeducational or single-sex. The College Board data set also includes other variables such as the schools' minority student population percent-

ages, Advanced Placement course offerings, students' postgraduate plans, and the top and bottom quartile of SAT and ACT scores. Because several high schools in our sample did not report their minority student population to the College Board, we turned to the Department of Education private school data for that additional information. Ultimately, we created an educational database that combines wide-ranging characteristics of students with those of the high school and college they attended.

For the purposes of this study, we identified a subset of women who attended private high schools, including 6,842 women who graduated from 250 all-girls high schools and 19,327 women alumnae of 2,047 coeducational high schools.<sup>1</sup> Because Catholic high schools tended to overpower the sample, we further disaggregated the single-sex and coeducational school samples into three categories: independent, Catholic, and "other" religious affiliation. Students attending schools with other religious affiliations (e.g., Episcopalian, Jewish, Quaker, Islamic) were eliminated because they were typically too varied a group to be included as a stand-alone comparison group.<sup>2</sup> The final sample used for this study consists of 6,552 women who graduated from 225 private all-girls high schools (39 independent and 186 Catholic) and 14,684 women who graduated from 1,169 private coeducational high schools (589 independent and 580 Catholic).

The distribution of the single-sex and coeducational graduates by selected high school and college characteristics is shown in Table 1. Among the independent school graduates, single-sex alumnae tended to come from smaller high schools located in suburban and/or East Coast settings and tended to attend private four-year colleges more often than their coeducational counterparts. Within the Catholic school sample, single-sex alumnae were more likely than coeducational graduates to have attended smaller urban high schools located on the East or West Coast and to have attended private universities. When it came to selectivity, however, only marginal differences were observed, with median SAT scores slightly higher within the high schools and colleges attended by the single-sex sample (whether independent or Catholic). In addition, the independent and Catholic single-sex high school alumnae in this sample were slightly less likely than their coeducational counterparts to have attended a women's college. These and other differentiating characteristics were controlled in the multivariate analyses.

**Table 1. Distribution of the Sample by High School and College Characteristics**

	Independent		Catholic	
	Single-Sex N = 825	Coeducational N = 5,587	Single-Sex N = 5,727	Coeducational N = 9,097
<u>High School Variables</u>				
Median 12th-grade enrollment	52	77	116	169
SAT Math 75th percentile	660	670	590	590
SAT Verbal 75th percentile	680	660	620	590
<i>Region</i>				
East	41.3%	33.1%	41.6%	33.5%
West	22.1%	24.7%	23.6%	20.8%
South	23.9%	32.1%	7.6%	14.2%
Midwest	12.1%	9.6%	26.8%	31.2%
<i>Urbanicity</i>				
Urban	23.3%	21.1%	40.4%	33.6%
Rural	9.8%	17.5%	0.3%	7.0%
Suburban	66.9%	61.2%	59.3%	58.9%
<u>College Variables</u>				
Median selectivity (SAT composite or equivalent ACT scores)	1258	1219	1139	1118
<i>Control and type</i>				
Public university	13.3%	17.2%	16.8%	20.1%
Public four-year college	4.0%	7.3%	12.4%	16.3%
Private university	37.0%	50.8%	24.6%	18.3%
Private four-year college	45.7%	24.7%	46.1%	45.3%
<i>Institutional sex</i>				
Women's college	5.9%	7.0%	3.8%	4.9%
Coeducational college	94.1%	93.0%	96.2%	95.1%

## VARIABLES

The dependent variable academic engagement represents a factor constructed from six variables representing the frequency of women's self-reported engagement in the following academic behaviors in the last year of high school: studying independently, studying with other students, talking with teachers outside of class, participating in student groups, tutoring others, and asking teachers for advice after class (Cronbach's of .61). These items collectively reflect two dimensions of high school engagement as defined by Yazzie-Mintz (2009): cognitive/intellectual/academic engagement (with its focus on course-related engagement) and social/behavioral/participatory engagement (which emphasizes student behaviors outside of instruction). Table 2 presents the factor loadings for the six items included in the academic engagement construct.

**Table 2. Factor Loadings for Academic Engagement (Cronbach's  $\alpha = .61$ )**

Item Loading	
Hours per week: Studying/homework	.51
Hours per week: Talking with teacher outside of class	.47
Hours per week: Student clubs/groups	.52
Past activity: Tutored another student	.54
Past activity: Asked a teacher for advice after class	.53
Past activity: Studied with other students	.54

The primary independent variable in the analyses is a dichotomous variable indicating whether a high school is single-sex or coeducational. At the institutional level, we also controlled for a number of structural characteristics of the high school, including enrollment, region, the proportion of students of color, the total number of Advanced Placement courses offered by the high school, the counselor-to-student ratio, and the average top quartile of students' SAT scores.

At the student level, we accounted for a number of student background characteristics such as religion, socioeconomic status, and race. The model includes controls for Catholic, Protestant, Other Christian, and Jewish, with all other religions, including no religion, representing the reference group. Among the racial classifications, students who identified as White represented the reference group. Socioeconomic status is a three-item scale that combines students' self-reports of their parents' total income, mother's education, and father's education. Finally, we accounted for students' high school grade point average and their SAT composite scores, computing equivalent SAT scores for those students who completed only the ACT. Table 3 provides a complete list of variables included at the institutional and student levels as well as the coding scheme associated with each variable.

**Table 3. Table of Measures**

Variable	Coding Scheme
<i>Student Demographics (Level 1)</i>	
Race/ethnicity: Black, American Indian, Asian, Latino, White/Caucasian <sup>a</sup>	All dichotomous: 1 (not marked), 2 (marked)
Student religion: Catholic, Protestant, Jewish, Other <sup>a</sup>	All dichotomous: 1 (not marked), 2 (marked)
Socioeconomic status	Continuous: 3-item scale composed of parental income, mother's education, father's education

High school GPA	8-pt scale: 1 (D) to 8 (A or A+)
Academic engagement	Continuous factor
SAT composite	Continuous
<i>High School Characteristics (Level 2)</i>	
School gender	Dichotomous: 1 (coed), 2 (single-sex)
12th-grade enrollment	Continuous
High school region: East, Midwest, West, South <sup>a</sup>	All dichotomous: 1 (not marked), 2 (marked)
Grade span: high school only	Dichotomous: 1 (K-12), 2 (9-12)
Counselor-to-student ratio	Continuous
Percent students of color	Continuous
SAT 75th percentile composite	Continuous
School environment: urban, suburban, rural <sup>a</sup>	All dichotomous: 1 (not marked), 2 (marked)
Permits dual enrollment (high school & college)	Dichotomous: 1 (not marked), 2 (marked)
Number of Advanced Placement courses offered	Continuous

<sup>a</sup> indicates reference group.

## ANALYSES

We assessed differences in reported academic engagement between single-sex and coeducational alumnae in two ways. The first involved simple descriptive comparisons (conducted separately within independent and Catholic school sectors) between single-sex and coeducational alumnae in terms of the items constituting the academic engagement factor and for the factor as a whole. These analyses used *t* tests to compare means and chi-square analysis to compare distributions.

The second approach involved a multilevel analysis that accounted for differences in reported academic engagement between the single-sex and coeducational groups. Multilevel modeling, also known as hierarchical linear modeling (HLM), allowed us to distinguish between the effects of a school characteristic (such as school gender composition) and the effects associated with differences across students enrolled at those schools (Lee, 2000). Multilevel modeling appropriately partitions variation in the outcome variable to the individual and school levels, respectively (Raudenbush & Bryk, 2002). HLM reduced the possibility of making a Type I statistical error by erroneously concluding the significance of a parameter.

In building the model, we assessed the predictive power of school gender on women's academic engagement after controlling for their background characteristics (as indicated by race, class, and other forces in students' upbringing) and features of the high school they attended, such as enrollment, location, or course offerings. The importance of applying these controls in research on single-sex education has been

forcefully articulated by Lee (2000), Mael (1998), Salomone (2003, 2006), and the U.S. Department of Education (2005), among others.

Finally, in addressing whether the effects of race and socioeconomic status were conditional on school gender, we allowed the variance components associated with these student-level effects to vary across schools. This process allowed us to detect whether the effect of race or socioeconomic status on academic engagement was stronger at some high schools and weaker at other schools. If we found significant variation across schools in the effects of race or socioeconomic status, we observed the extent to which this variation was attributable to school gender. In doing so, we ask the question of whether school gender mitigates or enhances the association between a student's race or socioeconomic status and academic engagement.

## LIMITATIONS

This study has several limitations, many of which are identified in other reviews of single-sex research (Arms, 2007; U.S. Department of Education, 2005). First, the data are cross-sectional rather than longitudinal, because we have just one data point on students via the 2005 Freshman Survey. This research design limits our ability to make causal inferences about what behaviors and characteristics actually lead students to be more academically engaged than other students. However, this concern is moderated by the richness of the data set, which includes a larger sample size and greater array of variables than we have found in previous studies.

Second, the research design likely includes an element of self-selection bias, because certain women may choose single-sex high school environments over coeducational ones. Although our model accounts for a number of relevant student- and institution-level traits (e.g., family income and parent education), we realize that we do not capture all the specific motivations that female students (or their parents) may have in their decision to choose to attend a single-sex high school. Given this self-selection bias, we may overestimate the extent to which attending a single-sex high school predicts students' level of academic engagement during high school.

Third, the reliability coefficient of our dependent variable is lower than desired ( $\alpha = 0.61$ ). Although this coefficient falls slightly below the recommended reliability threshold for the social sciences (McMillan & Schumacher, 2001; Pedhazur & Schmelkin, 1991), analyzing a multidimensional construct of academic engagement provides substantively more about students' experience than does a single survey item

(Sharfman & Dean, 1991). Rather than precluding the use of the measure, we instead use caution in interpreting results. In the case of this study, we believe it is valuable to interpret academic engagement from a theoretical perspective using the construct rather than examining each variable individually and losing the concept in exchange for single-measurement accuracy (Sharfman & Dean).

Fourth, the self-reported nature of the data requires that we interpret the results with some caution. Self-reported data are only as accurate as the ability and desire of the participant to answer questions with candor. In particular, surveys that ask students about high-risk or socially undesirable behaviors may have lower reliability and validity. However, because we are using a national data set that has been collecting data using similar questions over the past 50 years, we have the benefit of examining the trends of responses to see if students continue to answer questions in similar ways across time, as an additional measure of reliability. Gonyea (2005) and others suggested that this type of self-reported survey research can be trusted, but the results should still be viewed with some caution.

Additionally, our sample consists of only those students who enrolled in a four-year college or university in the fall of 2005 and completed the 2005 CIRP Freshman Survey. By having data on only those students who entered college, the variance of our dependent variable may be much more restricted than it would have been had we had access to information about students who attended two-year institutions or did not attend college at all. Future research should consider including students who attended two-year and community colleges as well as students from single-sex high schools who elected not to attend college.

Finally, as mentioned, this sample only includes students who attended private high schools. Although this study does provide new information related to how students from single-sex schools fare in college compared with their coeducational counterparts, it cannot be overemphasized that these students may differ in substantial and important ways from their public school peers. Future research should investigate the experiences of students from public single-sex high schools compared with both their coeducational-school counterparts and their private single-sex school peers.

## RESULTS

Table 4 displays results on the academic engagement factor and its constituent components and involves two primary comparisons: (1) graduates of single-sex versus coeducational private independent high schools,

and (2) graduates of single-sex versus coeducational private Catholic high schools. Regardless of school context, single-sex alumnae scored higher than coeducational alumnae on the academic engagement factor. The mean academic engagement score for women at Catholic high schools was 10.30, which was significantly higher than the mean of 9.78 for their peers at coeducational Catholic high schools ( $t = 14.58, p < 0.001$ ). Similarly, women attending single-sex independent high schools reported a significantly higher average level of academic engagement ( $M = 10.10$ ) than women enrolled at coeducational independent high schools ( $M = 9.95, t = 11.07, p < 0.001$ ). Further, women from single-sex high schools scored higher on all single-item indicators of academic engagement than did their coeducational counterparts.

For example, nearly two thirds (62%) of female graduates from independent single-sex schools reported spending more than 10 hours per week studying or doing homework in high school, compared with only 42% of independent coeducational school graduates. Among Catholic school alumnae, although study time was comparatively lower than in independent schools, the gap between single-sex and coeducational graduates was also significant; 34.5% of Catholic single-sex alumnae studied more than 10 hours weekly, versus 23.9% for Catholic coeducational graduates.

Students from single-sex schools were also more likely to engage in group study, with 52.9% of independent single-sex graduates reporting that they studied with other students on a frequent basis, compared with 44.6% among independent coeducational graduates. A similar trend exists within Catholic schools, where the rates of frequent group study are 40.2% for Catholic single-sex graduates, versus 33.6% of Catholic coeducational graduates. Additional evidence of peer-based academic engagement is seen in the finding that nearly two thirds (64.7%) of women graduates of independent single-sex schools reported frequently or occasionally tutoring other students in high school, compared with 48.0% of women who attended independent coeducational schools.

Women from single-sex schools also reported more frequent interaction with their teachers. Specifically, 36.7% of independent single-sex graduates spent 3 or more hours per week talking with teachers outside of class, compared with 29.6% among graduates of independent coeducational schools. Single-sex high school graduates also reported asking teachers for advice more frequently than graduates of coeducational schools. This difference is greatest among independent school graduates, with 50.1% of women from single-sex schools frequently asking for a teacher's advice, compared with 42.2% of coeducational graduates.

Finally, the findings in Table 4 demonstrate small but significant differ-

ences in the amount of time that students devote to extracurricular involvement in clubs and groups during high school. Among single-sex alumnae in independent schools, 43.3% reported spending at least 3 hours per week on clubs and groups, compared with 36.6% of coeducational alumnae. These figures are nearly identical for women attending Catholic high school.

**Table 4. Differences in Academic Engagement by School Type**

Category	Independent <sup>a</sup>		Catholic <sup>a</sup>	
	Single-Sex (%)	Coeducational (%)	Single-Sex (%)	Coeducational (%)
<i>Hours per week studying or doing homework</i>				
	+		+	
None	0.1	0.4	0.2	0.5
Any to 2	4.6	12.6	15.5	21.9
3 to 5	13.6	19.9	24.2	28.3
6 to 10	19.7	25.1	25.6	25.2
11 or more	62.0	42.0	34.5	23.9
<i>Hours per week in student clubs and groups</i>				
	+		+	
None	6.8	17.4	11.5	16.1
Any to 2	49.9	45.9	46.5	46.8
3 to 5	27.6	21.6	24.3	20.7
6 to 10	10.0	8.9	10.1	9.5
11 or more	5.7	6.1	7.6	6.8
<i>Hours per week talking with teachers</i>				
	+		+	
None	1.4	2.7	4.8	5.9
Any to 2	62.0	67.9	75.9	77.6
3 to 5	25.3	21.8	14.5	12.1
6 to 10	7.1	4.9	3.1	2.9
11 or more	4.3	2.9	1.6	1.4
<i>Additional high school behaviors (frequently)</i>				
Tutored another student	19.0*	13.7	13.8*	11.7
Studied with other students	52.9*	44.6	40.2*	33.6
Asked a teacher for advice after class	50.1*	42.2	30.1*	27.1

<sup>a</sup> Significance tests compare single-sex and coeducational graduates within independent or Catholic schools. The higher scoring group is indicated by + (for *t* test) or \* (for chi-square).

\* Chi-square significant at  $p < .01$ .

+ *t* test significant at  $p < .01$ .

## MULTILEVEL ANALYSES

After establishing notable differences between women who attend single-sex schools and their coeducational school peers, we used multilevel modeling to examine whether these differences persisted after accounting for various student- and school-level characteristics. The first step in the multilevel analysis was to consider the intraclass correlations (ICCs), which indicate the proportion of total variability in academic engagement that is due to differences between schools. The ICC was 14.3% for the independent school sample and 6.1% for the Catholic school sample, suggesting that the range of scores on women's academic engagement is only marginally a function of high school context, with nearly all the variance occurring at the student level.

Still, the question remains whether school gender plays a significant role among school-level variables. Tables 5 and 6 display regression coefficients and variance statistics at three stages for the independent and Catholic school samples, respectively: (1) at Model 1, when only student background characteristics (Level 1 variables) have been controlled; (2) at Model 2, when school gender is the only Level 2 variable in the model; and (3) at Model 3, when all student characteristics (Level 1) *and* high school characteristics (Level 2) have been controlled. Examining school gender at the final two steps enables us to assess both the unique and shared predictive power of this school-level variable.

*Independent schools.* Table 5 shows that attending a single-sex independent high school is associated with higher levels of academic engagement than attending a coeducational independent high school even after controlling for student characteristics that positively predict academic engagement, such as high school GPA, socioeconomic status, race (African American and Asian American), and religion (Jewish). Further, the predictive power of school gender remains significant when other school attributes are controlled, though the coefficient drops from 0.85 to 0.58.

This reduction in predictive power suggests that women's higher reported academic engagement in single-sex environments is at least partially attributable to other features of those schools. Specifically, academic engagement is bolstered when attending independent schools with the following attributes: smaller enrollments, higher SAT scores, greater proportions of students of color, located in the East, and offering high school only (as opposed to the full K–12 spectrum) courses. Of those attributes, two represent characteristics more prevalent at all-girls independent schools—lower enrollments ( $r = -0.12^*$ ) and higher SAT scores ( $r = 0.13^*$ )—suggesting that these features partially account for the

higher levels of engagement among women from independent girls schools. In other words, the apparent ability of single-sex independent schools to engage women academically is due in part to their small size and higher measured aptitude among the student body, not solely school gender. Despite this, the predictive power of school gender remains significant when these and other school features are controlled, suggesting that either all-female academic settings promote academic engagement among women, or the higher engagement among women from single-sex schools can be explained by student or school characteristics not accounted for in this study.

Table 5. Results from Multilevel Analysis of Academic Engagement for Independent High Schools

	Model 1			Model 2			Model 3		
	b	SE	Sig.	b	SE	Sig.	b	SE	Sig.
<i>Institutional</i>									
Single Sex				0.85	0.14	***	0.58	0.13	***
Enrollment							-0.20	0.06	*
East							0.38	0.12	***
Midwest							0.10	0.14	
West							0.14	0.14	
% Students of color							0.05	0.01	***
SAT 75th %							0.05	0.01	***
Grade span							0.48	0.16	**
Counselor-student ratio							0.01	0.01	
Dual enrollment							-0.16	0.13	
Urban							0.06	0.16	
Suburban							0.20	0.15	
AP Total							0.01	0.01	
<i>Student</i>									
HSGPA	0.35	0.03	***	0.35	0.03	***	0.35	0.03	***
Catholic	0.17	0.09		0.15	0.09		0.15	0.09	
Protestant	0.11	0.07		0.10	0.07		0.16	0.07	*
Jewish	0.28	0.12	*	0.27	0.12	*	0.25	0.12	*
Other Christian	0.12	0.11		0.12	0.11		0.16	0.11	
SAT Composite	0.01	0.01		0.01	0.01		0.01	0.01	
SES	0.18	0.04	***	0.18	0.04	***	0.16	0.04	***
Black	0.60	0.13	***	0.58	0.14	***	0.54	0.14	***
American Indian	0.23	0.21		0.22	0.21		0.21	0.21	
Latino	0.10	0.17		0.08	0.17		0.09	0.17	
Asian American	0.51	0.13	***	0.49	0.13	***	0.47	0.12	***
<i>Statistics</i>									
Level-1 variance	3.48			3.48			3.48		
Level-2 variance	0.58			0.51			0.39		
Level-1 variance explained	0.06			0.06			0.06		
Level-2 variance explained	0.03			0.15			0.35		

\* $p < 0.05$ . \*\* $p < 0.01$ . \*\*\* $p < 0.001$ .

*Catholic schools.* Results for the Catholic school sample are shown in Table 6. As with the independent school findings, women from single-sex Catholic schools reported higher levels of academic engagement than their coeducational counterparts even when controlling for significant student characteristics, including high school GPA, religion (Catholic, Protestant, and other Christian), socioeconomic status, and race (African American and Asian American). Further, as observed with independent school students, when school-level variables were controlled, the predictive power of school gender remained significant; however, it decreased from 0.58 to 0.43.

Table 6. Results from Multilevel Analysis of Academic Engagement for Catholic High Schools

	Model 1			Model 2			Model 3		
	b	SE	Sig.	b	SE	Sig.	b	SE	Sig.
<i>Institutional</i>									
Single Sex				0.58	0.06	***	0.43	0.06	***
Enrollment							-0.10	0.03	***
East							0.01	0.08	
Midwest							0.13	0.08	
West							0.21	0.09	*
% Students of color							0.04	0.01	***
SAT 75th %							0.01	0.01	
Grade span							-0.14	0.07	**
Counselor-student ratio							0.06	0.03	**
Dual enrollment							-0.08	0.05	
Urban							-0.03	0.13	
Suburban							-0.05	0.13	
AP Total							0.03	0.01	***
<i>Student</i>									
HSGPA	0.44	0.02	***	0.44	0.02	***	0.44	0.02	***
Catholic	0.22	0.07	***	0.22	0.07	***	0.25	0.07	***
Protestant	0.22	0.09	**	0.23	0.09	**	0.23	0.09	**
Jewish	0.32	0.37		0.32	0.36		0.26	0.36	
Other Christian	0.33	0.09	***	0.34	0.10	***	0.33	0.10	***
SAT Composite	0.01	0.01		0.01	0.01		0.01	0.01	
SES	0.15	0.02	***	0.15	0.02	***	0.14	0.02	***
Black	0.40	0.11	***	0.40	0.11	***	0.37	0.11	***
American Indian	0.02	0.18		0.03	0.18		0.01	0.18	
Latino	0.15	0.09		0.14	0.09		0.08	0.09	
Asian American	0.51	0.10	***	0.49	0.10	***	0.44	0.10	***
<i>Statistics</i>									
Level-1 variance	3.62			3.62			3.62		
Level-2 variance	0.25			0.18			0.14		
Level-1 variance explained	0.09			0.09			0.09		
Level-2 variance explained	0.04			0.31			0.46		

\* $p < 0.05$ . \*\* $p < 0.01$ . \*\*\* $p < 0.001$ .

Once again, we turned to the significant school-level variables for clues as to the possible reasons for higher levels of engagement in all-girls schools. School features associated with higher academic engagement in Catholic high schools include lower enrollment, more AP course offerings, located in the West, enrolling greater percentages of students of color, offering a full K–12 grade span, and a greater counselor-to-student ratio. Of those high school characteristics, only two were more prevalent in Catholic girls schools than in Catholic coeducational schools: AP course offerings (0.12\*) and enrollment of students of color (0.17\*). Thus, higher levels of academic engagement in Catholic girls schools are at least partially attributable to the fact that these schools offer more AP courses and enroll more students of color. The latter finding is particularly interesting because it suggests that increasing minority enrollments can raise the level of academic engagement for all students, regardless of their own race/ethnicity.

*Conditional effects.* For both independent and Catholic school samples, the tests for interaction by race and class revealed no significant results, suggesting that the effects of these student characteristics are consistent across high school contexts. In other words, class- or race-based variations in academic engagement hold constant between single-sex and coeducational high schools.

## SUMMARY

To contribute to the ongoing debate over single-sex education, this study compares levels of self-reported academic engagement between alumnae of single-sex and coeducational private high schools using nationwide data on these students at the point of college entry. Further, the study reveals the extent to which differences between single-sex and coeducational graduates are attributable to individual student characteristics and/or features of the high school other than gender composition.

Results reveal that, relative to their coeducational counterparts, women attending all-girls high schools report higher levels of academic engagement across numerous fronts: studying individually or in groups, interacting with teachers, tutoring other students, and getting involved in student organizations. Further, the multilevel analyses reveal that, for both the independent and Catholic school samples, the predictive power of school gender remains significant even when student background characteristics and high school characteristics have been controlled. In other words, attendance at an all-girls school is related to slightly higher levels of academic engagement even when accounting for the socioeconomic backgrounds of these women, as well as a range of important

school characteristics. Such results certainly support the claims of single-sex education advocates who contend that all-female environments provide a unique opportunity for young women to thrive.

However, the results also show that the higher levels of academic engagement observed at single-sex schools are at least partially attributable to other features that differentiate single-sex from coeducational schools. In the independent schools, these features include smaller enrollments and a higher caliber student body (at least as determined by standardized test scores). In the Catholic schools, attributes that contribute to the positive role of single-sex education include offering more Advanced Placement courses and enrolling greater numbers of students of color than Catholic coeducational schools. Such findings suggest that we would expect a narrower gap in academic engagement between women in Catholic single-sex and coeducational schools if the *features* of these schools were more aligned.

Finally, no interactions were found between school gender and either race or class, leading to the implication that the benefit of single-sex education on women's academic engagement may be the same for students across race and class lines.

## DISCUSSION

This study demonstrates that school gender remains a significant predictor of self-reported academic engagement when controlling for other school characteristics, thus lending support to the claims of single-sex education advocates who contend that all-female environments provide a unique opportunity for young women to thrive. As discussed earlier, proponents of single-sex education link all-female settings to a number of positive outcomes, such as political and civic engagement (Lee & Marks, 1990), increased leadership ability (Riordan, 1994), and higher motivation and academic engagement (Karpiak et al., 2007; Monaco & Gaier, 1992). Taken alone, the results of the present study appear to support single-sex education.

However, these results should be interpreted with some caution. Because of the limitations of the study (the private school sample, the fact that it is not longitudinal, and the self-report methodology), it is difficult to make definitive inferences about the relationship between single-sex education and academic engagement, and we cannot assert with confidence that school gender alone is responsible for higher reported academic engagement. The question remains, why do these students report higher academic engagement? What other features (not accounted for in this study) might further account for the apparent

single-sex benefit? School attributes such as mission, pedagogy, teacher attitudes, and course content may further explain the single-sex advantage suggested by these results (Smithers & Robinson, 2006). In fact, as purported by Riordan (2002), factors such as more equitable curricula, more favorable student–teacher interactions, and more active pedagogy may help to explain why we observe benefits of single-sex education. Ultimately, a vital question is whether such productive environments are simply more prevalent in single-sex settings or whether they have greater benefit in single-sex settings. Future research will need to further disentangle the effects of school gender from the effects of other school characteristics.

Finally, although some scholars have found evidence that single-sex education is especially beneficial for low-income and minority populations (Riordan, 1990, 1994, 2002), in the present study, the effects of race and income appear to be consistent across high school type. Nonetheless, this study does provide evidence that a school’s racial composition contributes to the reported effectiveness of single-sex schools. In fact, in the present study, we found that the reported differences in academic engagement between single-sex and coeducational students in the Catholic schools is partially attributable to the fact that the single-sex schools enroll a greater proportion of students of color. Further, African American and Asian American students in this sample reported more academic engagement than their White counterparts in both single-sex and coeducational Catholic schools, and yet the presence of more minority students predicts higher levels of academic engagement for all students regardless of race. Such a finding is not identified in prior research and thus represents a call for new research into how academic engagement is manifested in diverse single-sex and coeducational settings.

## CONCLUSION

This study advances research on single-sex education by including a large and diverse sample of high school graduates as well as a range of relevant student characteristics and high school features. It also uses a methodology that enables us to partition the statistical effects of school gender from the role played by student characteristics and other characteristics of single-sex and coeducational schools. Though results do suggest that single-sex high schools predict higher levels of academic engagement for female students, the effects are fairly small and are to some extent attributable to school features other than school gender. The study points the way for future research that further distinguishes the role of individual and school-level attributes and ideally examines this issue using longitu-

dinal data. Finally, given the current expansion of single-sex education in the public schools, future research ought to employ these methodological advances in studies on single-sex public education and should consider the consequences of single-sex settings for both female and male students.

### Notes

1. Although the number of public single-sex high schools is increasing, available data for these populations are limited.
2. Though previous literature did not indicate that religious affiliation would be a significant predictor of academic engagement, we included the variable in the model nonetheless, in an effort to control for students' self-selection into their school context.

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