

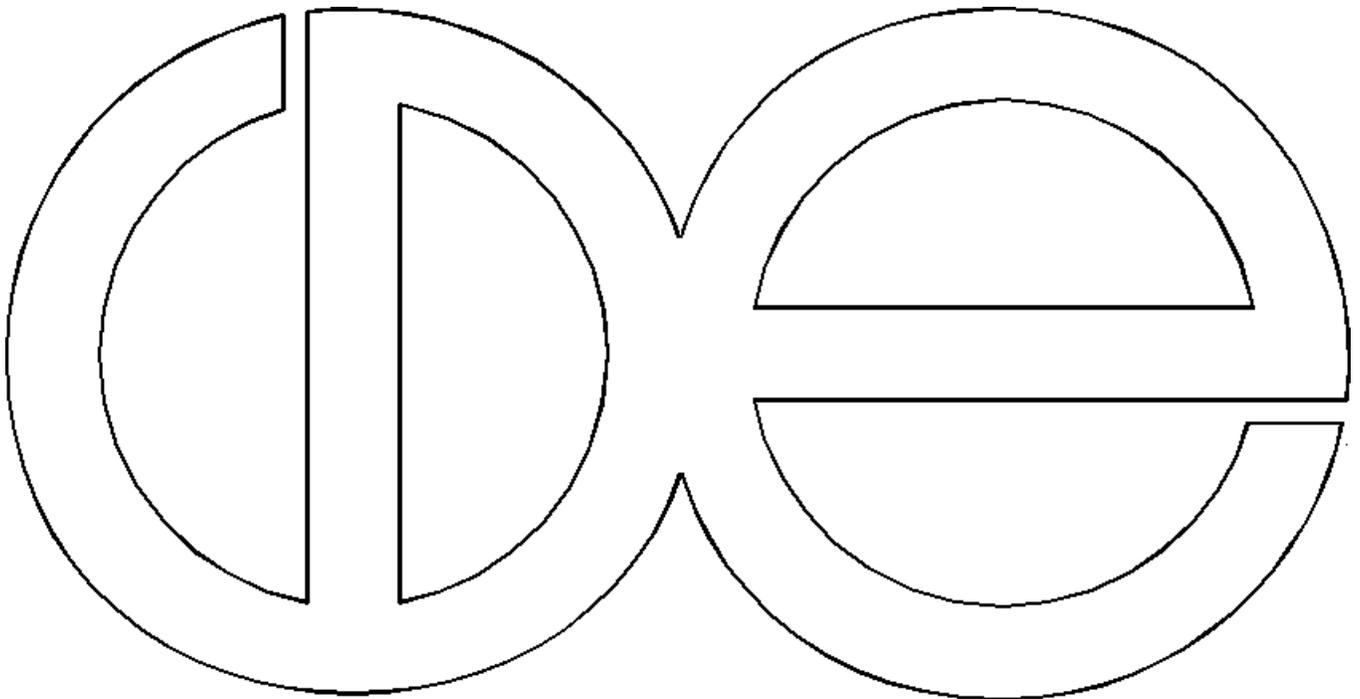
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University of Wisconsin-Madison

**The Effectiveness of Single-Sex Catholic Secondary Schooling:
Evidence from the National Educational Longitudinal Study of 1988**

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ABSTRACT

Using data from the National Education Longitudinal Study of 1988, we ask three questions. First, are there differences between single-sex and coeducational Catholic secondary school students in academic and social psychological outcomes? Second, do these differences especially favor young *women* in single-sex Catholic secondary schools, as prior research has concluded? Third, can pre-enrollment differences between students account for these sector effects?

We conclude that single-sex Catholic secondary schools are *not* especially advantageous academic settings, and that the few observed advantages of attending these schools benefit *boys* more than *girls*. In the end, we argue that the few observed sector differences in 10th and 12th grade student achievement test scores are due to pre-enrollment differences in measured background and prior achievement.

INTRODUCTION

In this paper, we ask three questions: First, are there differences between single-sex and coeducational Catholic secondary school students in academic and social psychological outcomes? Second, do these differences especially favor young women in single-sex Catholic secondary schools? Third, can differences in students' pre-enrollment characteristics account for more favorable outcomes among single-sex Catholic school students? In general, we ask whether the benefits of single-sex Catholic secondary schooling as described by Lee and Bryk (1986), Riordan (1990), Bauch (1988) and others can be reproduced using a more recent body of data. Then, we ask whether any of the apparent advantages of single-sex Catholic schooling can be attributed to selective patterns of enrollment, and not to single-sex Catholic schools' academic structure, communal school organization, or "inspirational ideologies" as Lee and Bryk (1986) suggest.

Although we limit our analyses to Catholic single-sex and coeducational secondary schooling, we believe that our analyses are more broadly relevant². In recent years, state and local initiatives to establish single-sex classrooms or schools in the *public* sector have had a measure of success. These initiatives are founded on the notion that single-sex schools, whether they are public or private, offer specific educational advantages. The results of our analyses should better inform the debate surrounding these proposed educational reforms.

A BRIEF HISTORY OF SINGLE-SEX SCHOOLING IN THE UNITED STATES

The Catholic Church has long regarded secondary school coeducation as a violation of the proper and appropriate separation of the sexes (Tyack and Hansot 1990). The Sacred Congregation of the Affairs of Religious, mandated by Pope Pius XII in the 1950's to deal more thoroughly with the "difficult question" of mixed education of the sexes, reiterated the Church's

long-standing policy against secondary school coeducation. In its 1957 *Instruction on Coeducation*, the Congregation concluded,

False also and harmful to Christian education is the so-called method of 'coeducation.' This too, by many of its supporters, is founded upon naturalism and the denial of original sin; but by all, upon a deplorable confusion of ideas that mistakes a leveling promiscuity and equality, for the legitimate association of the sexes... (Frison 1959, p. 18).

Despite the clarity and straightforwardness of the Congregation's *Instruction*, in practice an increasing proportion of Catholic schools in the United States (particularly new schools) during the 1960's and 1970's became coeducational. By 1983, only about one-quarter of Catholic high schools were girls' schools and about one-fifth were boys' schools, so that just under half of all Catholic schools were single-sex (Bryk, Lee, and Holland 1993). This shift mirrored a general movement toward coeducation in other private school sectors and echoed a more global, cross-national trend away from curriculum differentiation by gender (Tyack and Hansot 1990; Ramirez and Cha 1990).³

In the Catholic sector, these changes can be attributed both to a softening of the Church's hard-line doctrine precipitated by the reforms of Vatican II and to more pragmatic and financial considerations (Tyack and Hansot 1990; Bryk, Lee, and Holland 1993). Quite simply, by the 1960's, many Catholic communities found it prohibitively expensive to build separate high schools for boys and girls, or to support financially the daily operation of existing single-sex institutions (Bryk, Lee, and Holland 1993).

In other (non-Catholic) private school sectors, the number of single-sex institutions has also dropped significantly at all levels. Between 1966 and 1986, the percentage of single-sex universities and colleges declined from 25 percent to 6 percent. In that twenty year period, the

number of all-male colleges dropped from 236 to 99 and the number of all-female colleges dropped from 231 to 102 (Tyack and Hansot 1990). At the secondary school level, declines in the numbers of (non-Catholic) private single-sex high schools have been equally pervasive. From 1963 to 1987, among the membership of the National Association of Independent Schools, the percentage of coeducational institutions increased from 38 percent to 76 percent, the proportion of boys' schools dropped from 37 percent to 11 percent, and the proportion of girls' schools dropped from 24 percent to 12 percent (Tyack and Hansot 1990).

While single-sex schooling declined in the private sector after World War II, coeducation had become nearly universal in public schooling by the late 19th century (Riordan 1990). By the beginning of the 1800's, most publicly funded "common" grammar schools operated under a system of coeducation, and by the end of the 19th century nearly all public secondary schools were coeducational as well. One can point to a variety of factors which contributed to the expansion of public high school coeducation (Kolesnik 1969), but the development of coeducation as the normative course in public high schools also was largely due to economics (Riordan 1990). Similar to the movement away from single-sex Catholic schooling, witnessed a century later in the post-Vatican II reform era, public school districts in late 19th century simply found it too costly to fund separate schools for girls and boys. As Kolesnik (1969) argues,

Coeducation at the high school level was not adopted as a consequence of any careful consideration of the inherent values such a system might have, and certainly not because of any research evidence pointing to its benefits. Nor was it introduced or accepted or defended, to any great extent, on the basis of any such principle as equality of the sexes. Rather, coeducation came into being rather unobtrusively as the more economical, and often only possible means of providing a more advanced education for the majority of American youth (Kolesnik, p. 90).

ARGUMENTS FOR AND AGAINST COEDUCATION

Amid the decline of single-sex secondary schooling in the United States, researchers in the 1970's began to reexamine the educational benefits of single-sex schooling relative to coeducational schooling. The debate surrounding this issue has been revived of late as states and local communities have sought to implement single-sex schools or classrooms in the public sector. Although the evidence is mixed, proponents of single-sex Catholic secondary schooling argue that such schools provide specific advantages for students that can not be found in coeducational Catholic school settings. Indeed, as Lee and Bryk (1986) and others (Riordan 1985, 1990) have concluded, students in single-sex secondary Catholic schools take more academically oriented courses, score higher on standardized achievement tests, and have higher educational aspirations. On the other hand, advocates of coeducational schooling have cast doubt on the differential effectiveness of single-sex and coeducational schooling, arguing that single-sex schools are no more advantageous, either academically or socially, than coeducational schools (Dale and Miller 1972; Dale 1974; Marsh 1989a, 1989b; Marsh, Owens, Myers, and Smith 1989; Marsh 1991).

If we grant for the moment that students who attend single-sex Catholic secondary schools enjoy more favorable educational and social outcomes relative to coeducational Catholic secondary school students, then we are led to ask, "Why might single-sex Catholic secondary schools be especially advantageous educational settings?" In the next section of this paper, we review the evidence for the differential effectiveness of single-sex Catholic secondary schooling and present three broad explanations for the supposed advantages of single-sex schooling. After reviewing these explanations, we formulate a series of hypotheses that are implied by the literature and that we test empirically in our subsequent analyses.

Youth Culture and School Climate

Since the 1960's, many observers have claimed that coeducational school settings are oriented toward a “youth culture” in which social and/or romantic considerations preclude the optimal intellectual development of students (Coleman 1961; Goodlad 1984; Riordan 1985, 1990). As a result, in single-sex schools, students are better able to concentrate on academic matters. As Coleman (1961) notes,

Coeducation in some high schools may be inimical *to both* academic achievement *and* social adjustment. The dichotomy often forced between “life-adjustment” and “academic emphasis” is a false one, for it forgets that most of the teen-ager’s energy is not directed toward either of these goals. Instead, the relevant dichotomy is cars and the cruel jungle of rating and dating versus school activities, whether of the academic or life-adjustment variety (Coleman 1961, p. 51, emphasis original).

Similarly, in arguing for the efficacy of single-sex schools, Riordan (1985) suggests that Catholic single-sex schools operate with a “reduced adolescent subculture,” providing fewer nonacademic distractions, fewer problems of control and discipline, and a greater display of same-sex academic role models. He goes on to argue that “Catholic single-sex schools are nearly twice as effective as Catholic mixed-sex schools” (p. 536), and adds that his results “suggest the need to halt temporarily the closing of single-sex schools” (p. 518).

Not all studies, however, have come to this conclusion. For example, in Dale’s voluminous (and opinionated) research, he argues that coeducational grammar schools are happier social environments, that anxiety and neuroticism are lower among students and teachers in coeducational settings, and that these social and affective advantages of coeducational over single-sex schools do not come at the expense of academic progress (e.g., Dale 1974; also see

Riordan 1990 for a review).

Gender Bias in Coeducational Settings

Other researchers claim that gender discrimination is so pervasive in coeducational school settings that the complete separation of girls from boys is essential (Shaw 1980; Howe 1984; Mahony 1985). As a result, the apparent advantages of single-sex secondary schools, especially for girls, may be attributable to the absence of gender discrimination and bias in these settings, or to the presence of same-sex role models (Riordan 1990). As numerous studies have demonstrated, despite coeducational opportunities, boys and girls hardly receive the same education: boys tend to dominate classroom discussion, interrupt girls more often, and are more frequently rewarded for active thinking; girls are under-represented in math and science classes; history textbooks tend to distort, trivialize, or ignore the roles of women; boys and girls both tend to believe that teachers have higher expectations for boys; girls are more often “picked-on” by boys and are more frequently the subjects of jokes and sexual innuendo; teacher training shows little awareness or acknowledgment of the ways in which teachers and schools perpetuate sex bias; and despite the fact that two-thirds of all teachers are women, the overwhelming majority of administrators are male (for reviews see Tyack and Hansot 1990; Mahony 1985; Shaw 1980; Jones 1990; Bauch 1988; Howe 1984).

Underscoring the critical approach that the “New Feminists” of the 1970's brought to the study of coeducation, Florence Howe explains the connection between society and coeducational schooling:

Coeducation—in elementary schools or in colleges—functions within the larger patriarchal limits of the society in which it exists. In mythic terms, coeducation opened doors to women. And so it did. But those doors were—and to a

significant extent still are—different from those open to men (1984, p. 209).

As Tyack and Hansot (1990) note, “For some, it was only a small step from criticizing coeducational schools to advocating single-sex girls’ schools” (1990, pp. 284-285). Shaw (1980), for example, argues that returning to single-sex schools for girls (schools run by women for women), far from being politically reactionary or regressive, would provide a form of affirmative action for girls in a sexist society, offer parents and families a choice of curricular program, and produce a model of educational excellence that might be adopted more widely.

Following from this philosophical stance, recent observers have argued that single-sex schools are more effective learning environments, especially for young women (Riordan 1985, 1990). Bauch (1988) writes that “students in single-sex schools consistently outperform students in mixed-sex schools in mathematics, science and reading ability” (p. 56), and Lee and Marks (1990) find that in the United States “the single-sex experience appears to be somewhat more empowering for young women than for young men” (p. 589). In the end, Bauch (1988) echoes a common sentiment among these observers when she argues that it is “important to continue to provide the option of single-sex schooling and to create such options where they do not already exist” (p. 57).

However, not all feminist critiques of coeducational schooling see the shift to single-sex education as the logical reaction to gender inequities. Jones (1990), for example, asserts that creating single-sex schools is an overly simplistic solution. She argues that policies and practices need to be devised, at all levels of the educational system, to persuade male administrators, teachers, guidance counselors, and students that the problem of sexism exists and must be faced. As Willis and Kenway (1986) add, “the strategy of single-sex schooling [whether in the form of single-sex schools or single-sex classes within schools] is limited because it focuses exclusively on changing the attitude and behavior of girls and shows little potential for changing teachers, the

curriculum or boys” (p. 132).

Pre-Enrollment Differences in Student Characteristics

Some researchers (e.g. Dale 1974; Willis and Kenway 1986; Marsh 1989a, 1989b, 1991; Marsh, et al. 1989) have argued that single-sex schools have more rigorous and demanding entry standards and are attended by pupils who are more intelligent, more highly motivated, and have more favorable class and family backgrounds. As a result, these observers attribute the apparent advantages of single-sex secondary schools to the selectivity of these schools, and not to any differential educational effectiveness.⁴ In a review of studies of single-sex schools in Great Britain and Australia, Willis and Kenway (1986) note that researchers are often too eager to attribute differences in academic ability between girls in single-sex and coeducational schools to “school effects.” As the authors argue,

In both the United Kingdom and Australia, it is suggested girls in single-sex schools achieve greater academic success than do girls in coeducational schools.

This is interpreted as establishing that single-sex schooling produces these results.

Such arguments show a failure to understand (or a refusal to acknowledge) that, in both Britain and Australia, single-sex schools are most often private schools, selective on the basis of ability and/or income (and consequently social class)

(Willis and Kenway 1986, p. 135).

Echoing this sentiment, Marsh (1989a, 1989b, 1991) notes that studies which compare single-sex and coeducational schools are hampered by the nonequivalent group comparisons used in most research designs.

LEE AND BRYK (1986)

In their analyses, Lee and Bryk (1986) examine single-sex and coeducational Catholic secondary schools in the High School and Beyond (HS&B) sample and present analyses that they claim demonstrate “a broad base of positive effects for single-sex schools across a diverse array of educational outcomes” (Bryk, Lee, and Holland 1993, p. 239). After holding constant students’ social backgrounds, academic curriculum tracks, and school social contexts, the authors make the following conclusions regarding academic achievement⁵ compared to their counterparts in coeducational Catholic schools, 1) students in boys’ Catholic schools score higher on reading, mathematics, and writing achievement tests in their sophomore years; 2) students in boys’ Catholic schools score higher on mathematics achievement tests in their senior years; 3) students in girls’ Catholic schools score higher on reading achievement tests in their senior years; and 4) between their sophomore and senior years, students in girls’ Catholic schools enjoy larger increases in their reading and science achievement test scores⁶. The authors argue that these reported differences “appear very substantial” (Bryk, Lee, and Holland 1993, p. 236), that “something positive is occurring in single-sex Catholic high schools” (Bryk, Lee, and Holland 1993, p. 239), and that “public policy should focus on finding ways to preserve existing single-sex schools and to encourage their development in other contexts where the option does not currently exist” (Bryk, Lee, and Holland 1993, p. 241).

The validity of Lee and Bryk’s (1986) assertion that single-sex Catholic secondary schools are more effective than Catholic coeducational secondary schools depends heavily on their ability to consider preexisting (pre-enrollment) differences between coeducational and single-sex Catholic school students that might also account for the observed sector differences in educational outcomes (Jones 1990; Lee and Lockheed 1990; Willis and Kenway 1986). To their credit, Lee and Bryk (1986) are aware of this methodological issue⁷ the authors note that in response to their concern over selectivity issues, they have introduced into their analyses statistical

adjustments for other factors (listed above) that may also influence achievement test scores. Furthermore, the authors also analyze gain scores (the differences between sophomore and senior year test scores) to account for the fact that single-sex school students have higher mean sophomore year test scores. In the end, they argue that their adjustments yield a sample of schools and students that “presents a nearly ideal natural experiment” (BL&H, 1986, p. 383).

In a 1989 exchange with Lee and Bryk in the *Journal of Educational Psychology*, Marsh (1989a, 1989b) takes issue with Lee and Bryk’s (1986) claims about the adequacy of their controls for pre-enrollment differences between students, especially in their analyses of 10th and 12th grade test scores (as opposed to their more methodologically defensible analyses of gains scores, which generally yield little evidence that single-sex schools are especially advantageous). He writes that

Interpretations of tests of the 1980 [sophomore year] and 1982 [senior year] scores, corrected for just the background differences, are not defensible because the background variables are not sufficiently strong to equate for potential preexisting differences. Whereas their background variables may be important, there were no controls for possible preexisting differences in academic achievement, prior course work, self-concept, locus of control or other school related behaviors and attitudes that were considered as outcomes. (Marsh 1989a, p. 72)

Lee and Bryk counter by arguing that the “characteristics of students attending single-sex and coeducational Catholic schools are reasonably well-balanced” and that there is little support for the hypothesis that single-sex schools “enroll a superior clientele of students” (1989, p. 648).

Marsh (1989b) responds by pointing out that since no measures were collected prior to the sophomore year, there is no way to properly test Lee and Bryk’s assertion of the relative equality

of students who enroll in single-sex and coeducational Catholic secondary schools.

We also wonder whether the adjustments for 10th grade student characteristics and school social context address pre-enrollment differences between single-sex and coeducational school students. Fortunately, as we will discuss below, we have access to data which include pre-enrollment measures of variables which we later use as student outcomes in grades 10 and 12. The fact is, as Lee and Bryk (1989) correctly point out, the types of statistical controls used by Lee and Bryk (1986) and Marsh (1989a) may have either *undercontrolled* or *overcontrolled* for pre-enrollment student differences. On one hand, if students who enroll in single-sex schools are advantaged relative to coeducational school students at the time they enter high school (typically the end of 8th grade) in terms of course taking histories, academic achievement, school social context, or any other factors that may influence later achievement outcomes, then the failure to control for these factors may bias the estimates of sector differences in educational effectiveness in favor of single-sex schools. On the other hand, by controlling for student characteristics in grade 10, midway through students' high school careers, Lee and Bryk (1986) may have actually *underestimated* the effects of single-sex school attendance, especially if most of the advantages of attending single-sex secondary schools occur before grade 10. In short, in order to assess more adequately the true impact of single-sex school attendance on student outcomes in grades 10 and 12, we must control for differences between students before they enroll in their respective school sectors.

ANALYSIS PLAN

To summarize, the literature on single-sex schooling is divided about whether such schools are more effective than coeducational schools. Proponents of coeducation argue that there are no unique educational advantages to single-sex schooling, and that previous analyses

that purport to show otherwise have failed to consider that pre-enrollment differences between students might account for any observed differences in outcomes. On the other hand, proponents of single-sex schooling argue that the “youth culture” and gender biases which permeate coeducational school settings make them potentially inferior educational environments, and as a result, students in coeducational Catholic secondary school settings learn less and have less favorable social psychological outcomes. In our analyses, we test three hypotheses that are designed to address these issues.

Hypothesis #1: Boys and girls who attend single-sex Catholic secondary schools score higher on tests of academic achievement and self-concept than their counterparts who attend coeducational Catholic secondary schools.

Hypothesis #2: Any advantages associated with enrollment in single-sex Catholic secondary schools are especially powerful for *female* students.

Hypothesis #3: Any advantages associated with enrollment in single-sex Catholic secondary schools can be explained by *pre-enrollment differences* between students who attend single-sex and coeducational institutions.

The first hypothesis simply tests the assertion that single-sex Catholic secondary schools are more effective learning environments than coeducational schools. Do single-sex Catholic school students have more favorable outcomes than students in coeducational Catholic schools? This question has been the essential focus of debate for most of the research in this area. Also, if it is true that the “reduced adolescent subculture” found in single-sex settings has specific educational advantages, then we should find support for the first hypothesis. The second hypothesis asks whether the first hypothesis is especially true for female students. That is, if gender biases in coeducational settings impair girls’ academic and emotional development, then we would expect girls in single-sex schools to score higher on achievement tests and tests of psychological well-

being than their counterparts in coeducational schools. The third hypothesis addresses the argument that observed differences between students who attend single-sex and coeducational schools are due to prior differences between students, and not to anything that happens within single-sex schools.

OVERVIEW OF THE NATIONAL EDUCATION LONGITUDINAL STUDY OF 1988 (NELS:88)

NELS:88 is a longitudinal survey of the eighth grade student cohort of 1988. In the base year, the sample included approximately 25,000 randomly selected students in 1,000 public and private schools across the United States. In addition to the data collected from student interviews, NELS:88 contains information from parents, school administrators, and teachers. Since the basic unit of analysis is the student, information from these other sources can be thought of as providing contextual data. The initial student cohort has been followed-up on three occasions, in 1990, 1992, and 1994. Students who dropped out of school between survey waves were also interviewed, and for each follow-up the sample was “freshened” with new sample members in order to make the first and second follow-ups cross-sectionally representative of 1990 sophomores and 1992 seniors, respectively.

NELS:88 contains a vast amount of information about students and their classmates, families, and schools. Students’ grades, course work, educational aspirations and attitudes, family backgrounds, and other academically relevant considerations are described in great detail. Information about the type of schools students attended (single-sex versus coeducational; private versus public; Catholic versus other private; etc.), the organization of those schools, and characteristics of other students enrolled in those schools is available and can be linked to individual students’ characteristics and outcomes. In addition, and importantly for our purposes,

social psychological tests and achievement tests in reading comprehension, mathematics, science, and social studies were administered to students in each wave of the study⁸. The achievement test scores administered in NELS:88 are scaled using Item Response Theory (IRT) techniques, and are constructed in such a way that scores are comparable across survey waves (National Center for Education Statistics 1994).

The NELS:88 data are not only suitable for answering the questions we seek to ask, but they are also better than other available data in two important respects. First, like HS&B, the sample is large enough that it contains a sufficient number of students in Catholic single-sex and coeducational secondary schools for relatively sophisticated analyses which compare these sectors of schools. Second, and most significantly, the design of the survey is such that students are initially observed *before* they enter high school. Most recent analyses, including those by Lee and Bryk (1986), utilize data from the HS&B study that initially observed students in grade 10 *after* they entered high school. When students are initially observed at grade 10 they have already spent at least one year in either a single-sex or a coeducational Catholic secondary school. Analysts who control for “initial” differences between students as measured at grade 10 are not, in fact, controlling for initial differences between students at the time that they enter high school. Since NELS:88 initially observes students at grade 8, we are much better able to control for pre-enrollment differences before assessing the relative effectiveness of different school sectors (Marsh 1991).

DEFINITION OF ANALYSIS SAMPLE

For analyses of 10th grade student outcomes, we selected cases in which students were: 1) enrolled in either Catholic single-sex or Catholic coeducational secondary schools in 10th grade; 2) attending schools which reported that fewer than 25 percent of their students were in a

vocational curricular program; and 3) in-school and in-grade in 1990 (their sophomore years). We follow Lee and Bryk (1986) in excluding students who were attending more vocationally-oriented schools. As Lee and Bryk (1986, p. 383) note, these schools generally specialize in stenographic and clerical training and are “atypical of the Catholic sector as a whole, which emphasizes a traditional academic program” (see also Bryk, Holland, Lee, and Carriedo 1984). In our opinion, this restriction may be unjustified since it probably biases the analyses (both ours and theirs) in favor of finding advantages of single-sex secondary schooling. However, in analyses parallel to the ones presented below, we retain these excluded students and obtain essentially the same results.

For analyses of 12th grade student outcomes, we further restricted our sample to cases in which students: 4) responded to the first three survey waves; 5) did not drop out between grades 10 and 12; and 6) did not change schools between grades 10 and 12. These sample limitations ensure that we are comparing students who have spent equivalent amounts of time in their respective school sectors. The final restriction, for example, is necessary so that we can be sure that students classified as attending a Catholic school in grade 10 were still attending *the same* Catholic school in grade 12.

Table 1 describes the effects of each of these restrictions on the number of cases retained in the final analysis sample. In all, more than 80 percent of potential male and female students in each sector were retained, with one exception: only 67 percent of single-sex Catholic school girls are retained in the final analysis sample, primarily because of the restriction on predominantly vocational Catholic schools discussed above.

In order to approximate population characteristics and to account for panel attrition over time, users of the NELS:88 data must weight their sample by one of the many weights provided by National Center for Education Statistics in the NELS:88 data file (U.S. Department of

Education 1990). As Table 1 shows, we use a different weight for different stages of our analysis. When we consider 10th grade student outcomes, we weight the data using a transformation of the variable F1PNLWT, but when we consider 12th grade student outcomes, we weight the data using a transformation of F2PNLWT.

In order to adjust our weights in such a way as to have standard errors reflect actual sample sizes (as opposed to the size of the reference population), we divided each weight by its mean before weighting. Also, because NELS:88 employed a cluster sampling design, and because commonly available statistical software packages assume that data were collected through simple random sampling, we also adjusted each weight in such a way as to correct for design effects. Specifically, after dividing each weight by its mean, we further divided them by DEFF, the mean (Catholic school-specific) design effect across variables in the survey wave or waves in question (U. S. Department of Education 1990).⁹ The bottom half of Table 1 lists the final weighted sample sizes for male and female students in each school sector and in each analysis sample.

STUDENT BACKGROUND DIFFERENCES

Tables 2 and 3 describe the characteristics of male and female students in each school sector in grades 8 and 10, respectively.¹⁰ For the purposes of our descriptive analyses, we use the sample of students included in analyses of 12th grade outcomes and we have weighted the data by a transformation of F2PNLWT, which is designed for analyses which use student-level data from all three survey waves.¹¹ Due to item non-response, the sample sizes vary from item to item, but the maximum weighted sample sizes are presented in each table.

The first panels of Tables 2 and 3 show that students who attend single-sex and coeducational Catholic schools come from families which are essentially equal in terms of family background. The differences in SES¹² between single-sex and coeducational Catholic school

students are not statistically significant in either grade 8 or grade 10. Tables 2 and 3 also show that students in single-sex and coeducational Catholic secondary schools tend to have roughly the same number of siblings and are equally likely to live in two-parent households. Finally, these results indicate that Catholic single-sex schools enroll an essentially equal proportion of nonwhite pupils as Catholic coeducational schools. In addition, in separate analyses (not shown), we have found that the combined Catholic sectors enroll roughly the same proportions of white and non-white students as public comprehensive schools. This finding is consistent with recent analyses which have shown tremendous increases in the numbers of non-white students enrolled in Catholic schools (Brigham 1993, 1994).

We used three items from the NELS:88 data to assess students' educational aspirations. Each item is included in all three survey waves. The three items asked students how likely they thought it was that they would graduate from high school, continue their education beyond high school, and finish college. There is little compelling evidence in Tables 2 or 3 that single-sex Catholic school students have higher educational aspirations than coeducational Catholic school students, especially in the case of female students. In grade 8, boys in single-sex schools are more likely to say that they are very sure they will go on beyond high school and that they are very sure they will finish college; these same differences, however, are not evident in grade 10. In no case do we observe sector differences in educational aspirations among girls.

Table 3 also reports the percentage of students in each type of school who have ever repeated a grade.¹³ We find little difference between single-sex and coeducational school girls in this regard, but among boys there is a considerable difference between single-sex and coeducational school pupils. Boys in single-sex Catholic high schools are much less likely than coeducational high school boys to have ever repeated a grade.

We should note here that although we have criticized Lee and Bryk (1986) and others for

not considering student characteristics before grade 10, the results of Table 2 (that reports student characteristics in grade 8) do not tell us how important selection effects may or may not have been in accounting for observed sector differences in student outcomes in their analyses. We observe no family background differences between students as observed in grade 8 or grade 10, and this appears to confirm Lee and Bryk's (1989) speculation that single-sex and coeducational Catholic schools enroll roughly the same sorts of students. However, since Lee and Bryk (1986) and others (Riordan 1985, 1990; Marsh 1989) who used the HS&B data did find sector differences in family background as measured in grade 10, and since we did not, we are left to wonder whether something about Catholic schools has changed between 1980 and 1990. In any case, we are unable to say whether users of HS&B would have observed no sector differences in students' family backgrounds had they been able to observe students in grade 8, and our data do little to clear up the matter.

DIFFERENCES IN STUDENT OUTCOMES

Although Lee and Bryk (1986) consider a broad array of student outcomes, we have decided to consider only achievement tests and social psychological measures. We examine achievement test scores because we feel that it is intrinsically interesting to study the factors that foster learning in schools. Our interest in social psychological measures stems from our desire to explore the possibility that single-sex schools are more effective, especially for girls, because of the absence of gender-based competition and discrimination that exists in coeducational schools. In short, if girls in single-sex Catholic schools are empowered through their separation from boys, we would expect girls have higher locus of control and self-esteem scores when they attend these schools.

Table 4 reports the weighted, design effect-adjusted means and standard deviations for

reading, mathematics, science, and social studies achievement test scores for girls and boys in each school sector as measured in grade 8, grade 10, and grade 12. In addition, the table reports the average change in these scores between grades 8 and 12 for students in each school type; these are generally referred to as “gain scores.” As in Tables 2 and 3, the data include students in the 12th grade analysis sample and are weighted by a transformation of F2PNLWT; the sample sizes for individual items vary due to item nonresponse.

In accordance with previous findings, Table 4 shows that boys who attend single-sex Catholic high schools have higher achievement test scores than boys enrolled in coeducational Catholic high schools, although the differences are not universally statistically significant⁴. The differences are statistically significant for all four tests in grades 8 and 10, and for the reading and mathematics tests in grade 12. Surprisingly, though, we find that girls in single-sex and coeducational Catholic schools have roughly equivalent scores. In no case do we observe statistically significant differences in achievement test scores between girls in these sectors. Table 4 also shows that there are no significant differences in gain scores between single-sex and coeducational high school pupils. Although single-sex school boys appear *to know* more than coeducational school boys in many cases, single-sex school boys and girls do *not learn* more than coeducational school boys and girls during the high school years.

Table 5 reports students’ scores on scales which assess locus of control and self-esteem in grades 8, 10, and 12. These scores are standardized across the entire NELS:88 sample with a mean of zero and a standard deviation of one. Here, we find no significant differences between sectors in students’ psychological test scores or in changes in those scores over the high school years.

MULTIVARIATE REGRESSIONS

In the preceding section we observed that boys who attend single-sex Catholic schools generally score higher than boys who attend coeducational Catholic schools on academic achievement tests; we observed no such effects for girls. Next, we consider whether observed differences (or the lack thereof) between these sectors on student outcomes are related to sector differences in student characteristics (observed in Tables 2 and 3)⁵

In Table 6 we present a series of regressions of 10th and 12th grade student outcomes on students' family backgrounds, educational aspirations, and test scores as measured in grade 8. While it is perhaps preferable to analyze the impact of school sector on gain scores (see Marsh 1989a, 1989b), we note that since we include 8th grade test scores as independent variables, our models are algebraically equivalent to models which analyze 8th to 10th grade gain scores and 8th to 12th grade gain scores. Considering 10th grade outcomes first, Model A includes only the single-sex school dummy variable. As expected, Model A of Table 6 shows that the associations between attending a single-sex school and achievement or psychological test scores are weak or non-existent; we have already learned this from Tables 4 and 5. Model B adds terms for family background, educational aspirations, and prior achievement, each measured in grade 8. By controlling for pre-enrollment differences between students, as opposed to differences between them at grade 10, we hope to get a better picture of the impact of enrollment in single-sex Catholic secondary schools. As Model B in Table 6 shows, after controlling for these 8th grade student characteristics, there are still no positive statistically significant effects of attending single-sex schools.

The next series of models in Table 6 examine 12th grade student outcomes. We add to the baseline model (Model C) terms for students' family background, educational aspirations, and achievement and self-concept test scores as measured in grade 8. As model D shows, after controlling for 8th grade student characteristics, there are again no statistically significant effects

of attending a single-sex Catholic school.

While our conclusion that single-sex school attendance has no independent consequences for boys' or girls' academic or psychological outcomes suggests that the "effect" of single-sex school attendance is equal for boys and girls, we are unable to formally evaluate this hypothesis using the models presented in Table 6. Instead, we carried out separate analyses (the results of which are not shown) in which we pooled the samples of boys and girls and entered independent variables representing gender and an interaction term between gender and school type. Although we reestimated all of the models in Table 6 in this manner, we found neither the interaction term nor the single-sex school dummy variable to be statistically significant in any of the models. In short, there is no evidence that the effect of attending a single-sex Catholic school differs for boys and girls.

In two respects we have made methodological decisions which might lead us to accept the null hypothesis that single-sex Catholic schools are neither more or less advantageous than Catholic coeducational schools. First, we have used listwise deletion in our OLS regression models; this technique limits the analysis to cases in which data is present for all variables included in the model, and thereby reduces sample sizes and perhaps the likelihood of rejecting null hypotheses. To assess the impact of this technique, we reestimated all of our models using pairwise deletion, in which each of the moments in the covariance matrix used in the regression model are estimated using cases which have valid data for the two variables pertaining to that moment. This technique raised our sample sizes somewhat, but changed our conclusions not at all. Second, we have weighted the data in our models so as to account for design effects. As we saw in Table 1, this procedure lowers the *effective* sample size for our analyses. If we adjust the standard errors in the regression models to ignore design effects, we find that the coefficients for the single-sex school dummy variable are frequently statistically significant and positive when that

indicator is the only independent variable. However, once the array of 8th grade student characteristics are controlled, those coefficients are never statistically significant. That is, our failure to find positive effects of single-sex school attendance is not due to our use of design effect-adjusted weights.

DISCUSSION

To conclude, we return to the three hypotheses outlined earlier. First, do boys and girls who attend single-sex Catholic secondary schools have higher achievement and self-concept test scores than students who attend coeducational Catholic secondary schools? Single-sex school boys have higher achievement test scores in grades 8, 10, and 12 than boys in coeducational schools, but they do not appear to learn more. The strongest evidence for this is the finding that boys in both sectors increase their scores between grades 8 and 12 (and between grades 8 and 10 and grades 10 and 12) by about the same amount. That is, across the high school years, boys in single-sex schools do not increase their test scores any more than boys in coeducational schools. For girls, the first hypothesis is clearly rejected: Nowhere did we find statistically significant positive effects of single-sex school enrollment for girls. In short, we cannot conclude that single-sex Catholic schools are especially advantageous academic settings, at least relative to coeducational Catholic schools. We simply find no evidence that single-sex Catholic school boys or girls *learn* more than their coeducational Catholic school peers during the high school years.

Why might our results differ so markedly from those of Lee and Bryk (1986) and others? One possibility is that something important about Catholic schools has changed since 1980, when the HS&B data were initially collected. Throughout the 1980s and early 1990s, a significant number of Catholic secondary schools (both coeducational and single-sex) closed their doors, while many other single-sex Catholic schools merged with other single-sex institutions or

converted to coeducational instruction (Bauch 1988; Brigham 1994). One apparent consequence of this trend is that the demographic distinctions between the student populations of Catholic single-sex and Catholic coeducational schools, as well as the student populations of Catholic and public schools in general, have become much less pronounced. While the number of students attending Catholic secondary schools declined from 796,000 in 1982 to 584,000 in 1992 (a 27 percent enrollment decrease), and the overall numbers of Catholic high schools dropped from 1,482 schools to 1,249 schools, the percentage of non-white pupils enrolled in Catholic schools increased from 16.3 percent in 1982 to 23.2 percent in 1992 and the percentage of non-Catholics enrolled in Catholic high schools increased from 11.2 percent in 1982 to 15.3 percent in 1992 (Brigham 1993). Moreover, the teaching staffs within Catholic secondary schools continue to undergo significant change. While 73 percent of all full-time Catholic school teachers were laity in 1982, by 1992 that number had increased to 84 percent (Brigham 1993). Our data echo these changes and underscore a significant difference between our sample of Catholic high school students and those in the HS&B sample. As Tables 2 and 3 show, single-sex and coeducational school students in our sample come from essentially equivalent family backgrounds and generally have similar educational aspirations; the same cannot be said of students in these sectors in the HS&B data.

Given that one of our central arguments is that it is important for researchers comparing the effectiveness of single-sex and coeducational schooling to take into account pre-existing differences among students, these demographic changes warrant close scrutiny. It is unclear, however, how these demographic changes may have differentially affected single-sex and coeducational Catholic secondary schools. In the analyses and discussion we present in this paper, we have not addressed how these demographic changes might affect the relative advantages and disadvantages of single-sex and coeducational schooling, and are reluctant to

offer uniformed conjectures. We do, however, believe that it is important to note these differences and to point to the need for further study.

Second, are the advantages associated with enrollment in a single-sex Catholic secondary school especially powerful for female high school students? Obviously, given the discussion above, the answer is no. The strongest evidence for this comes from the models in which we pooled the data for boys and girls, estimated the effects of gender and an interaction term for gender and school type, and found no significant effects for the interaction term.

How can we reconcile this finding with those of previous studies which purport to show “strong” and “pervasive” effects of single-sex Catholic secondary schools on girls’ achievements and self-esteem? Again, we wonder whether Catholic schools have changed in important ways since the early 1980's. A cursory search through a bibliographic data base shows that from the time the HS&B data were collected in the early 1980's until today, hundreds of books and journal articles¹⁶ have been published which highlight sexism and gender bias in our nation’s schools. In terms of educational policy, calls for a radical overhaul of the sexist socialization practices embedded in schools and in classrooms and a sharpened focus on schools as “primary sites for sexist socialization” (Lee, Marks, and Byrd 1994, p. 92; see also, American Association of University Women 1990; Orenstein 1995) have been equally evident. Gender discrimination is no longer simply the bailiwick of Feminist scholars, but has reached the forefront of debate in educational reform movements. The implementation of gender equity measures such as Title IX not only underscores the importance of this issue, but helps to propel much needed changes in classrooms and in schools. However, before we become overly optimistic about the pace and scope of these reform efforts, one thing that research in this area has demonstrated is that gender discrimination is a far more subtle and complex problem than is implied by past research. More to the point, what the limited amount of cross-sector research that has been done in this area (e.g.

Lee, Marks, and Byrd 1994) suggests is that incidences of sexism occur in all school sectors regardless of gender composition.¹⁷

It would be naive to suggest that schools have not responded to the recent focus on gender bias in schools and classrooms. If coeducational schools have “cleaned up their acts” to an important extent since the early 1980's, then the advantages for girls of attending single-sex secondary schools may have declined. In any case, those advantages for girls are not evident in our data.

Third, are the advantages associated with enrollment in a single-sex Catholic secondary school due to pre-enrollment differences in the characteristics of students who attend single-sex and coeducational institutions? Since we observe so few advantages of single-sex Catholic schooling, it is hard to answer this question. We initially expected to find that single-sex Catholic school students had higher test scores than their coeducational Catholic school peers, and that we might explain this by controlling for pre-enrollment characteristics. However, besides finding few differences between single-sex and coeducational schools in 10th and 12th grade student outcomes, we also found few differences between students in pre-enrollment characteristics.

REFERENCES

- American Association of University Women. 1990. *Shortchanging Girls, Shortchanging America: Full Data Report*. Washington, DC: American Association of University Women.
- Bauch, Patricia A. 1988. "Differences Among Single-Sex and Coeducational High schools." *Momentum* 19:56-58.
- Brigham, Frederick H. Jr. 1993. *United States Catholic Elementary and Secondary Schools 1992-1993: Annual Statistical Report on Schools, Enrollment, and Staffing*. Washington, DC: National Catholic Educational Association.
- Brigham, Frederick H. Jr. 1994. *United States Catholic Elementary and Secondary Schools 1993-1994: Annual Statistical Report on Schools, Enrollment, and Staffing*. Washington, DC: National Catholic Educational Association.
- Bryk, Anthony S., P. B. Holland, V. E. Lee, and R. A. Carriedo. 1984. *Effective Catholic Schools: An Exploration*. Washington, D.C.: National Catholic Education Association.
- Bryk, Anthony S. and Stephen W. Raudenbush. 1992. *Hierarchical Linear Models: Applications and Data Analysis Methods*. Newbury Park, CA: Sage Publications, Inc.
- Bryk, Anthony S., Valerie E. Lee, Peter B. Holland. 1993. *Catholic Schools and the Common Good*. Cambridge, MA: Harvard University Press.
- Coleman, James S. 1961. *The Adolescent Society*. New York: Free Press.
- Coleman, James S., Thomas T. Hoffer, and Sally B. Kilgore. 1982. *Public and Private Schools. Report to the Center for Education Statistics*. Chicago: National Opinion Research Center.
- Dale, Reginald R. 1974. *Mixed or Single-Sex School? Volume III: Attainment, Attitudes and Overview*. London: Routledge & Kegan Paul.

- Dale, Reginald R. and P. McC. Miller. 1972. "The Academic Progress of University Students from Coeducational and Single-Sex Schools." *British Journal of Educational Psychology* 42:317-319.
- DiPrete, Thomas A. and Jerry D. Forristal. 1994. "Multilevel Models: Methods and Substance." *Annual Review of Sociology* 20:331-357.
- Frison, Basil M. 1959. *Coeducation in Catholic Schools: A Commentary on the Instruction on Coeducation*. Rome: Institutum Iuridicum Claretianum.
- Gabriel, Susan L. and Isaiah Smithson, (Eds.). 1990. *Gender in the Classroom: Power and Pedagogy*. Urbana, IL: University of Illinois Press.
- Goldstein, Harvey. 1987. *Multilevel Models in Educational and Social Research*. New York: Oxford University Press.
- Goodlad, John I. 1984. *A Place Called School*. New York: McGraw-Hill.
- Greeley, Andrew M. 1982. *Catholic High Schools and Minority Students*. New Brunswick, NJ: Transaction Books.
- Hamilton, Laura S., E. Michael Nussbaum, Haggai Kupermintz, Joannes I. M. Kerkhoven, and Richard E. Snow. 1995. "Enhancing the Validity and Usefulness of Large-Scale Educational Assessments: II. NELS:88 Science Achievement." *American Educational Research Journal* 32:555-582.
- Howe, Florence. 1984. *Myths of Coeducation: Selected Essays 1964-1983*. Bloomington, IN: Indiana University Press.
- Jones, Jennifer. 1990. "Outcomes of Girls' Schooling: Unraveling Some Social Differences." *Australian Journal of Education* 34:153-167.
- Kolesnik, Walter Bernard. 1969. *Coeducation: Sex Differences and the Schools*. New York: Vantage Press.

- Kupermintz, Haggai, Michele Ennis, Laura S. Hamilton, Joan E. Talbert, and Richard E. Snow. 1995. "Enhancing the Validity and Usefulness of Large-Scale Educational Assessments: I. NELS:88 Mathematics Achievement." *American Educational Research Journal* 32:525-554.
- Lasser, Carol. 1987. *Educating Men and Women Together: Coeducation in a Changing World*. Urbana, IL: University of Illinois Press.
- Lee, Valerie E. and Anthony S. Bryk. 1986. "Effects of Single-Sex Secondary Schools on Student Achievement and Attitudes." *Journal of Educational Psychology* 78:381-395.
- Lee, Valerie E. and Anthony S. Bryk. 1986. "Effects of Single-Sex Schools: Response to Marsh." *Journal of Educational Psychology* 81:647-650.
- Lee, Valerie E. and Marlaine E. Lockheed. 1990. "The Effects of Single-Sex Schooling on Achievement and Attitudes in Nigeria." *Comparative Education Review* 34:209-231.
- Lee, Valerie E. and Helen M. Marks. 1990. "Sustained Effects of the Single-Sex Secondary School Experience on Attitudes, Behaviors, and Values in College." *Journal of Educational Psychology* 82:578-592.
- Lee, Valerie E. and Helen M. Marks. 1992. "Who Goes Where? Choice of Single-Sex and Coeducational Independent Secondary Schools." *Sociology of Education* 65:225-253.
- Lee, Valerie E., Helen M. Marks, and Tina Byrd. 1994. "Sexism in Single-Sex and coeducational Independent Secondary School Classrooms." *Sociology of Education* 67:92-120.
- Mahony, Pat. 1985. *Schools for the Boys? Coeducation Reassessed*. Dover, NH: Hutchinson.
- Marsh, Herbert W. 1989a. "Effects of Attending Single-Sex and Coeducational High Schools on Achievement, Attitudes, Behaviors, and Sex Differences." *Journal of Educational Psychology* 81:70-85.

- Marsh, Herbert W. 1989b. "Effects of Single-Sex and Coeducational Schools: A Response to Lee and Bryk." *Journal of Educational Psychology* 81:651-653.
- Marsh, Herbert W. 1991. "Public, Catholic Single-Sex, and Catholic Coeducational High Schools: Their Effects on Achievement, Affect, and Behaviors." *American Journal of Education* 41:320-356.
- Marsh, Herbert W., Lee Owens, Margaret R. Myers, and Ian D. Smith. 1989. "The Transition from Single-Sex to Co-Educational High Schools: Teacher Perceptions, Academic Achievement, and Self-Concept." *British Journal of Educational Psychology* 59:155-173.
- National Center for Education Statistics. 1994. *A Guide to Using NELS:88 Data*. September 1994 edition. Washington, D.C.: National Center for Education Statistics
- Orenstein, Peggy. 1995. *School girls: young women, self-esteem, and the confidence gap*. New York: Anchor Books.
- Ramirez, Francisco O. and Yun-Kyung Cha. 1990. "Citizenship and Gender: Western Educational Development in Comparative Perspective." *Research in Sociology of Education and Socialization* 9:153-173.
- Riordan, Cornelius. 1985. "Public and Catholic Schooling: The Effects of Gender Context Policy." *American Journal of Education* 36:518-540.
- Riordan, Cornelius. 1990. *Girls and Boys in School: Together or Separate?* New York: Teachers College Press.
- Rock, Donald A. and Judith M. Pollack. 1990. *Psychometric Report for the NELS:88 Base Year Test Battery*. National Center for Educational Statistics Report No. 91-467. Washington, DC: U. S. Department of Education.
- Rosenberg, Morris. 1986. *Conceiving the Self*. Malibar, FL: Robert E. Krieger Publishing

- Company.
- Rosenberg, Morris. 1989. *Society and the Adolescent Self-Image*. Middletown, CT: Wesleyan University Press.
- Rotter, Julian B. 1966. "Generalized Expectancies for Internal Versus External Control of Reinforcement." *Psychological Monographs* 80:1-28.
- Shaw, Jennifer. 1980. "Education and the Individual: School for Girls, or Mixed Schools—a Mixed Blessing?" Pp. 66-75 in *Schooling for Women's Work*, edited by Rosemary Deem. London: Routledge and Kegan Paul.
- Tyack, David and Elizabeth Hansot. 1990. *Learning Together: A History of Coeducation in American Schools*. New Haven: Yale University Press.
- U. S. Department of Education, National Center for Education Statistics. 1990. National educational longitudinal study 1988 [computer file]. Chicago: National Opinion Research Center [producer]. Ann Arbor, MI: Inter-University Consortium for Political and Social Research [distributor].
- Willis, Sue and Jane Kenway. 1986. "On Overcoming Sexism in Schooling: To Marginalize or Mainstream." *Australian Journal of Education* 30:132-149.

NOTES

1. Lee and Bryk's (1986) analyses were largely reproduced in Chapter 9 of *Catholic Schools and the Common Good* (1993), by Bryk, Lee, and Holland. Since the two works are essentially the same, we refer to both when we mention "Lee and Bryk (1986)." In focusing on their research, we do not wish to suggest that there is anything extraordinary about Lee and Bryk's (1986) analyses that cause us to question them specifically. Their work is merely the most recent in a series of analyses that purport to demonstrate the advantages of single-sex secondary schooling.
2. We could have examined non-Catholic single-sex private schools in our analyses as well, but decided against doing so for two reasons. First, our primary interest is in comparing single-sex and coeducational schooling. Were we to include non-Catholic single-sex private schools in our analyses, we would be faced with the fact that non-Catholic private schools are extremely heterogeneous in character. As a result, the focus of our analyses would be less sharp. Second, most recent comparisons of single-sex and coeducational secondary schooling have focused on Catholic schools in the High School and Beyond (HS&B) data (Riordan 1985; Lee and Bryk 1986; Marsh 1989a, 1991), and we would like our work to be viewed as an extension of that literature.
3. As Tyack and Hansot (1990) note, during the 1980's coeducation had also become increasingly prevalent in European religious schools. In Great Britain, where there is a long tradition of single-sex schools for upper and middle class families, educators deliberately imitated the American model of coeducational and socially comprehensive schools in an attempt to remedy inequalities in schooling based not only on gender but also on class.
4. The issue of selectivity in regard to Catholic schooling reached the forefront of debate following the publication of two controversial books in 1982 (Coleman, Hoffer, and Kilgore 1982; Greeley 1982). Advocating that Catholic schools produce higher cognitive achievement and are less racially segregated than public schools, both Coleman et al. and Greeley suggest that achievement in Catholic high schools is less dependent on family background and personal circumstances than in public sectors. Commentators widely criticized both studies, primarily for their methodological shortcomings, and initiated a lively debate (see, for example, *Sociology of Education* vol. 55 in 1982; *Sociology of Education*, vol. 58 in 1985; and *Harvard Educational Review*, vol. 51, in 1985).
5. Lee and Bryk (1986) also focus on differences between single-sex and coeducational Catholic school students in school-related attitudes and behaviors, course enrollments, educational aspirations, and sex-role attitudes. We focus primarily on academic achievement, locus of control, and self-concept as outcomes, but consider other issues as necessary.
6. We should note that Lee and Bryk (1986) never report standard errors or other measures of variability in their outcome measures. As a result, it is difficult to tell whether their observed sector differences are ever statistically significant
7. In fact, in recent works by Lee and her colleagues, the authors acknowledge the methodological problems associated with the issue of selectivity (e.g. Lee and Marks 1990, 1992; Lee and Bryk 1986) and readily admit that "no aspect of independent schools provokes more interest and controversy than does selectivity Admissions criteria, which vary widely, include

considerably more than test data. Students and families also generally exercise self-selection, based on a school's reputation" (Lee and Marks 1992, pp. 233-234). Moreover, Lee and her colleagues are vocal critics of previous studies which typically involved small, non-random samples, and as they have argued, "... researchers generally have not adjusted for differences in the background characteristics of students attending coeducational versus single-sex schools and often have not considered whether the effects might be different for boys and girls" (Lee and Bryk 1986, p. 382). But as Marsh (1989a, 1989b) demonstrates in his review of their study, despite rhetoric to the contrary, HS&B does not contain, nor do Lee and Bryk (1986) provide, adequate controls "... for possible preexisting differences in academic achievement, prior course work, self-concept, locus of control or other school-related behaviors and attitudes that were considered as outcomes" (1989a, p. 72).

8. As measures of self-esteem and locus of control, we use a 7-item self-esteem scale adapted from Rosenberg's self-esteem inventory and a 6-item locus of control scale adapted from Rotter's locus of control measure (for a discussion of the general reliability and validity of these instruments see Rosenberg 1986, 1989; Rotter 1966). For tests of reading, mathematics, science, and social studies, we use the IRT (Item Response Theory) composites developed in each wave of the NELS:88 survey. Rock and Pollack (1990) provide a detailed psychometric report for the base year test battery. In addition, two recent studies (Kupermintz, Ennis, Hamilton, Talbert, and Snow 1995; Hamilton, Nussbaum, Kupermintz, Kerkhoven, and Snow 1995) explore the validity and usefulness of the mathematics and science tests.

9. Following the NELS:88 codebook (U.S. Department of Education 1990), we used the following values for DEFF: For analyses of 10th grade student outcomes, DEFF=2.619; for analyses of 8th, 10th, and 12th grade student data, DEFF=2.532.

10. The standard deviations in all tables describing student characteristics are adjusted for design effects.

11. We could also have presented these descriptive statistics using the sample of students included in the analyses of 10th grade student outcomes and weighted by a transformation of F1PNLWT. However, for the sake of space, we provide only one of these sets of results, which are substantively the same.

12. This SES score is a composite of parents' education, parents' occupations, and family income, and is standardized across the entire NELS:88 sample in such a way that its mean is zero and its standard deviation is one.

13. It makes no sense to report this figure for students in grade *and* grade 10 because of the construction of the analysis sample. Since students must have been in-grade and in-school in grade 10, retention could only have occurred *before* grade 8.

14. Following Marsh (1989a, p. 72) we break from Lee and Bryk (1986) by rejecting the use of one-tailed tests of statistical significance for these analyses. Marsh (1989a, p. 72) points out that had Lee and Bryk (1986) used two-tailed tests and a $p < .01$ level of significance, only 3 of their 74 comparisons would have been statistically significant.

15. We recognize that multi-level models would be appropriate for our analyses, but we have decided against such models for two reasons. First, in a sizable proportion of our schools we have fewer than 5 students. Second, since multi-level models are generally more conservative (that is, since we are more likely to accept the null hypothesis in such models), and since we find few sector effects in our OLS regressions, we feel that we would learn nothing new by going beyond OLS regressions.

16. For example, see edited volumes by Gabriel and Smithson (1990) and Lasser (1987).

17. As Lee and her colleagues (Lee, Marks, and Byrd 1994) have shown in an observational study of 86 classrooms in 21 independent secondary schools, the *frequency* of sexist incidents occurring in single-sex boys', coeducational, and single-sex girls' schools is similar across all school types. However, the *form* that sexism takes and the *severity* of these incidents may differ between school sectors.

Table 1.
Sample Selection Criteria and Sample Sizes by High School Sector and Sex

	Male Students		Female Students	
	Sing.-Sex	Coed	Sing.-Sex	Coed
<i>Unweighted Data</i>				
Sample for Analyses of 10th Grade Student Outcomes Restricted to Students Who ...				
... attended Catholic Single-Sex or Coeducational Secondary Schools in 1990,	186	238	127	285
... AND did not attend a Catholic School in Which more than 25 Percent of Students were in the Vocational Track,	186	223	109	263
... AND were Attending School and In-Grade in 1990.	185	223	109	263
Sample for Analyses of 12th Grade Student Outcomes Further Restricted to Students Who ...				
... Participated in all Three NELS:88 Survey Waves,	178	217	107	254
... AND did not Drop Out of School Between 1990 and 1992 (Students' Sophomore and Senior Years of School),	177	215	105	251
... AND did not Change Schools Between 1990 and 1992 (Students' Sophomore and Senior Years of School).	157	190	85	227
<i>Weighted Data</i>				
Sample for Analyses of 10th Grade Student Outcomes Using 8th and 10th Grade Data (Weight: F1PNLWT, adjusted)	105	79	65	96
Sample for Analyses of 12th Grade Student Outcomes Using 8th, 10th, and 12th Grade Data (Weight: F2PNLWT, adjusted)	95	64	53	87

Table 2.
 Characteristics of Students in Grade 8 by High School Sector and Sex

Source Variables(s)	Male Students		Female Students		
	Sing.-Sex	Coed	Sing.-Sex	Coed	
<i>Socioeconomic Circumstances in Grade 8</i>					
SES Composite	BYSES	0.45 (0.60)	0.43 (0.65)	0.35 (0.66)	0.26 (0.57)
Number of Siblings	BYS32	1.94 (1.43)	2.30 (1.71)	1.93 (1.39)	2.09 (1.46)
Proportion of Households w/ 2 Parents	BYPARMAR	0.90 (0.31)	0.89 (0.31)	0.88 (0.33)	0.91 (0.29)
Race/Ethnicity (Proportion White)	BYS31A	0.75 (0.44)	0.72 (0.45)	0.79 (0.41)	0.71 (0.46)
<i>Educational Aspirations in Grade 8</i>					
Proportion Who Think They Will Finish College	BYS45	0.91 (0.28)	0.77 ** (0.43)	0.84 (0.37)	0.92 (0.28)
Proportion Who Are Very Sure They Will Graduate From High School	BYS46	0.91 (0.28)	0.87 (0.34)	0.87 (0.34)	0.92 (0.27)
Proportion Who Are Very Sure They Will Go on Farther Than High School	BYS47	0.83 (0.37)	0.70 ** (0.46)	0.78 (0.42)	0.84 (0.37)
Maximum (Weighted) Sample Size		95	64	53	87

Sample: Sample restricted to individuals who 1) were in one of the two school sectors; 2) did not attend a Catholic school in 10th grade in which 25 percent of the students were in the vocational track; 3) were in-school and in-grade during the sophomore-year follow-up; 4) participated in all three survey waves; 5) did not drop out of school between 1990 and 1992; and 6) did not change schools between 1990 and 1992.

Weighting: Sample weighted so that standard deviations are based on actual sample sizes and are adjusted for design effects. See text for details. Specifically:

$$\text{NEW WEIGHT} = (\text{OLD WEIGHT} / (\text{Mean Value of OLD WEIGHT})) / \text{DEFF}.$$

Note: Numbers in parentheses are design-effect adjusted standard deviations.

Sign. Tests: Tests compare scores for single-sex and coeducational school students, separately for boys and girls.
 * = $p < 0.10$; ** = $p < 0.05$; *** = $p < 0.01$ (all two-tailed tests)

Table 3.
 Characteristics of Students in Grade 10 by High School Sector and Sex

Source Variables(s)	Male Students		Female Students		
	Sing.-Sex	Coed	Sing.-Sex	Coed	
<i>Socioeconomic Circumstances in Grade 10</i>					
SES Composite	F1SES	0.51 (0.61)	0.42 (0.71)	0.39 (0.71)	0.32 (0.59)
Number of Siblings	F1S90A-91B	2.08 (1.77)	2.48 (1.89)	1.91 (1.49)	2.25 (1.68)
Proportion of Households w/ 2 Parents	F1S92A-F	0.86 (0.35)	0.86 (0.35)	0.86 (0.35)	0.88 (0.33)
Race/Ethnicity (Proportion White)	F1RACE	0.75 (0.43)	0.73 (0.45)	0.79 (0.41)	0.73 (0.45)
<i>Educational Aspirations in Grade 8</i>					
Proportion Who Think They Will Finish College	F1S49	0.92 (0.27)	0.89 (0.32)	0.86 (0.35)	0.87 (0.34)
Proportion Who Are Very Sure They Will Graduate From High School	F1S18A	0.93 (0.25)	0.92 (0.27)	0.94 (0.23)	0.93 (0.26)
Proportion Who Are Very Sure They Will Go on Farther Than High School	F1S18B	0.83 (0.38)	0.76 (0.43)	0.87 (0.34)	0.83 (0.38)
<i>Grade Delay</i>					
Proportion Who Have Ever Repeated a Grade	F1N22	0.06 (0.23)	0.14 (0.35)	0.03 (0.16)	0.02 (0.15)
Maximum (Weighted) Sample Size		95	64	53	87

Notes: Numbers in parentheses are design-effect adjusted standard deviations. See notes below Table 2 for descriptions of sample selection, weighting, and adjustments for design effects.

Sign. Tests: Tests compare scores for single-sex and coeducational school students, separately for boys and girls.
 * = $p < 0.10$; ** = $p < 0.05$; *** = $p < 0.01$ (all two-tailed tests)

Table 4.
Achievement Test Scores by School High Sector and Sex

Source Variables(s)		Male Students		Female Students	
		Sing.-Sex	Coed	Sing.-Sex	Coed
Achievement Test Scores: Grade 8					
Reading Test (IRT)	BY2XRIRR	31.18 (8.10)	28.71 * (8.75)	31.93 (7.67)	31.51 (7.82)
Math Test (IRT)	BY2XMIRR	43.19 (9.92)	39.24 ** (10.86)	39.72 (11.60)	39.85 (9.90)
Science Test (IRT)	BY2XSIRR	21.59 (4.40)	19.95 ** (4.41)	19.54 (4.78)	19.37 (4.01)
Social Studies Test (IRT)	BY2XHIRR	32.42 (4.16)	31.25 * (4.58)	31.24 (4.22)	31.03 (3.76)
Achievement Test Scores: Grade 10					
Reading Test (IRT)	F12XRIRR	35.57 (8.15)	32.81 ** (8.78)	35.17 (9.86)	35.58 (8.22)
Math Test (IRT)	F12XMIRR	53.06 (10.45)	48.81 ** (10.70)	49.11 (13.23)	48.91 (11.05)
Science Test (IRT)	F12XSIRR	24.83 (5.36)	22.80 ** (5.37)	22.66 (5.63)	23.12 (4.92)
Social Studies Test (IRT)	F12XHIRR	34.63 (4.06)	33.15 ** (4.46)	33.45 (4.44)	32.92 (3.92)
Achievement Test Scores: Grade 12					
Reading Test (IRT)	F22XRIRR	37.96 (7.93)	35.45 * (9.07)	38.84 (7.47)	39.03 (8.10)
Math Test (IRT)	F22XMIRR	58.54 (10.45)	54.94 ** (11.47)	54.28 (14.63)	53.95 (11.32)
Science Test (IRT)	F22XSIRR	27.15 (5.67)	25.93 (5.14)	24.01 (5.78)	24.85 (4.95)
Social Studies Test (IRT)	F22XHIRR	38.54 (4.48)	37.66 (4.31)	36.75 (5.02)	37.12 (4.61)
Gain Scores: Grade 8 to 12					
Reading Test (IRT)	F22XRIRR - F12XRIRR	6.78 (16.03)	6.74 (17.82)	6.91 (15.13)	7.52 (15.92)
Math Test (IRT)	F22XMIRR - F12XMIRR	15.35 (20.37)	15.70 (22.32)	14.55 (26.24)	14.10 (21.22)
Science Test (IRT)	F22XSIRR - F12XSIRR	5.57 (10.07)	5.98 (9.55)	4.48 (10.57)	5.48 (8.96)
Social Studies Test (IRT)	F22XHIRR - F12XHIRR	6.12 (8.64)	6.42 (8.88)	5.51 (9.24)	6.10 (8.37)
Maximum (Weighted) Sample Size		95	64	53	87

Notes: Numbers in parentheses are design-effect adjusted standard deviations. See notes below Table 2 for descriptions of sample selection, weighting, and adjustments for design effects.

Sign. Tests: Tests compare scores for single-sex and coeducational school students, separately for boys and girls.

* = $p < 0.10$; ** = $p < 0.05$; *** = $p < 0.01$ (all two-tailed tests)

Table 5.
Psychological Measures by High School Sector and Sex

Source Variables(s)		Male Students		Female Students	
		Sing.-Sex	Coed	Sing.-Sex	Coed
<i>Psychological Measures: Grade 8</i>					
Locus of Control	BYLOCUS2	0.22 (0.56)	0.16 (0.55)	0.16 (0.52)	0.23 (0.48)
Self-Esteem	BYCNCPT2	0.28 (0.56)	0.19 (0.60)	0.06 (0.57)	-0.02 (0.64)
<i>Psychological Measures: Grade 10</i>					
Locus of Control	F1LOCUS2	0.19 (0.59)	0.03 (0.57)	0.07 (0.56)	0.15 (0.60)
Self-Esteem	F1CNCPT2	0.33 (0.64)	0.12 (0.63)	-0.01 (0.67)	-0.02 (0.58)
<i>Psychological Measures: Grade 12</i>					
Locus of Control	F2LOCUS2	0.12 (0.61)	0.06 (0.65)	0.07 (0.54)	0.17 (0.60)
Self-Esteem	F2CNCPT2	0.26 (0.71)	0.13 (0.79)	-0.06 (0.83)	-0.02 (0.63)
<i>Change in Psychological Measures, Grade 8 to Grade 12</i>					
Locus of Control	F2LOCUS2 - F1LOCUS2	-0.10 (1.18)	-0.10 (1.19)	-0.09 (1.06)	-0.07 (1.08)
Self-Esteem	F2CNCPT2 - F1CNCPT2	-0.02 (1.27)	-0.06 (1.39)	-0.12 (1.40)	-0.01 (1.27)
Maximum (Weighted) Sample Size		95	64	53	87

Notes: Numbers in parentheses are design-effect adjusted standard deviations. See notes below Table 2 for descriptions of sample selection, weighting, and adjustments for design effects.

Sign. Tests: Tests compare scores for single-sex and coeducational school students, separately for boys and girls.
* = $p < 0.10$; ** = $p < 0.05$; *** = $p < 0.01$ (all two-tailed tests)

Table 6.
Regressions of 10th and 12th Grade Psychological and Achievement Test Scores on Students' 8th and 10th Grade Characteristics

	Boys						Girls					
	Reading	Math	Science	History	Locus	Esteem	Reading	Math	Science	History	Locus	Esteem
<i>Regressions of 10th Grade Test Scores</i>	N = 184						N = 161					
A. Single Sex School Dummy Variable	0.63 (0.42)	3.69 (1.95)	1.19 (1.27)	0.76 (1.08)	0.09 (0.84)	0.15 (1.29)	-0.10 (0.07)	-0.07 (0.04)	-0.10 (0.12)	0.67 (0.94)	-0.14 (1.39)	-0.09 (0.82)
B. A + Family Background, Educational Aspirations, Achievement Test Scores, and Psychological Test Scores in Grade 8	-1.38 (1.35)	0.78 (0.70)	0.12 (0.17)	0.09 (0.17)	-0.00 (0.04)	0.10 (0.94)	-0.31 (0.31)	0.22 (0.23)	-0.33 (0.53)	0.50 (1.03)	-0.09 (0.97)	-0.03 (0.35)
<i>Regressions of 12th Grade Test Scores</i>	N = 160						N = 140					
C. Single Sex School Dummy Variable	0.51 (0.33)	2.06 (0.93)	0.98 (0.90)	0.05 (0.06)	0.10 (0.81)	0.21 (1.40)	0.39 (0.22)	1.90 (0.67)	0.08 (0.07)	0.36 (0.34)	-0.05 (0.43)	0.16 (1.07)
D. C + Family Background, Educational Aspirations, Achievement Test Scores, and Psychological Test Scores in Grade 8	-0.01 (0.01)	1.22 (0.81)	0.40 (0.49)	-0.27 (0.43)	0.09 (0.72)	0.17 (1.22)	-0.81 (0.61)	-0.16 (0.10)	-0.79 (0.97)	-0.27 (0.34)	-0.05 (0.44)	0.10 (0.71)

Notes: Sample for analyses of 10th grade outcomes restricted to individuals who 1) were in one of the two school sectors; 2) did not attend a Catholic school in 10th grade in which 25 percent of the students were in the vocational track; and 3) Were in-school and in-grade as of the sophomore year follow-up. Sample for 12th grade outcomes further restricted to individuals who 4) participated in all three survey waves; 5) did not drop-out of school between grades 10 and 12; and 6) did not change schools between grades 10 and 12. All analyses are then restricted to cases with no missing data on any of the dependent or independent variables. Samples weighted so that standard errors are based on actual sample sizes. Note that numbers in parentheses are the absolute values of the ratios of unstandardized coefficients to standard errors which are adjusted for design effects.

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