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ABSTRACT

In New Zealand, single-sex public schools are held in greater esteem by the community. Because single-sex public schools are more popular than coeducational public schools, the single-sex schools in larger population areas have selective admission policies to screen the large number of applicants. This paper argues that single-sex schools end up with a more socially exclusive group of pupils, whose ability levels are considerably higher than for pupils at coeducational schools. It presents findings of a study that first compared the achievement levels of girls to those of boys in a sample of New Zealand schools. The study also compared the achievement levels of girls in all-female schools with those of girls in coeducational schools after proper controls had been exercised for ability and social and cultural differences between the pupil populations of the different schools. Data from the "Progress at School" Project, a longitudinal study of over 5,000 pupils in 37 secondary schools in New Zealand, were analyzed. The data show that when adequate control is exercised for the different ability levels and the social and ethnic mix of the two types of school, the initial significant differences in academic achievement disappear. Thus the popular belief that girls will do better academically at single-sex schools is not sustained by the data. School type does not appear to be an important factor in attempts to improve the performance levels of girls in mathematics and science. Finally, the analysis did not consider such variables as self-concept, dropout rates, and social maturity. Nine tables are included. (Contains 31 references.) (LMI)

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School type and the education of girls: Co-ed or girls only?

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Introduction

Eileen Byrne, in her incisive review of the operations of educational establishments as they impinge on the lives of women, invokes what she calls the 'Snark syndrome' - that is, if something is repeated often enough, it becomes true! Much of the conventional wisdom surrounding the education of girls and women is, she argues, of this type. Where evidence is used, much of it 'is unscholarly, or anecdotal, or based on small samples, or inconclusive' (1993:182). It is a commonly held belief in New Zealand that girls will do better in academic subjects (particularly Maths and Science) at a single-sex school, than they would if they attended a co-educational school (Jones *et al* 1972). Single-sex schools (for both boys and girls) are held in greater esteem by the community and are generally thought to achieve better academic results for their students in public examinations (see for example Cocklin and Battersby 1987:61). The effect of this belief is to create a situation in which the public, single-sex schools in the larger towns and cities in New Zealand have more applicants than available places, hence exercise to a greater or lesser extent, some selection policy. The criteria on which the policies are based vary, and by no means all, or even most, of the schools select on the basis of ability. However, the existence of a competitive market for places in high status schools will always favour some families over others - those with the requisite financial, cultural, and social resources to know how the game is played (Nash 1993). Whatever the criteria for selection may be, we want to argue that the

outcome is much the same (for girls and boys alike) - the single sex schools end up with a more socially exclusive group of pupils, whose initial ability levels are considerably higher than for pupils at co-educational schools. We want to look first at the achievement levels of girls as compared to boys in our sample of New Zealand schools, then, secondly, for girls , to compare the achievement levels of single-sex and co-educational schools *after* proper controls have been exercised for ability and social and cultural differences between the pupil populations of the different schools.

Previous research

The presence in New Zealand of a substantial number of single-sex schools in the public sector, provides a unique environment in which to carry out controlled comparisons between single-sex and co-educational schools. This avoids an important confounding factor that exists in a number of the countries with which, from an educational perspective, New Zealand is frequently compared - namely that while single sex education is a common feature of the private sectors in those countries, it is not common in the public sector, or even entirely absent from the public sector as in the United States (Lee and Marks 1992)[1]. Studies from other countries need to be considered carefully in this regard, as well as with regard to the adequacy of controls for initial ability and social and ethnic mix of the student populations (see Byrne (1993;176-184) for a thorough review and discussion of relevant issues).

The single-sex - co-educational debate in the United States has focussed around comparisons within the private sector, most noteably the debate arising from Lee and

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1 The interesting debate in the U.S.A. over the legal position in relation to the 1972 Title IX ammendments to the 1964 Civil Rights Act, and the Equal Educational Opportunities Act of 1974 ar discussed by Caplice (1994).

Bryk's (1986) secondary analysis of the large longitudinal data base, 'High School and Beyond', using data from the Catholic school sector. They found a number of advantages to students in single-sex schools, particularly girls, because, they claim, of the ability in such schools to separate social from academic concerns. Marsh (1989a), using the same data set, has criticised the Lee and Bryk study on a number of grounds, the most germane of which is that the study inadequately controlled for any pre-existing differences between the school populations. From his re-analysis, Marsh concluded

> In summary, when appropriate controls were introduced, almost no differences ... could reasonably be attributed to the effect of school type, and there was no tendency for the few differences that did exist to consistently favor students from single-sex or co-ed schools. (p.80)

Part of the problem is that the High School and Beyond data-set has no clear cut and agreed measure of initial ability, and resort has to be made to a variety of proxy variables. The debate continued for some time (see Lee and Bryk 1989; Marsh 1989b; Marsh 1992), and for our purposes, clearly underlined the message that without proper controls for ability-mix, comparisons between schools (and school types) are hazardous and potentially misleading.

In England and Wales, the situation is also confounded by cross sectoral problems. Bell (1989) found that pupils at single-sex schools (both boys and girls) achieved higher test scores in Science, but concluded that pre-selection by the schools on the basis of ability is a key factor and that it is not sensible to attribute the differences directly to the school type without proper controls since the data he used (the Assessment of Performance Unit's Science Project 1980-1984) showed that 40 percent of the single-sex schools were either private or elite state "grammar" schools, while only 3 percent of the co-educational schools were in those categories (p.195).

Steedman (1983) [cited in Byrne 1993:178] reviewing the findings of a longitudinal study of a single birth cohort of some 14,000 people, concluded that the apparent differences in examination results between students at single-sex and co-educational schools were markedly reduced with proper control for differences in background and initial ability.

Australian research shows a similar development, with early studies based on uncontrolled samples giving way to more comprehensive studies. Young and Fraser (1992) found that the average socioeducational level of the school population was a more important predictor of student attainment in Science than school type (single-sex or co-ed). Marsh *et al* (1988) report on a longitudinal study of the conversion of two single-sex schools into two co-educational institutions and found positive gains in self-concept and no detectable changes in academic achievement outcomes. Willis and Kenway (1986) reviewed the popular beliefs that single-sex education is better for girls, both in relation to achievement and the absence of sexist practices. They question whether single-sex schools are any less sexist, and argue that as a policy strategy it

> is unlikely to change the educational opportunities of girls in any fundamental way because it focusses almost exclusively on changing the behaviour of girls. It neglects the much more difficult problem of changing the attitudes and behaviours of boys and teachers, and the nature of the curriculum itself. (p.138)

Willis and Kenway go on to argue that co-education has 'vastly more potential' (p.147) for counter sexist practices, and to deal simultaneously with the curriculum and the attitudes of teachers, girls *and* boys. Jones and Jacka (1995) similarly point out that treating girls as an homogeneous group and as a "problem", renders invisible many crucial differences between them, and assumes that it is they 'who need "treatment" rather than, say, the curriculum, the school or some other aspect of girls' social and cultural context.' (p.168) Such views are also expressed by Byrne (1993:185-6) in her argument against single-sex education.

The various experiments in a number of countries (including New Zealand - see Scott 1991) of having single-sex classes within co-educational schools for particular subjects (Maths and Science) also avoids the issues outlined by Willis and Kenway, Byrne, and Jones and Jacka. However, there appears to be some evidence of academic gains in particular subject areas for both boys and girls. For example the reports by: Syal and Trump (1996) on an experimental programme in England, which reports large gains for adolescent boys in English language and literature examination results when taught separately from girls; Kumagai (1995) who reports gains for girls in physics in girls only classes in the U.S.A. Scott's (1991) New Zealand case study shows an increase in confidence and self-esteem for girls in a girls only science class, but no achievement gains. Willis and Kenway (1986) see the problem being addressed best through teacher education, and Byrne (1993:186) reminds us that

> the problems of negative peer attitudes, of the poor image of some disciplines, and of presence or lack of esteem and confidence which are centrally authenticated in research, stem from teachers and from the classroom environment: they do not spring unaided from students alone.

Students in one of the studies reviewed by Kumugai (1995:74) comment "that if all teachers were sensitive to the concerns of young women, then it wouldn't matter if the class were coed or single-sex, or if a man or a woman were teaching." In her extensive review of research on the relative efficacy of co-ed versus single-sex education for girls, Byrne (1993:182) concludes that 'there is no conclusive evidence on either side of the argument', and adds that we should be very cautious about applying findings from other countries in areas of policy or practice.

Though single-sex schools have always been a part of the public school system in New Zealand, research on the issue is rather scarce. An early study by Jones, Shallcrass and Dennis (1972) of three schools in Wellington (one co-ed, one boys and one girls school) which found in favour of single-sex schools did not control for initial ability or

social background. Their assertion that pupils at the three schools 'did not differ markedly from one another in background or motivation upon entry' (p.335) cannot be taken seriously, since there is simply no evidence produced to support it. McCulloch (1986) argues that this kind of view was a prevalent myth in New Zealand education, and that despite various "loopholes" in the zoning regulations that required all public schools to admit pupils in their local neighbourhood (or "Zone"), the myth of equality and fairness remained intact. The "loopholes" allowed schools to recruit some pupils from beyond their zone, which meant that 'selection, while being controlled and regulated by the zoning mechanism, was at the same time an inherent part of the system.' (p.104) The myth of equality and fairness, however, has become increasingly difficult to maintain. With the recent abolition of the zoning regulations on the grounds of facilitating choice, it is to be expected that selection will increase, exacerbating the division of the nation's secondary schools in larger towns and cities, into low status neighbourhood schools (usually co-educational), and high status inner city schools (usually single-sex) to which students commute.

Whatever the pros and cons of single-sex vs co-ed schooling, the literature indicates that there is a need to address a number of criteria when considering school outputs, and conclusions might very well vary depending upon which criterion is being used. In this paper, only academic outcomes are considered.

There are a number of issues here (political and social as well as educational), and the research questions addressed in this paper are concerned to provide some answers that may inform the debate, at least in-so-far as it concerns academic outcomes.

1. Is there a difference in outcome on selected academic criteria between girls and boys?

2. Is there a difference in outcome on selected academic criteria between girls at single-sex schools when compared to girls at co-educational schools?
3. Are there differences in social background and measured ability between the student intakes of the two school types?
4. What effect would adjustment for differences found under question 3 have on any differences found in response to question 2?

Sample and methodology

The data used here are from the 'Progress at School' Project,[2] a longitudinal study of over 5,000 pupils in 37 secondary schools scattered throughout the country. The pupils were Third Formers (grade 8) in 1991, and data have been regularly gathered on them throughout their secondary school careers. The academic criteria used in this study are of two types:

1 test and examination marks on three subject areas, at two points in time. As Fourth Formers (grade 9), our students sat tests of English Language, Mathematics and Science that were specifically designed to test for coverage of the school syllabus in each of those areas - i.e., they were not "power" tests to test the limits of knowledge and ability, but to test for coverage of the set curriculum.[3] A year later (grade 10), over half of our original sample sat the National School Certificate Examinations in a variety of subjects of which we have used the English, Mathematics and Science scores;

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2 Funded by the Ministry of Education, this project is directed by Roy Nash and Richard Harker.

3 Copies of these tests, designed by teams of teachers under the direction of Don McAlpine, are available from the Educational Research and Development Centre, Massey University.

2 in the Sixth Form (grade 11) students can enrol in a range of subjects for the award of the Sixth Form Certificate. Grades are awarded on a scale from 1 (high) to 8 (low) and the Certificate awarded on the basis of grades in the best 4 subject areas. No use is made of these data in terms of multivariate analyses as numbers become rather too small to sustain HLM (for example) without an unacceptable loss of reliability, however they are used to analyse enrolment and achievement patterns by simple comparisons between school types.

There is, of course, variation in numbers between the sets of scores as not all students were present on days when the tests were administered, and not all sit the School Certificate examinations, and fewer of these enter for the Sixth Form Certificate. In general it is to be expected that the attrition rate at each higher level of assessment will be related to levels of initial ability.

The analytic techniques used were simple means analysis with t-tests (to answer question 1), and Hierarchical Linear Modelling (HLM), which allows for the simultaneous control of variables at the individual level (such as initial ability, SES and ethnicity), and data aggregated at the school level (such as school type).[4] Under HLM, an unconditional model (with no explanatory variables at either level) produces the same results as a one-way ANOVA, and the individual school residuals show the distance of the individual school mean from the overall mean of all schools. This generates what Willms and Kerckhoff call a measure of 'gross productivity' (1995:117). By adding explanatory variables at the level of the individual student (initial ability, SES and ethnicity), together with school type at the level of the school,

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4 The procedure is outlined in more detail in Harker and Nash (1995), but see Bryk and Raudenbush (1992) for a definitive treatment.

the effect of each can be evaluated (question 3) and the adjusted scores for the two types of schools re-aggregated (question 4), into what Willms and Kerckhoff (*ibid*) call measures of 'net productivity'.

Variables

The variables used in this analysis are as follows:

Initial ability - standardised scores (mean=0.0, sd=1) generated at the beginning of Third Form (1991), based on reading comprehension and school aptitude tests;

SES - nine point SES scale based on labour force status of care givers (modified Elley-Irving[5]) with category 9=Professional; 8=Lower Professional; 7=White collar; 6=Farmer; 5=Skilled; 4=Semi skilled; 3=Unskilled; 2=Beneficiary; 1=Unemployed;

Maori - Maori coded 1, else 0;

Pacific Islands - Pacific Islanders coded 1, else 0;

European - Europeans coded 1, else 0;

Asian - Asian coded 1, else 0;

Form 4 Maths - score on standardised test of curriculum coverage in Mathematics;

Form 4 English - score on standardised test of curriculum coverage in English;

Form 4 Science - score on standardised test of curriculum coverage in Science;

SCMATHS - score awarded in School Certificate Mathematics Examination;

SCENGL - score awarded in School Certificate English Examination;

SCSCI - score awarded in School Certificate Science Examination;

School type - dummy variable, co-ed coded 0, single-sex coded 1.

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5 The Elley-Irving scale is the most widely used SES index in New Zealand, based on census data, and which ranks occupations on an index which combines average income and average years of education for every occupational category.

Results

The criterion tests that form the main part of the analysis which follows are in two groups - namely the grade 9 tests for curriculum coverage, and the grade 10 national examinations. It was claimed in the introduction that the School Certificate Candidates, as a group, would be of a higher ability level than the group that sat the Fourth Form tests. This proved to be the case, with means on our initial ability scale of 0.06, 0.06 and 0.07 for the Fourth Form English, Maths and Science test takers, and 0.14, 0.28 and 0.24 for the School Certificate examinees in English, Maths and Science. The School Certificate candidates then, are a rather more able sub-set of the total school population. After passing the School Certificate examinations, pupils opt for a variety of subjects in the final two years of schooling, and we will refer to data on their subject choices and grades attained.

In order to provide a background to the discussion, and, more specifically, to provide a response to Question 1, the differences in achievement between the boys and girls in our sample of New Zealand students were first examined in relation to the Fourth Form tests and the School Certificate results. The data are shown in Table 1 and indicate a pattern that is in some respects similar to other countries.

Table 1 about here

The girls are substantially ahead of boys in English (both in terms of curriculum coverage (the grade 9 tests) and examination results (the National examinations - grade 10). In Maths, the girls are a little behind the boys, while in Science the difference is minimal, though slightly in favour of boys on the examination criterion. Only in the case of Fourth Form Science results does the 95% confidence interval include zero.

achievement are not sustained by the data in Table 2. The data show that girls are more likely than boys to study English in the Sixth Form, and more likely to achieve a good grade. The gender balance for Maths and Chemistry is close to even and in both cases girls are more likely to achieve higher grades. Girls are rather more likely to be studying Biology than boys (with a ratio of about six to four), and more likely to achieve a higher grade. The largest discrepancy is in Physics (exagerated in out sample) where the ratio in favour of boys is about two to one, however, the smaller number of girls are considerably outperforming the boys. These New Zealand data then are consistent with data from other countries which show that girls' enrolments in science and mathematics subjects at the senior secondary level are now very similar to the rates for boys (with a "trade-off" between physics and biology), and are achieving a higher proportion of high grades in their subjects (see O'Brien and Porter, 1994; Younger and Warrington, 1996).

Against this general background, the next step is to see if this pattern of enrolments and achievements is to be found in both single sex and co-educational schools.

Table 3 about here

Table 3 shows the high achievement data from our sample in Table 2 broken down further, by school type. The Table shows that having enrolled in a subject, the percentage of students obtaining high grades is somewhat greater in a single sex school than in a co-ed one - much more so for boys than for girls (reflecting our oversampling bias). However, it is important to compare the data in Table 3 with the data in Table 4 where the initial ability of the students taking each subject is shown. In all cases the

The differential in Science would appear to be less than is common in other countries (see for example O'Brien and Porter (1994)). With these data in mind, it is clear that the major concern in terms of the education of girls would appear to be in the areas of Maths and Science, and the question of co-ed versus single-sex schooling will have particular pertinence for those subjects. However, before looking into that issue, it is worth examining the Sixth Form (grade 11) subject enrolments in the nationally monitored Sixth Form Certificate qualification. Out data set allows us to find the gender balance in the subjects of interest, and the allocation of grades within each subject area.[6] The relevant data are shown in Table 2, together with national data from the Ministry of Education, which highlights a considerable bias in our sample, due largely to the presence of two elite boys' schools with very low drop-out rates, in which virtually all students stay on to take out a Sixth Form Certificate. Hence our data set has oversampled boys. This caution also applies when looking at Tables 3 and 4.

Table 2 about here

In terms of looking at the larger picture, the national data are quite revealing, showing overall that girls outnumber boys in the Sixth Form Certificate qualification by more than 8 to 7, and with regard to the proportion of high grades, outperform boys in all subject areas examined. Bearing in mind our oversampling of high achieving boys, our sample pattern is consistent with this. Many commonly held myths with regard to girls

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6 The Sixth Form Certificate awards grades from 1 (high) to 8 (low) in each subject area. We look at the gender balance in the numbers graded overall, and then at the numbers awarded grades 1 to 3.

students attending the single sex schools were at a higher initial ability level than their co-educational peers, hence it is not surprising that their achievement levels are somewhat higher. What is of more interest is that in the cases of Biology and English for the girls, the significantly higher levels of initial ability in the single sex schools, are not translated into higher grades in the Sixth Form Certificate, in which the co-ed girls are doing at least as well. The smaller number of girls taking physics have significantly higher levels of initial ability than the boys, and this is translated into higher grades than the boys. Similarly in English for the boys. Careful examination of the data in these two tables shows very clearly the danger of comparing schools or types of schools on the basis of the gross productivity measures represented by the examination results, unmodified by considerations of, in this case, the initial ability of the relevant pupil populations.

More detailed analysis of the Sixth Form Certificate data will not be pursued here as the numbers in any subject area are too small, which in combination with a dependent variable with 8 ordinal points only, would lead to unacceptable levels of reliability. Hence for the rest of this paper we concentrate on the earlier achievement data - the Fourth Form tests and the School Certificate Examination results. We also no longer consider the achievements of boys.

To answer Question 2 for these criteria, it is necessary to establish whether or not there exists "gross productivity" differences on the outcome variables for girls between the single-sex and co-educational schools in our sample, to match the differences found for the Sixth Form Certificate. The results of the comparison of means are reported in the first two panels of Table 5, which shows (as with the Sixth Form data in Table 3) that on all six criterion measures, the girls at the single-sex schools scored higher, as a group, than did the girls at co-educational schools. In all cases the differences were

statistically significant, and the 95 percent confidence interval around the difference in no case included zero[7]. The response to Question 2 then from these data, is "Yes", and for each criterion the difference was in favour of single-sex schools.

Table 5 about here

To answer Question 3, similar comparisons can be made using the background variables as the outcome criteria. Comparisons using t-tests (for SES and initial ability) are shown in panel 3 of Table 5, and a cross-tabulation with ethnicity is shown in Table 6. As with the outcome variables, the two types of school differ significantly on the background variables, with girls at the single-sex schools having a significantly higher mean initial ability, higher social status backgrounds, and more often from the European or Asian ethnic groups. As with Question 2, the answer to Question 3 is also "Yes".

Table 6 about here

Question 4 then, asks for an analysis of the effects of a controlled comparison between the two types of school - if we can determine the effect of the various background

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7 The 95 percent confidence interval is found by subtracting from, and adding to, the differences found between the two types of school, 1.96 times the standard error of the difference.

factors on the outcome variables, and then apply the necessary adjustments to the mean differences between the schools, we should arrive at comparisons that are more fair - measures of what Willms and Kerckhoff (1995) call "net productivity". The analytic technique used (HLM) allows the variables at the individual level to be centred around the grand mean of the variable, hence the intercept coefficient is the score obtained by a pupil of average initial ability, and average SES. One of the four ethnic dummy variables has been excluded (European) to avoid the "dummy variable trap", hence the intercept score is also for a pupil of European origin. The coefficients shown in Table 7 then, are net effects - i.e., the effect of the variable after taking the effects of all the other variables into account. The "unadjusted" columns for each of the 6 criteria show the effect of controlling for just the background variables. For example, in School Certificate English (panel 2 of Table 7), an average ability, average SES girl of European origin could be expected to score 55.31. If she were one standard deviation above or below the average on initial ability, we should add or subtract 10.23, and add or subtract 0.61 for each SES category above or below the average. The net effect of being from ethnic groups other than European are shown as -3.25 for Maori, -2.28 for Pacific Island girls, and 2.35 for girls of Asian origin.

The "adjusted" column shows the effect of adding school type as a level-2 variable. The effect of this on the mean (intercept) coefficient is to now show the score for our hypothetical "average" Pakeha pupil at a co-ed school (coded zero on the dummy variable *school type*). The coefficient labelled 'Girls school" shows what needs to be added or subtracted if the school attended was a single-sex school. In no instance is the differential statistically significant, taking its largest value for S.C. English, and indicating a slight negative direction on both Mathematics criteria. The effect on the background coefficients is minimal, and, overall it can be concluded on the basis of the data reported here, that in no case does the extra information (whether the school is

single-sex or co-ed) make a significant contribution over-and-above the information already contained in the individual characteristics of the pupil populations that attend each type.

The effect of the background adjustments on the achievement means for each type of school is shown in another way in Tables 8 and 9, for the Fourth Form tests and School Certificate results respectively. The initial, unadjusted scores differ slightly from those shown in Table 5, due to listwise deletion in HLM and to the fact that Empirical Bayes estimates of the coefficients are used which make adjustments for differences in the numbers of pupils at each of the schools. These adjusted means show that consideration of the ability and social backgrounds of the girls attending the two types of schools, reduces the differences between them to non-significance (and reverses the order in the case of Maths).

The Tables also contain some additional information from the HLM analysis, which shows that of the total amount of variance on the six criteria, around 95 percent is at the individual level (within-groups), leaving only 5 percent as sytematically related to the school attended (between groups) - the school effect. Of this rather small school effect for girls, the characteristics of the pupils accounts for rather more of the examination outcomes (between 55 and 77 percent - see Table 9), than they do of the Fourth Form tests (between 23 and 43 percent - see Table 8). This is not an unexpected result, since the Fourth Form tests were designed to test coverage of the set curriculum, rather than as "power" tests which draw much more on the abilities of the pupils. It should also be noted that of the 95 percent of total variance attributable to individual difference, around half is accounted for by the same background factors.

The HLM analysis controls for initial ability by comparing the performances of sample average pupils in the various schools. There is some indication in the literature that the achievements of able girls may be better in the single-sex environment. To check this, the initial ability variable was re-coded with 1 (the standard deviation) being subtracted from each score, thus producing an initial ability variable with the zero point one standard deviation above the mean. Re-running HLM with this variables now produces results for girls one standard deviation above the mean. The result on the school effect is shown in panel 2 of Table 9, where it can be seen that for high ability girls in English, the school attended is more or less irrelevant. This is not so for Science, where the school effect is stronger for able girls than for average girls. In Maths, the difference is slight. When a comparison is made with the school type coefficients reported for average pupils in Table 7, some small changes are evident. For English, the coefficient (the adjustment for single-sex attendance) changes minimally from 1.41 for average pupils to 1.42 for the more able. In Maths the change is from -0.74 for average pupils to -0.97 for able pupils. In Science the change is from 0.07 for average to -0.20 for able pupils. Thus the stronger school effect for able girls in Science than for average ability girls, is as likely to be in a co-educational as in a single-sex school. The data presented here do not support the claim that the more able girls can achieve more at single-sex schools.

Conclusion

What these data show, then, is that the difference in the average academic attainment of girls who attend single-sex as against co-educational schools, is more apparent than real. When adequate control is exercised for the different ability levels and the social and ethnic mix of the two types of school, the initial significant differences between them disappear. This outcome occurs in all three subject areas examined (English,

Mathematics and Science) and for both types of test (curriculum coverage tests at the end of grade 9, and National "power" examinations at the end of grade 10), and is also evident in the Sixth Form Certificate results with regard to the measure of initial ability. For the National examinations, the result is the same for average and above average girls.

Thus the popular belief that girls will do better academically at single-sex schools is not sustained by the data reported here. The data also show that there is an element of ability selection taking place which sees the average initial ability scores about a quarter of a standard deviation apart in the two types of school. Given the close relationship between initial ability scores and test and examination results[8], most of the performance differences between them, are thus largely accounted for. The data support the arguments of Marsh (1989a, 1989b, 1992), Bell (1989), Young (1994) and Young and Fraser (1992) that comparisons made after adequate control for background and ability factors show no evidence of the academic superiority of either type of school.

When it comes to policy options that might be seen as emerging from the data, it would seem to be that school type is not an important factor in attempts that might be made to improve the performance levels of girls in Maths and Science (where in some respects they are doing as well as boys) any more than in English (where girls are significantly out-performing boys). As Monaco and Gaier (1992) point out, it is not a question of 'whether single-sex education is preferable or more beneficial for women

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8 The correlations between initial ability and the six criteria are: 0.70, 0.69, 0.65 for the Fourth Form tests in English, Maths and Science; and 0.67, 0.60, 0.68 for the School Certificate Examination marks in English, Maths and Science.

than is co-education; rather, the concern is how each of these settings interacts with learning variables to influence achievement behaviors' (p.592).

Finally, it should be noted that the criteria used in this study have been strictly academic. While such outcomes are an important part of the work of schools, they are not the only outcomes that schools work toward. The picture presented here could change substantially if such variables as self concept, confidence, drop-out rates, social maturity and so, were to be used as the criterion variables in the analysis.

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Table 1: Unadjusted means (Crude Productivity) on output criteria, by gender, N in brackets.

	English	Maths	Science
Fourth Form test results			
Boys	66.17 (2179)	32.41 (2028)	41.60 (2168)
Girls	69.32 (1925)	29.86 (1831)	41.34 (1930)
difference	-3.15**	2.54**	0.26
SE of difference	0.62	0.58	0.43
95 % conf. interval	-4.4, -1.9	1.4, 3.7	-0.6, 1.1
School Certificate results			
Boys	51.00 (1964)	56.44 (1753)	55.31 (1765)
Girls	55.10 (1917)	50.02 (1564)	53.47 (1598)
difference	-4.10**	6.41**	1.84**
SE of difference	0.49	0.72	0.62
95 % conf. interval	-5.1, -3.1	5.0, 7.8	0.6, 3.1

** t-test, $p<0.01$ (2-tailed)

Table 2: Selected subject options and high achievement in Sixth Form Certificate (grade 11) by sex.

	'Progress at School' sample				National data* (1994)			
	Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%
English								
number graded	1065	48.3	1139	51.7	11558	44.1	14621	57.9
high grade (1-3)	*246*	*23.1*	*256*	*22.5*		*16.5*		*25.9*
Mathematics								
number graded	861	57.0	650	43.0	9701	51.1	9292	48.9
high grade (1-3)	*216*	*25.1*	*167*	*25.7*		*22.6*		*28.2*
Physics								
number graded	560	71.3	225	28.7	5704	64.2	3186	35.8
high grade (1-3)	*184*	*32.9*	*81*	*36.0*		*30.9*		*41.6*
Chemistry								
number graded	420	57.8	307	42.2	4236	49.4	4346	50.6
high grade (1-3)	*156*	*37.1*	*103*	*33.5*		*34.9*		*39.8*
Biology								
number graded	384	40.8	558	59.2	4518	38.0	7366	62.0
high grade (1-3)	*85*	*22.1*	*121*	*21.7*		*20.9*		*23.3*
All subjects								
number graded	1500	51.5	1413	48.5	71087	45.9	83782	54.1
high grade (1-3)	*563*	*37.3*	*510*	*35.8*		*19.7*		*24.0*

* Data from Table A16, Learning Media (1995).

Table 3: Sixth Form Cert. candidates: percent high achievers (grades 1-3) by sex, school type and subjec

		All 6FC students		*Physics*		*Chemistry*	
		% high	*N*	*% high*	*N*	*% high*	*N*
Female	All	35.8	510	36.0	81	33.6	103
	s-sex	39.1	198	43.4	43	38.7	43
	coed	34.0	312	30.2	38	30.6	60
Male	All	37.3	563	32.9	184	37.1	156
	s-sex	49.8	355	40.0	120	44.7	101
	coed	26.1	208	24.6	64	28.4	55
	Total	36.6	1073	33.8	265	35.7	259

		Maths		*Biology*		*English*	
		% high	*N*	*% high*	*N*	*% high*	*N*
Female	All	25.7	167	21.7	121	22.5	256
	s-sex	30.0	74	20.8	42	22.0	91
	coed	23.1	93	22.2	79	22.8	165
Male	All	25.1	216	22.1	85	23.1	246
	s-sex	28.5	136	31.5	58	30.8	176
	coed	20.8	80	13.5	27	14.2	70
	Total	25.4	383	21.9	206	22.8	502

Table 4: Sixth Form Cert. candidates: initial ability means by sex, school type and subject.

		All 6FC students		*Physics*		*Chemistry*	
		mean	*N*	*mean*	*N*	*mean*	*N*
Female	All	**.2314	1413	*.9530	223	.8994	306
	s-sex	++.3502	505	1.0502	97	++1.0933	110
	coed	.1653	908	.8781	126	.7906	196
Male	All	.3677	1500	.8045	559	.8930	420
	s-sex	++.5853	713	++.9316	300	++.9954	226
	coed	.1706	787	.6573	259	.7736	194
	Total	.3016	2913	.8468	782	.8957	726

* male-female difference $p<0.05$ + coed-single sex difference $p<0.05$

** male-female difference $p<0.01$ ++ coed-single sex difference $p<0.01$

		Maths		*Biology*		*English*	
		mean	*N*	*mean*	*N*	*mean*	*N*
Female	All	.6963	645	.5802	555	**.4336	1130
	s-sex	+.7902	245	+.6820	202	++.5539	412
	coed	.6387	400	.5220	353	.3645	718
Male	All	.7064	858	.6061	383	.6383	1064
	s-sex	++.7862	477	++.7266	184	++.7532	571
	coed	.6066	381	.4947	199	.5053	493
	Total	.7021	1503	.5908	938	.5329	2194

Table 5: Unadjusted means (Crude Productivity) on output criteria, by school type, N in brackets (girls only).

Fourth Form test results School type	English	Maths	Science
Co-ed	68.19 (1251)	29.24 (1209)	39.85 (1251)
Single-sex	71.41 (674)	31.08 (622)	44.09 (679)
difference	-3.22**	-1.84*	-4.23**
SE of difference	0.90	0.82	0.61
95 % conf. interval	-5.0, -1.5	-3.4, -0.2	-5.4, -3.0
School Certificate results			
Co-ed	53.73 (1271)	48.71 (1031)	52.53 (1048)
Single-sex	57.81 (646)	52.57 (533)	55.26 (550)
difference	-4.09**	-3.86**	-2.73**
SE of difference	0.71	1.06	0.94
95 % conf. interval	-5.5, -2.7	-5.9, -1.8	-4.6, -0.9

Background variables	SES (scaled 1-9)	Initial Ability
Co-ed	5.14 (1504)	-0.08 (1634)
Single-sex	5.55 (804)	0.14 (864)
difference	-0.41**	-0.22**
SE of difference	0.09	0.04
95 % conf. interval	-0.6, -0.2	-0.3, -0.1

** t-test, $p<0.01$ (2-tailed)
* t-test, $p<0.05$ (2-tailed)

Table 6: Ethnic composition of pupil population, by school type.

School type	Maori	European	Pacific Is.	Asian
Co-ed (1668)	423	1050	153	42
percentage	*25.4*	*62.9*	*9.2*	*2.5*
Single-sex (866)	192	572	52	50
percentage	*22.2*	*66.1*	*6.0*	*5.8*

A chi-squared test of contingency gives a value of 26.96 (3 df), $p < 0.01$.

Table 7: Regression coefficients from HLM on means and background factors, unadjusted and adjusted for school type.

Fourth Form test results

Coefficient	English		Maths		Science	
	unadjusted	adjusted	unadjusted	adjusted	unadjusted	adjusted
Mean	69.42**	69.43**	29.68**	29.87**	41.15**	40.77**
Girls school	n.a	-0.06ns	n.a	-0.97ns	n.a	0.07ns
Initial ability	14.67**	14.67**	12.93**	12.94**	9.28**	9.29**
SES	0.47**	0.47**	0.47**	0.45**	0.45**	0.45**
Maori	-1.79*	-1.80*	-2.70**	-2.87**	-1.97*	-1.99*
Pacific Island	-3.11*	-3.12*	0.73ns	0.77ns	-0.89ns	-1.20ns
Asian	-1.17ns	-1.17ns	4.14*	3.99*	4.48**	4.26**

School Certificate results

Coefficient	English		Maths		Science	
	unadjusted	adjusted	unadjusted	adjusted	unadjusted	adjusted
Mean	55.31**	54.94**	50.25**	50.43**	53.70**	53.81**
Girls school	n.a	1.41ns	n.a	-0.74ns	n.a	0.07ns
Initial ability	10.23**	10.15**	12.58**	12.60**	12.73**	12.69**
SES	0.61**	0.60**	1.06**	1.06**	0.77**	0.78**
Maori	-3.25**	-3.22**	-4.28**	-4.29**	-4.77**	-4.71**
Pacific Island	-2.28ns	-2.31ns	-1.82ns	-1.80ns	-4.64**	-4.01*
Asian	2.35ns	2.20ns	10.05**	10.10**	7.52**	8.47**

** $p<0.01$

* $p<0.05$

ns not statistically significant

Table 8: A comparison of scores on Fourth Form Tests of English, Maths and Science.

School type	English		Maths		Science	
N	1841 (656; 1185)		1746 (599; 1147)		1842 (652; 1190)	
	unadjusted	adjusted	unadjusted	adjusted	unadjusted	adjusted
coed	68.75	69.43	29.33	29.87	40.35	40.77
girls only	70.81	69.37^{ns}	30.48	28.90^{ns}	43.41	42.49^{ns}
s.d. of school means	4.6	4.1	3.8	2.9	2.8	2.2
Percent of total variance between schools		6.0		5.3		4.8
Percent of between-school variance attributable to pupil background characteristics		23.5**		42.5**		40.8**
Percent of total variance between individuals		94.0		94.5		95.2
Percent of between-individual variance attributable to pupil background characteristics		55.9		54.1		50.3

** A significant amount of between-school variance remains unaccounted for by pupil background and ability factors.

Table 9: A comparison of marks in School Certificate English, Maths and Science.

School type	English		Maths		Science	
N	1799 (621; 1178)		1619 (511; 1108)		1514 (527; 987)	
	unadjusted	adjusted	unadjusted	adjusted	unadjusted	adjusted
HLM results						
coed	52.31	55.94	49.56	50.43	53.26	53.81
girls only	57.35	57.35[ns]	51.27	49.69[ns]	54.61	53.88[ns]
s.d. of school means	3.13	1.50	3.89	2.71	4.21	1.85
Percent of total variance between schools		4.5		4.0		5.7
Percent of between-school variance attributable to pupil background characteristics						
Average ability		76.9[**]		54.6[**]		77.6[**]
High ability		93.0[ns]		59.6[**]		66.0[**]
Percent of total variance between individuals		95.5		96.0		94.3
Percent of between-individual variance attributable to pupil background characteristics		46.0		37.6		48.1

[ns] the difference between the adjusted scores in not statistically significant.

[**] A significant amount of between-school variance remains unaccounted for by pupil background and ability factors.

[ns] After controlling for pupil background, there is no statistically significant difference remaining between schools.

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