

WHAT IS KNOWN ABOUT THE IMPACT OF SINGLE-SEX AND COEDUCATIONAL
SCHOOL STRUCTURES ON STUDENT LEARNING

A RESEARCH LITERATURE REVIEW

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Abstract

Throughout Australia, North America, UK and New Zealand, the earliest schools were private and single-sex. Publicly-run schools came later and were almost invariably coeducational, though a small percentage in some jurisdictions were single-sex. Many of the private schools have since become coeducational and many new private coeducational schools have been founded. However, the fact has remained that the vast majority of single sex schools have been private, and the vast majority of public schools have been coeducational. These two separate facts (which are not the obverse and reverse of the same fact) have together led to a reasonably common simplistic association of single sex schools with high quality education.

While many decades of the twentieth century saw a belief that single-sex schools were a residue of the past and that it was obvious that coeducation suited modern times, two phenomena have changed that. The first has been the concept of boys and girls having different learning styles, and the adoption of this idea in the marketing of single sex schools; the second has been the investigation in several jurisdictions of public single-sex schooling, and most particularly the challenging, in the USA, of Title IX's prohibition of single-sex schooling in public schools.

During this period, a number of studies have been carried out to try to compare the effectiveness of the two school types. There is probably a broad assumption in the community that research indicates that single-sex schooling leads to better academic outcomes, at least for girls.

This study sought to check the foundations of that assumption.

The finding has been that the situation is far from clear, and far from unequivocal. One of the most influential and earliest studies finding an academic benefit for girls from single-sex schools was contested by a later study. Since those two studies,

which did not resolve their disagreement to the satisfaction of either, very few studies have managed as thorough an investigation. However, of the forty-plus studies considered in this paper, covering a wide range from statistically strong methodology through to small, quite superficial investigations, the notable conclusion is that there is very little agreement.

A simple summary is that considerably more studies point to no discernible difference in academic outcomes or to a mixture of outcomes (some outcomes in the study showing a benefit from single-sex and some showing none) than point to an academic benefit from single-sex schooling. It has to be said, as a result, that the claim of increased academic performance for girls (or boys) attending single-sex schools is not supported by the whole field of research.

There have been a number of studies investigating consequences in the affective domain. These have also been equivocal but with, at least, some suggestions that co-education might produce more benefits.

This paper then develops the point that the whole field is in need of a new focus. To suggest that having a particular school composition will inevitably lead to better outcomes for all students is to ignore the diversity of student learning types and behaviours. Virtually all of the studies so far have concentrated on looking at segregated groups, observing the different dynamics within them, analysing results and then drawing statistical connections between the grouping, the observations and the results. This yields a very coarse level of analysis. What is needed is development of specific teaching styles which target boys' and girls' needs, and the application of these styles to segregated and mixed classrooms. When that has been done and the learning outcomes have been compared, real comparisons will be able to be made between schooling types.

Introduction

The history of schooling in the English-speaking world begins with the provision of choir schools for boys in England, initially in early Christian times in the monasteries. Numbers of schools were established with foundations from wealthy benefactors, often as schools for poor boys although soon turning into fee-based institutions mainly serving the wealthy. For centuries, the only schools were private and exclusively for boys, while girls received their instruction at home. In eighteenth century England, separate schools for girls were slowly established, though usually with a much different, less academic curriculum which was primarily designed to prepare them for their special female role in society. The attitude to the whole question of education for the two genders at that time is clearly reflected in the writing of the contemporary Charles Darwin, often but not here a scientific sceptic and iconoclast, who variously stated, "The chief distinction in the intellectual powers of the two sexes is shown by man's attaining to a higher eminence, in whatever he takes up, than can a woman – whether requiring deep thought, reason or imagination." (Darwin 1873 vol 2, p 311) and "Man is more courageous, pugnacious and energetic than woman and has a more inventive genius" (Darwin 1873 Vol 1 p 263). Segregation of the sexes was based on the belief that women were intellectually inferior and had a distinct purpose of nurturing their family (Albisetti. 2004), although there was also, at various times, a puritanical wish to keep the genders apart as a result of concern about the temptations each might offer the other. The Sacred Congregation of the Affairs of Religious, mandated by Pope Pius XII in the 1950s stated,

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)

Thus, private schools were single-sex and, for some time, remained so. The first coeducational schools were Quaker schools, these being founded from the eighteenth century. The late nineteenth century saw the establishment of compulsory public education in England, and this was generally, though not always, co-educational. By the twentieth century, new public schools were almost always coeducational.

Australia and the United States inherited their education systems from the UK and so they initially followed the same model, with private schools being single-gender and the state schools (Australia) and common schools (USA) usually being coeducational.

Consequently, for many years, it was generally the case in all three countries that coeducation equated to government schooling and single-sex schools to private schooling. This, in turn translated to a simplistic equating of single-sex to elitism, and the assumption of quality, and of co-education to mass-provision and the assumption of inferiority.

In the 1960s to 1980s, single-gender private schools in all three countries began merging or converting to become coeducational, frequently for reasons of economy. In addition, however, new private school foundations were almost invariably coeducational. By this time, there was almost no debate about such matters: any new school would be coeducational. Indeed, in the USA, the 1970s saw the creation of "Title IX" which has been taken as specifically prohibiting single-gender schools in the public sector. Consequently, the consistent picture throughout the three countries has been that a small number of private schools have remained single-gender while the whole public sector and the majority of private schools see coeducation as the obvious structure for a school. In the USA, coeducational schools comprise around 90% of the National Association of Independent Schools membership. Of the member schools of the Association of Heads of Independent Schools of Australia,

over 50% are coeducational, the others all having been Nineteenth or early Twentieth Century foundations which never changed.

There have subsequently been two distinct phases in some reversion to consideration of single-gender schooling. The first occurred around the 1970s when there was concern that too few girls were undertaking mathematics or science studies and there was discussion about the equity of girls' treatment in mixed schools. Were girls being overlooked in mixed classes as a result of noisier, more demanding boys? The second occurred in the 1990s when the girls' statistics in Year 12 public examinations started to outdo the boys'. Now the question changed to whether boys were reaching appropriate standards in areas such as reading while in the company of more literate, more literary, more verbal girls. Was the comparison fair in an area thought to favour girls' natural abilities?

Since the 1980s, there has consequently been a considerable research interest in the two styles of schools, coeducation and single-sex, and many attempts have been made to compare the effectiveness of the two. This increased research activity has coincided with a much stronger emphasis on marketing of schools and the latter has started driving a need for the former. The single-gender schools have established an International Boys' Schools Coalition and several national alliances of girls' schools, and these lobby groups have had some success in conveying a picture that girls and boys need separate schools. Their material often adverts to particular research projects. Coeducational schools have been tardy in engaging in the debate and so there has been less organised dissemination of contrary research.

This literature review is born out of a need to clarify just what the research does show and to consider what is being done in any schools to meet specific schooling needs of boys or girls.

The review indicates clearly that there is a dearth of research about specific approaches to classroom management based on gender. Until now, very few schools have given their classroom practice a practical pedagogical basis in gender. The research studies have almost always had to guess what causal factors might have led to the data. The simple gender composition of the environment does not lead to a satisfactory explanation of differences, so resort must be made to assumptions about consequent behaviours. Researchers have not been in a position to analyse the effect of a particular practice on outcomes, simply because there have been so few implementations of either single-sex or coeducationally focused practice. It is my view that this is in urgent need of change.

Brain Physiology and Gender

In recent times, commentators have alluded to different “learning styles” in boys and girls, and to “brain-based” research said to prove these differences.

In a typically populist skim, Laster (2004) blithely refers to a three or four year difference in brain development rates of boys and girls between the ages of 7 and 22. “Electroencephalogram patterns of a 17-year-old boy's brain resembled those of an 11-year-old girl”. (50) This un-cited use of data represents a disingenuous elision of thinking, implying that all boys lag several years behind all girls in brain development. But are all boys three to four years or six years behind all girls? This is superficial and unhelpful pseudo-science and is the sort of thing to which Geake (2008) refers as a “neuromyth” lacking scientific rigour.

There is a place, though, for “brain-based” research in the development of educational strategy. Michael Gurian, in *Boys and Girls Learn Differently* (2001), refers extensively to “brain-based research” relating to boys’ and girls’ learning, particularly mentioning the rates of development of sections of the brain, and the impact of hormones. His books provide many wise strategies for meeting the learning and behavioural needs in school and home of boys and girls. He does not refer to many specific studies but does provide physiological explanations. Naour (1985) refers to differences in verbal abilities (often stronger in girls) and spatial abilities (often stronger in boys) and cites research relating to these. (101)

Another writer, Eric P Jensen (2008), helpfully places these approaches in a clear context. He distinguishes between (a) basic, (b) clinical and cognitive, and (c) applied research:

An essential understanding about brain-based education is that most neuroscientists don't teach and most teachers don't do research....Neuroscience and many related disciplines (e.g., genetics, chemistry, endocrinology) are what we refer to as basic science. The work is done in labs, and the science is more likely to provide general guidelines or to suggest future directions for research. Of all the neuroscience studies published each month, only a small fraction have potential relevance for education.

Clinical and cognitive research are mid-level research domains. In clinical and cognitive studies, humans are more likely (but not always) to be subjects in controlled conditions. Finally, applied research is typically done "in context," such as in a school. Each domain has different advantages and disadvantages. Critics of using neuroscience for educational decision making assert that the leap is too great from basic science to the classroom. I agree with that assertion; education must be multidisciplinary. (5)

Jensen is careful to insist that each practitioner has a role and each should stick to the role of his or her expertise. "What educators should say is, 'These studies suggest that XYZ may be true about the brain. Given that insight, it probably makes sense for us, under these conditions, to use the following strategies in schools.'" (8)

Unfortunately, not all educators or educational theorists are quite so punctilious. And not all necessarily distinguish between behavioural and learning differences.

Certainly, many do not distinguish between knowledge about the learning process and knowledge about learning environment.

Gill (2004) reports:

By the mid 1970s a good deal of psychological research had established the fact that cognitive differences between males and females were both small and inconsistent over time, so much so as to warrant great caution in publicizing their existence. Such was the conclusion from researchers on both sides of the Atlantic who had completed major overviews of all the existing work on this topic (Fairweather 1976; Maccoby & Jacklin 1976). These conclusions have subsequently been confirmed by further research which investigated the results of a large number of studies of sex differences in mental

performance (Willingham et al 1997). Thus there is a large body of established research that discredits the idea of innate sex difference in intellectual functioning. (p 47)

Perhaps the most important conclusion is to remember that schools contain many individuals with vast ranges of abilities, behaviours and learning modes. Any approach which suggests that all members of a population fit into a statistically described stereotype will run the risk of denying individuality. As Diamond states in an interview in D'arcangelo (1998), "No two human brains are alike. An enriched environment for one is not necessarily enriched for another. No two children learn in an identical way."

If we revert to Jensen's (2008) description of the pathway from pure research to applied research, we have knowledge of the way young people's brains develop and we can then hypothesise how that might impact on classroom learning. However, there is an almost complete absence of research showing that segregated classrooms or schools make use of that knowledge to provide an improved educational product.

At the most then, we can say that an average boy and an average girl might, at the same chronological age, be at different stages of development or be subject to different hormonal impact. That is not a good basis on which to propose separate learning environments for the two groups. There is, however, a greater problem than this for those desiring to support single-gender education on the basis of physiology. It is that whatever differences are to be found, they are not found universally nor even, necessarily, in a great majority of cases. So both individual boys and individual girls will contradict the general trends. That means that, if we chose to implement separate boys' and girls' learning, we would only be meeting the needs of some of those girls and boys. Others, whose brain processes or development do not fit the general models, would be experiencing a teaching style which would apparently be

unsuitable. And where the teaching style was specifically directed towards meeting the needs of one gender, one wonders how these outliers would be regarded and would be served.

As Gill (2004) points out, the difference from within a gender population is greater than the difference between genders: "...in every case of gender differences in intellectual functioning...the degree of overlap is much greater than the degree of difference. This means that boys and girls taken as a group are more like one another than are all the boys or all the girls taken separately." (48). And Campbell and Storo (1996), referring to gender stereotypes, comment,

Not all girls are passive and not all boys are aggressive. Some girls and boys learn better in cooperative, low-key environments; others do better in more competitive, quickly-paced environments. Neither girls nor boys learn well in disruptive environments in which their efforts are ridiculed. We need to look at the individual student's needs, and not act on gender stereotyped assumptions. (6)

Research On Single-Gender Compared With Co-Educational Schools.

The area where literature on gender and teaching is most prolific is in the comparison of co-educational and single-sex environments in terms of academic achievement, attitudes and socialisation. Yet, for all that it is prolific, there is no unanimity of conclusion.

In this review, studies have been sourced from the Education Resources Information Centre (ERIC) database. Studies relating to Australia, North America, UK and New Zealand and dating from 1980 have been selected. It has been considered appropriate to limit the investigation to these nations since there is a similarity to the schooling systems there and the addition of work related to other nations with different cultural antecedents could well confuse the conclusions. The 1980 start provides thirty years of research and to extend beyond that would be to introduce two problems: the nature of schooling is changing all the time and the further back we go, the less the schooling resembles that of our own time. It is also important that statistical analysis has become more sophisticated and earlier work has needed to be re-examined by later researchers to remove the impact of confounding factors which were initially not noticed.

Apart from these geographical and chronological criteria, the only other criterion determining inclusion in the study has been availability of the publication. This review was undertaken as part of a fellowship at Teachers College, Columbia University, so studies needed to be available online through TC. It has been essential that, in order to obtain an accurate reflection of the pattern of research findings, inclusion should be objectively randomised, so the full spectrum of arguments is included. Some snowballing for sourcing works has also been undertaken so, where a study refers to another study, if the second study could be sourced, it was also included.

In virtually all the studies, the hypothesis being tested was whether single-sex schools led to improved outcomes, so only two results were possible, either that single-sex schools did improve outcomes or that there was no difference. The hypothesis that co-education provided a better result was rarely tested. A substantial majority of the studies found that no statistically significant improvement was gained by single-sex schooling.

One of the earliest studies, frequently cited as demonstrating stronger outcomes in the single-sex setting, is that by Lee and Bryk (1986).

Lee and Bryk carried out a series of analyses of the data from a random sample of 1,807 students in 75 U.S. Catholic high schools, 45 of them single-sex institutions, using material from the 1980 national *High School and Beyond* survey. Lee and Bryk interpreted their results as indicating that “single-sex schools deliver specific advantages to their students, especially female students”, in just about all domains, from academic achievement to academic improvement, to attitudes, behaviour, aspirations and independence from stereotyping. This 1986 publication analysing 1980 data continues to be cited today as a demonstration of the efficacy of single-sex schools. However, a later re-analysis of the same data, carried out by Marsh (1989) refuted the conclusions.

Marsh contested Lee and Bryk’s results, first on the basis of the statistical testing employed and secondly because he argued that their study did not adequately control for possible pre-existing differences in populations attending the two types of schools, single-sex or coeducation in their sample. Lee and Bryk had assumed that the common Catholic nature of their schools provided a homogeneous sample and that some standardising of socioeconomic factors satisfactorily eliminated confounders. The difference in opinion was pursued through further debate in which, however, Lee and Bryk did not offer any evidence to support their assumption that

the populations were similar in relation to relevant factors and that pre-existing confounding conditions could not be the cause of the outcome differences.

I might interpolate a further concern I have with the Lee-Bryk study. The study looked entirely at Catholic schools and the conclusion is carefully stated, “results of our investigation can be generalized to the majority population of American Catholic Schools”. However, they also place their work in the wider context of consideration of single-sex schooling in “secondary education in America.” My query is, in view of the Catholic Church’s 1950s official attitude to coeducation as expressed in the quotation reproduced on page 2 of this paper, is it not likely that those Catholics who sent children to Catholic co-educational schools differ in some significant ways from those who sent them to single-sex schools; further, is it stretching matters to assume a pedagogical consistency between 1980s American Catholic and non-Catholic schools?

Marsh (1989) did not only contest Lee and Bryk’s results. He also carried out his own review of a later set of High School and Beyond data, which now included information which was not available to Lee and Bryk and which allowed for some standardisation on pre-existing factors. His sample was of 2,332 students representing 21 single-sex boys’ schools, 26 single-sex girls’ schools, and 33 coeducational schools. When he controlled for pre-existing differences, Marsh found that almost no school-type effects were statistically significant, that there was no tendency favouring students from single-sex or coeducational schools, and this lack of effect for school-type was similar for boys and girls. There were correlations between sex and growth but these were again independent of school gender-type.

So, when Marsh analysed the same database but with additional data, providing some of the controls that he argued Lee and Bryk’s analysis ignored, his results

contradicted Lee and Bryk and indicated no school-type differences for single-sex and coeducation.

Marsh (Marsh et al 1988) also carried out a longitudinal study in Australia, involving the transition between 1982 and 1985 of two single-sex schools combining to make two coeducational schools, with a population of 2250 students being tested for self-concept and academic achievement before and after the changes, and with teachers also providing input. The finding was that the transition benefited all in stronger self-concept for both boys and girls, and that these benefits were gained “not at the expense of academic achievement.” (16)

There is also support for Marsh’s conclusions in other jurisdictions. Harker and Nash (1997) examined data from a New Zealand longitudinal collection of school data, the Progress at School project, analysing data from 5000 students from 37 schools. Their results, controlled for initial ability levels, social and ethnic factors, corroborated Marsh’s, indicating that school type was not an important factor in improving maths or science achievement amongst girls.

Lepore and Warren (1996) and Lepore and Warren (1997) used another national US database, the National Educational Longitudinal Study of 1988 (NELS:88) with a sample population of 25,000 randomly selected students. These data included a thorough set of information obtained from students, teachers and parents indicating results, attitudes, aspirations and family circumstances. Lepore and Warren extracted data for just under 800 Catholic school students, using Lee and Bryk’s criteria for inclusion.

Lepore and Warren concluded their data provided no evidence that single-sex Catholic school students, either boys or girls, learnt more than those attending coeducational Catholic schools in these two tested years of Year 10 and Year 12. They noted that they had expected that there would be outcome differences and that

these might be found to disappear when pre-existing factors were controlled, but the differences did not show up in the first place. Steinback & Gwizdala (1995) also researched within the US Catholic system, observing the merger of two single-sex schools in 1988, and looking particularly at the attitude of girls towards maths. While some comparisons were made between these girls and girls at a school which was already coeducational, and between the girls' and the boys' cohorts in the new school, the most pertinent part of the study here is in the 173 girls' attitudes at the beginning of the merger and again one year on. While the authors' conclusion is that the inclusion of boys in the classes did not change the girls' attitudes to maths or to their own abilities in maths, it is notable that the percentage of respondents who felt that "having boys in the class affects the atmosphere of the mathematic classroom" decreased from 71.5% at the beginning of the merger to 50.3% after a year of the merger, and those who felt that "there is no difference in mathematical ability between boys and girls" rose from 84.6% to 88.3% in the same period. However "do you think you are good at mathematics?" received an affirmative response from 65.5% in the first year but only 54.1% in the second.

Chouinard, Vezeau & Bouffard (2008), administered several questionnaires relating to motivation towards language arts and mathematics to two cohorts of girls, a total of 340 girls moving between 7th and 9th grade; and 9th and 11th grade, from eight coeducational and two single-sex schools during a period of three academic years in a longitudinal research scheme. Their conclusion was that, while there was general decline in mathematics motivation for boys and girls, this was not related to the type of school attended.

Gilson (1999) also carried out a study on American students, concentrating specifically on girls and Mathematics since the prevailing assumption amongst believers in single-sex education is that girls are the ones gaining from single-sex schooling, and that Mathematics and Science are the areas where they gain. There

is an anecdote-based argument (Steinback & Gwizdala, 1995; Streitmatter, 1999; Jackson & Smith 2000; Dunlap, 2002; Wills, Kilpatrick & Hutton, 2006; Hughes, 2006) that this could occur because girls in mixed classes are intimidated into not participating.

Gilson used a pre-tested attitudinal questionnaire and independently-administered standardised test results on a sample of 467 girls from 10 independent single-sex schools and 208 girls from 10 independent coeducational schools. Although one of the common criticisms of direct comparisons of single-sex and coeducational schools is, as we have seen, the danger that students have relevant pre-existing differences before arriving at their schools, Gilson did not control for any such factors other than a measure of mathematics ability. She, again, found that there was no significant difference in maths course choices on the basis of school types and differences in attitude to maths could not be ascribed to school type; maths achievement measures showed non-significant differences with both school types registering a higher score at various levels. There was, however, a significant difference in Mathematics achievement in just one of the three levels examined and Gilson speculates that this was likely due to between-school differences. Her conclusion? "It is a mistake to view gender as the 'key variable' that determines a school's effectiveness. What is most apparent from the results of this study is the importance of good mathematics teaching regardless of school sector." (14)

Robinson and Smithers (1999) examined 1997 UK GCSE and A-Level results in the light of newspaper articles noting that single-sex schools dominated the "league tables". They found that, when the data are adjusted to compare like schools with like, there is no difference. They refer to the common misperception of single-sex superiority as a "caricature of a complex reality": "When, as far as possible, like is compared with like, the apparent academic differences between single-sex and co-educational schools largely disappear." (23). Their study also involved a series of

interviews, and these showed that former students had similar levels of regard for their school irrespective of whether it was single-sex or co-education, but that of those who had experienced both, 48.5% of boys preferred their coeducation experience, as against 18.2% preferring single-sex, and for girls, the respective figures were 38.5% and 23.1%.

An Australian study from the 1980s reflects the difficulty in using any of this data as proof of one system being better than the other. Carpenter & Hayden (1987) analysed data from girls in single-sex and coeducational schools in both Victoria (n = 632) in 1979/80 and Queensland (n = 503) in 1978, the specific sample members being drawn from the population according to a controlled formula designed to ensure representative validity. A number of factors relating to parents, the school, and the girl's friends were examined and a quite high correlation was found between school type and academic achievement for Victorian girls, but a very low correlation was revealed in Queensland.

Gibb, Fergusson & Horwood (2008) analysed data on 940 New Zealand students, gathered as part of the Christchurch Health and Development Study (CHDS), a longitudinal study of a birth cohort of 1265 individuals born in Christchurch, New Zealand in 1977. They found that, girls were significantly advantaged over boys by attendance at coeducational schools while, in comparing single-sex schools, boys were advantaged. There was not a direct comparison for either gender at the different school types. However, the findings were contrary to many people's assumptions. The authors suggested, "These results indicate that single-sex schooling may mitigate male disadvantages in educational achievement." (301)

If a problem in comparing groups of school types is the uncertainty whether the two groups reflect comparable population characteristics, one means of controlling for this is to examine a single population which experiences both school types. A double-

barrelled study by Jackson & Smith (2000) – with the first part also described in Smith (1996) – was able to examine this situation when two Sydney secondary single-sex schools joined together in a two-year transformation into a co-educational school. In a five-year study, the authors found that there was no change in English or Mathematics achievement levels for fifteen-year-old boys or girls, and this despite a general expectation amongst the teachers that single-sex schooling was better, academically, for girls. It was also found that a measure of self-concept showed a small decline immediately after the merger, followed by a change to levels higher than those pre-merger, these being sustained for the five years of the study and still sustained in a review ten years after the change. The authors note that academic self-concept and academic achievement are usually positively related.

The discrepancy between statistical evidence and prejudice is significant. Harker (2000) quotes Byrne (1993) in relation to the education of girls, and “...what she calls the ‘Snark syndrome’ – ie if something is repeated often enough, it becomes true.” (203). Harker extends the work described in Harker and Nash (1997) from just the Form 4 Progress at School data, now including 6th Form School certificate data. Again, when the data are standardised to allow for starting ability level, ethnicity and social background, school type is seen not to be a causal factor in achievement: “Thus, the popular belief that girls will do better academically at single-sex schools is not sustained by the data reported in this paper.” (216). The snark bites the dust... but will no doubt rise again.

In work which limited its focus to boys’ attitudes, Tickner (1992) administered a twenty-nine item Likert scale questionnaire to two sets of San Francisco private school fourth grade boys: thirty-nine from an all-boys’ school and twenty-three from a coed school. The results are presented in a curiously unrefined form but Tickner states that there is, without a strong statistical difference, a more positive attitude to school in the boys from the coeducational sample. It is difficult, however, to assert

with any confidence that these results are due to differences between two schooling types rather than, simply, two schools.

Haag (2000) carried out a literature review of eleven studies, most of them different from those cited herein, and covering situations in a number of different nations.

Haag's finding was that there was no consistent finding. She noted that those studies which found a school-type statistical difference usually attributed this to other contexts and factors such as socioeconomic status, rather than directly to the school type. However, she also noted that while girls anticipate that the single-sex environment is more conducive to learning (the snark re-appears), "research fails to confirm significant gain in girls' maths and science achievement in the single-sex classroom."

A more interesting broad examination of this issue is provided in Mael et al (2004) and Mael et al (2005). Mael and collaborators examined over 150 studies with some sort of theoretical explanation of differences between single-sex and co-educational schools, sometimes with the theory being provided in explanation of quantitative data and sometimes on its own. The researchers tend to give credence to the single-sex case although, for example, in the 2005 work, they indicate that of the forty-three studies relating to concurrent academic accomplishment, only 35% find for single-sex schools whereas the remaining 65% find no difference or a mixture of differences. Even more interestingly, their very thorough analysis (Mael et al 2004) leads to a cogent description of the problems identified with the theories generally. Four of these problems deserve to be quoted in full:

1. The explanations do not specify what outcome(s) SS schools purport to affect and by what mechanism.
2. The explanations do not clarify whether these effects *require* SS schools or whether they are just more typically found at SS schools.

3. The explanations do not specify whether SS schools would be expected to affect all students. For instance, it is possible that the claimed benefits would help males but not females, high school but not elementary school students, or subsets of each.
4. The explanations may reflect differences between SS and CE schools that were true at a given time or under a given aegis that would no longer be applicable if SS schooling were attempted in public schools equivalent in size and structure to other public CE schools.

They conclude that single-sex schooling is highly unlikely to be found, in future studies, so superior or so inferior that it will, respectively, overcome the concerns of its opponents or be banned as an alternative choice. They do, however, refer to the likelihood that single-sex schooling may be found unequivocally useful for disadvantaged students.

A number of studies focus on the situation in the US where, while Title IX has meant there are very few public single-sex schools, some proponents feel that more should be permitted so their effect could be gauged. Jacobson et al (1995) carried out interviews with twenty-two public intellectuals, academics/researchers; government officials/legislators; public interest groups/educational associations, and practising lawyers/legal scholars. There was, unsurprisingly, no consensus but the authors arrived at a tentative conclusion that, from all these views, they thought “potential pedagogical benefits of single-sex K-12 public education might (original emphasis) be meritorious of further study” if it was limited in scope and occurred within a context of choice. (21) However, “In general, informants expressed strong hesitations about public K-12 single sex education and stressed the need for an overhaul of coeducation as a solution to educational problems.” (abstract).

Datnow, Hubbard and Woodey (2001) studied a late 1990s Californian project in which six pairs of single-sex schools were established, sometimes within coeducational school campuses, sometimes not; the project was spearheaded by the

then state governor, seeking to provide better options, better choices and better preparation for the real world. The researchers' original intention was that the boys' schools would employ stronger discipline and the girls' schools would give students better opportunities in the study of Maths and Science. The study employed a primarily qualitative case-study methodology and found that the experiment did not yield significant benefits. It found that gender stereotypes tended to be emphasised in the new structure and that there was a significant dearth of consideration of teaching strategy suitable for a single sex. However, the program really related to a unique situation and carries limited generalizability to other situations as a consequence.

Certainly, a number of researchers have also found or argued, that single-sex schooling models produce academic or attitudinal benefits.

In several cases, these are more polemic than quantitative.

Bauch (1989) argues that the distinctive feature to Catholic education has traditionally been, not some broad Catholic nature but a Catholic boys' school nature and a Catholic girls' school nature. She describes the former as a factory-model, structured, functional and economically efficient (none of which sounds particularly attractive), and the latter as an ecological model, inclusive, interactive, caring and imparting values. She bemoans the trend in Catholic education towards coeducation, although her greatest support is for Catholic girls' schools: "it is evident that girls' schools, more than any other type of Catholic education, come closest in their traditions and mission in pointing the way for a preferred future in Catholic education." (23) which seems to leave boys' needs rather neglected. Her argument is that the Church should reverse its then trend of changing from a single-sex model to a coeducational model for schools. Some support for Bauch's analysis in an Australian context is found in Dorman (1997) who found that levels of student

affiliation, interactions and cooperation were significantly higher in Catholic girls' schools than in Catholic boys' or coeducational schools, using a 66-item classroom environment instrument in 80 Grade 9 and Grade 12 Science and Religion classes in metropolitan and provincial Queensland. Dorman attributed this to the fact that the single-sex schools derive from religious orders and that "folklore suggests that single-sex schools (being more established and permeated by the order's charism) have a distinctive (and superior) environment compared to Catholic co-educational schools." (7)

Carol Laster (Laster 2004) pins her colours to the mast with the title of her article, *Why We Must Try Same-Sex Instruction*, and notes that, "while many people will disagree with single-sex education, this researcher feels it must be considered because it can be a viable option to meet students' learning needs." (60). She refers to uncited brain research which shows a development lag in boys' brain development, and to more dense packing of neurons in girls' brains. As assistant principal of a Mississippi elementary school, she instituted a structure with each of a girls', a boys' and a coed class. Teachers at the school are reported espousing a variety of views about the various groupings. Testing indicated that girls' scores in language arts, mathematics and reading were not significantly different for class-type; testing results for boys found a consistent superiority for those in single-sex classes. Laster proposes that, regardless of such statistics, the principle remains that choice of single-sex or coeducation should be provided.

Hughes (2006) argues that US school districts should give public schools the option of establishing single-sex schools in the same way that private schooling systemically offers a choice between single-sex and coeducation. Much of her argument is based on concern about distraction in the classroom. She also refers to observations from Gurian and Ballew (2003) about differing learning behaviours of girls and boys, though without any findings that these differences are best accommodated by

segregating the genders. Hughes also refers to the contention, which seems to be uncontested, that single-sex schooling works well for disadvantaged and minority populations. It is in these contexts that boys' behaviour can be dominating, intimidating, sexist and distracting, interfering with the learning of girls (though also, it needs to be remembered, of boys who wish to learn) and requiring a firm and highly structured teaching approach. The need is graphically illustrated in Smith (2007), an ethnographic study of a socially deprived housing estate school in a north-eastern coastal city in the UK. This powerful work describes the "white patriarchal masculinity forged out of an intimate relationship with industrialized manual labour" (182) and the aggressively masculine hegemony which discredits learning as either feminine or "gay", with teachers adopting a survival mechanism of accepting and reinforcing the culture. Smith's focus is on the boys and we see how the whole environment is anathematic to their learning; although the school is coeducational, the girls are all but invisible and presumably are as badly affected in their learning as are any boys who should want to learn anything. Smith's concern is with the whole culture and with the complicity of the system in maintaining a destructive ethos, but one can readily see a prospective benefit to separating boys from girls; even if the boys, who have demonstrably not been "civilised" by the presence of girls, made no improvement, the girls, evidently less directly responsible in the creation of the culture, would surely have a better chance of engaging in some learning.

Malacova (2007) investigates another dimension to the point that school-type might suit certain sub-sets of the genders differently. She analyses paired data from the UK, looking at 2002 Key Stage 3 data and 2004 GCSE data, and thus what is often referred to as a value-adding measure. Malacova's analysis showed that, amongst independent school students, single-sex school girls made more progress than coeducation school girls; for boys, the trend was reversed. It is also suggested that the benefit from single-sex schooling reduced as the initial achievement level

increases, so that the strongest students gained the least benefit from the school-type factor.

Daly & Defty (2004) also reviewed UK GCSE data, though without the controls either of comparison with earlier KS3 data, or of thorough consideration of demographic factors. The authors seem to contend that such controls are unnecessary since the large sample is “broadly representative of English and Welsh state-funded secondary schools and, to a lesser extent, of private schools.” While it may be representative of the schools, it seems to ignore the complicating fact that single-sex schools often enrol more students who are higher-performing at the time of enrolment. However, Daly & Defty’s conclusion was that single-sex girls achieved higher in mathematics than coed girls, by slightly less than 0.1 of a standard deviation, and their attitude to maths was a little higher again. Results for the boys were reversed, with coed boys ahead in mathematics achievement by slightly more than 0.1 standard deviation and by 0.3 standard deviation in attitude.

A study by Campbell & Evans (1993) of enrolment patterns in advanced mathematics and science courses looked into the various factors which might impact on women’s access to higher-salaried professions. The 790 sample students were from parochial single-sex schools and public coeducation schools in Louisiana. This is a relatively early study and again recognises no need to surmise that the populations of single sex and coeducational schools might be inherently different and should be controlled in some way. Results might relate as much to the difference between public and parochial as to the difference in gender make-up. The findings were that the all-girls’ schools provided more courses in advanced mathematics and science and had higher enrolment in these than applied to girls in coeducational schools. When looking at career aspirations and at positive and negative influences on course selection, the two groups of girls presented similar results.

Mention has already been made of a literature review by Mael et al (2004); it is worth referring briefly here to an earlier study, Mael (1998). In the earlier work, Mael was a little more inclined to see single-sex schools as beneficial, “the predominance of research certainly shows a role for single-sex schools (as an option if not a norm)” (121), a view which, as we have seen has been somewhat diluted in his 2004 review. However, it would be appropriate to quote at this point some very salient ideas he expresses in the earlier piece: “

comparisons of CE and SS schooling on any number of dimensions generally takes as a given that each school of either type embodies the qualities or deficiencies typical of that form, without considering the possibility that within-type differences due to variables such as locale, school tradition, school administration values and ideologies, and student body characteristics may be greater than between-type differences. (119).

Beware the snark!

Single-sex Classes in Co-ed Schools

A variation on the question of single-sex versus coeducational schools comes with the proposal that, in order to retain what are seen as the advantages of co-educational schools, while gaining what are proposed as advantages from single-sex instruction, a solution might be to establish single-sex classes in coeducational schools. It is generally proposed that this would happen in Maths and Science classes, on the basis that girls might be intimidated in these subjects. It is not made clear why they should be intimidated more in these subjects than in others but it would seem that the idea gained currency before recent research which has shown girls now tending to occupy more of the top placings in all subjects. The findings do not provide much strength to the argument that segregation is efficacious. There does seem to be a general approval of the single-sex classes by participants, but it has not been translated into evidence of improved academic achievement.

Wills, Kilpatrick & Hutton (2006) were invited to research a program in a Tasmanian coeducational government primary school where single-sex classes had been conducted for some time. Unusually for such experiments, the segregated classes operated across the curriculum although they would be “brought together as a coeducational class for specific pedagogical purposes.” (282) The ethnographic methodology employed with staff, students and parents found a preference for the single-sex structure, although the single-sex zeal of the initiator of the project might be considered to reduce the validity and generalizability of this finding. Interestingly, as is reasonably commonly found in studies about gender segregation, while the participants thought the arrangement led to higher achievement, the statistics showed otherwise, apparently to the disappointment of the drivers: “The whole school community, including parents, indicated there had been real improvement in

the general school climate as a result of the innovation. However, the paradox revealed by this study is that formalised indicators of academic achievement do not seem to show an equal level of improvement.” 288

Leder and Forgasz (1994) studied a program introduced at a Melbourne state school to make all Year 10 Maths classes single-sex. Students undertook attitudinal surveys and interviews and their performance was measured via teacher assessments. Students' parents were also surveyed. Overall, little difference was found to have accrued over the course of the study, in performance, in maths self- concept or in maths study intentions. Generally, boys were found to over-estimate their maths achievement and girls to underestimate theirs, but this remained the case across the two schooling models. Girls and their mothers were more inclined to support the new arrangement than were boys and their fathers.

Dunlap (2002) in a brief, seven-week project split a pair of mixed Year 5 maths classes in a Kentucky K-12 private Baptist school into a boys' and girls' class. She only looked at outcomes for girls. Her findings were that, first, the girls felt they learnt better in the segregated classes but, secondly, results did not bear this out. However, the brevity of the project, the researcher's other role as teacher in the project, and the lack of control for teaching uniformity detract from the findings.

Jackson and Smith (2000) and Jackson (2002) examined an experiment in an English school wherein single-sex Maths classes were set up in the intake Year 7 in 1994; this structure remained in place throughout Year 7 and for two terms of Year 8. Students' mathematics self-concept was measured during the single-sex and the coeducational phases and was found to increase, contrary to usual findings that it decreases over time. However, interviews showed that the girls preferred single sex and the boys preferred coeducation.

A US study was carried out by Friend (2006) in a midwest middle school, following concern that girls saw Science as a male activity. Students were randomly allocated to an all boys or a coeducational class, both taught by a male teacher, or an all-girls or coeducation class, both taught by a female teacher. Classroom observations, assessment scores and attitudinal surveys were employed. The conclusion was that the creation of single-sex classes did not produce significant differences in science academic achievement, and did not create a more positive classroom climate.

A study was undertaken at a school in Northern Ireland, medium sized with a working-class catchment area. All curriculum areas were segregated. The methodology was use of teacher interviews and questionnaires. Gray & Wilson (2006) found that there was no improvement in behaviour or academic achievement, and there were suggestions of deterioration. The study emphasised that such initiatives would require significant professional development for staff in order to have any chance of success.

Younger & Warrington (2006) operated within a national UK Raising Boys' Achievement project. They carried out three case studies, involving six schools spread around the country. The schools generally felt that there were achievement improvements, although the provision of single-sex classes was only one amongst several strategies employed specifically to raise boys' achievement, and the researchers stress that any improvement in achievement can not, at this stage, be attributed to the gender segregation. Younger and Warrington used a series of interviews, questionnaires and observations. Their findings were cautiously that single-sex classes in a coed school "can have a positive impact on the atmosphere and ethos for learning". However, they note that several of the projects collapsed after the conclusion of the study and that success is only possible with school-management support, with strong initial professional development of teachers and with ongoing analysis and review of pedagogical strategies. One is inclined to

suggest that, with those three factors present, any school will do well, regardless of its gender structures.

Wills (2006) investigated two Tasmanian coeducational primary schools in socio-economically disadvantaged areas, both trying single-sex classes. The experiment was undertaken because of concerns about tensions between boys and girls and lack of curriculum engagement. There appears to have been a broadly held conclusion that the new structure was of social benefit. The researcher was not concerned with comparative evaluations so much as with examination of how the new structures led to new pedagogy and new teaching strategies, and what strategies might be considered valuable. Wills's conclusion was that a single-sex strategy could be distilled out of the experiments and that,

The teachers demonstrated that, despite the influence of social and cultural constraints that had previously discouraged them from engaging with the curriculum, a classroom ecosystem could be created in which all participants became empowered and engaged as learners. (140)

The Choice

Our consideration so far has been on the main contentious question relating to gender school type, whether one school type can proffer better results for students. This question itself assumes that academic results are the prime factor as families choose their school type. It might not, however, be as simple as that.

Lee and Marks (1992) investigated families' choices of single or mixed sex schools, and the reasons for their choice. They surveyed over 3000 1989 senior class students from sixty private schools, as a stratified random sample from girls', boys', and coeducational schools. For the study, they employed the database of the US National Study of Gender Grouping in Independent Secondary Schools. They identified a trend away from single sex schools ("single-sex education seems to be a less and less desirable option for independent-school students and their families" 245) and found that the families still seeking single sex education for girls were what they described as traditional families seeking a traditional structure and protective environment. Mensinger (2001a) extended this, describing the "elite, conservative and protective environment" (418) sought by such families. Lee and Marks also found a tendency for families with a history of single-sex schooling to send their children to a single-sex institution. Interestingly, though, Robinson & Smithers (1999) found that, while 90% of co-educated students in their study said they would send their own children to a coeducational school, only 30% of those from single-sex schools expected to send their children to a single-sex school.

The Affective Domain

There are two principal outcomes which proponents of girls' single sex schooling propose might arise from it. The first is better academic achievement, as a result of avoiding male intimidation and hegemonic behaviour; the second is a stronger sense of women's, and therefore their own, right to ungendered pathways in the world. In relation to this latter point, there is an assumption that the all-female environment will allow the girl and young woman to grow up, unfettered by sexist restrictions. Lee, Marks & Byrd (1994) investigated sixty private schools, twenty of each type, and administered questionnaires, studied records, and carried out interviews and classroom observations, as well as field study visits. Data was cross-validated and the observations were the main source of data. Their conclusion was that, "Since the frequency of sexism was roughly equivalent across the three types of schools, neither coeducation nor single-sex schooling may be exonerated." (113). Signorella, Frieze & Hershey (1996), studied a range of mixed and segregated class types in continuing coed, newly coed and continuing single-sex classes on two campuses of a US K-12 private girls' school. Their finding was that the "comparison of students in different classroom settings showed no consistent tendency for students in single-sex classrooms to display less gender stereotyping."

There are certain propositions which might seem to embody a self-evident truth but, when examined, are found to blur a more complex reality. It might seem on the face of it that an advantage of single sex schooling would be that it was helpful to adjust teaching styles to the single gender and its needs. Hypothetically, that proposition is probably correct – though potentially offset by the disadvantage that the one gender misses out on the points of view or approaches to thinking of the other gender. However, there is a further danger that teaching to a gender might, in fact, entrench

attitudes and behaviours which would better be modified to something less stereotypical. This is neatly described by Sukhnandan (2000) as quoted in Martino and Meyenn (2002):

The modification of teaching approaches, in terms of lesson structure, teaching methods and curriculum materials, to match the learning styles of boys and girls can be perceived as an approach that simply reinforces the different learning styles of boys and girls by exploring the areas where they are strong and by ignoring their areas of weakness. Although this may lead to increased pupil achievement in terms of examination performance, it may work to reinforce gender stereotypes regarding appropriate teaching and learning methods for boys and girls.

(304)

Martino and Meyenn (2002) carried out their own study, with a series of interviews with teachers at a Western Australian Catholic coeducational school which had begun single-sex English classes at Year 8 as a response to what they saw as literacy problems for boys. In analysing the teachers' explanations and descriptions of their classroom strategies in the new single sex classes, Martino and Meyenn identified some tendency to "perpetuate particular constructions of active masculinity and passive femininity". Heywood (1995), a teacher of fifteen years' experience in a Canadian private all girls' school, sought to analyse the "gender regime". While she maintains that all-girl schools such as hers are "an important antidote to our society's tradition of gender bias" (1), she still identifies a number of intrinsic contradictions in these schools between the search for a contemporary image of womanhood and the maintenance of residual gender stereotypes: "negative effects that traditional gender norms still have on even privileged young women who study in single-sex environments designed to foster their education and personal development." (1) She concludes that, "the very existence of single-sex schools will teach girls the principles of gender classification and when they leave these schools (even ones as 'girl friendly' as this one) they will still face the gender-stereotyped realities of the outside world." Signorella, Frieze & Hershey (1996)

A further element of socialisation in gendered schools is considered in Mensinger's various studies, Mensinger (2001a); Mensinger (2001b). We noted earlier that some commentators have suggested that coeducational schools create problems in that the girls seek to be attractive to the boys and that this undermines the seriousness of their academic pursuits and their academic commitment. Mensinger (2001a) re-examines a previous inconclusive study by Dyer and Tiggemann (1996), employing elements of Eating Disorder Index (EDI) data obtained from 146 South Australian adolescent females from two demographically comparable private schools, one all girls and the other coeducational. It might seem intuitively obvious that girls in the presence of boys would be more likely than those in the presence only of other girls to worry about body image. On the contrary, Mensinger found that, in the single-sex setting, girls were less likely to accept their larger body size than were those in coeducational settings. In seeking an explanation of this finding, she refers to "subtle conflicting expectations placed on young women attending single-sex institutions" (420) and to the "'hidden curriculum' (which) offset the good intentions of the school's endorsement of feminism and a push for female empowerment." (420). Mensinger (2001a) hypothesised that, "girls attending single-sex schools will exhibit greater body dissatisfaction and eating disorder symptomatology than their coeducational counterparts." (417) She finds the data support the hypothesis. Furthermore, she counsels that, "parents would be wise to thoroughly investigate the climate of a particular single-sex school before sending a child there on the basis of wanting an egalitarian environment for their daughter." (421).

These last few studies have considered how young people view themselves and each other in relation to gender stereotypes. We will conclude with a study of the way students relate to each other. Barton & Cohen (2004) carried out research in a Memphis public elementary school where students from a mixed Grade 4 were offered the opportunity to learn in a single-sex or mixed Grade 5 and Grade 6. The study focused on the nineteen boys and twenty girls who chose the single-sex

classes for both grades. Comparisons were with the Grade 4 classes from which they came; the new coeducational class was not included in the analysis because it contained over twice as many girls as boys and was also mixed-grade. A variety of instruments was employed to obtain data about self-concept and relations with others. The benefit from not using the Grades 5 and 6 coed data was that the control for each student was him or herself in the coed Grade 4; the drawback was that differences in behaviour between Grades 4 and 5 needed to be ignored as a factor. The study determined that,

No association is found between classroom gender composition and attributions of sociability-leadership behaviors. It is interesting, and perhaps not surprising, that the positive behavior items show strong consistency from mixed sex to same-sex classrooms. Being friendly, cooperative, and generally prosocial would appear to be context-free and gender-free behaviors for children. (41)

The study also found that the all-girls class revealed a statistically significant increase in overt and relational aggression behaviours. There were also initial increases in victimization and rejection behaviours although these diminished again after a year. The main initial outcome for the boys was an increase in the proportion of mutual friendships but, after a year, they also showed an increase in overt and relational aggression.

What do all these studies, together, tell us? First, that school-type can not be assumed to provide any answer to any issue. Much more important are the ethos, practices and values of the individual school. Secondly, that it is time for schools to investigate specific classroom management strategies which provide all students in the classroom with equitable learning experiences. The sum of all these studies can be characterised as follows:

1. There is no consistent indication of superior academic performance for either boys or girls in single-sex environments. Studies which satisfactorily

controlled other factors such as student demographics tended to find no benefit for single-sex structure.

2. The numerical majority of the randomly selected studies reviewed here find no advantage for either school type.
3. No study identified particular approaches to teaching undertaken in single-sex or coeducational schools and related those to academic outcomes. There is a clear need for work to be done in this area.
4. Those studies which also examined such Affective Domain characteristics as ambition or attitude to studies tended to show the same results for these as for academic achievement.
5. There is a similar lack of consistent evidence indicating any benefits from single-sex classes in coeducational schools.
6. While the trend in private schools across the countries examined has been consistently towards coeducation increasing in proportion to single-sex in the last fifty years, there has been an increase in interest in the USA in public single-sex schools. While the results of studies of these experiments have, again, been indeterminate, there is broad support for the idea of the US public school system offering some choice of single-sex options.
7. There appears to be uncontested evidence that single-sex structures can lead to better academic outcomes for disadvantaged or minority populations, especially for the boys.
8. There is little evidential support for the concept that single-sex schools diminish sexist beliefs or behaviours.

9. There appear to be slight advantages to coeducation in behavioural areas such as body-image and eating disorder; and aggressive behaviours.

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