GDST

GIRLS' DAY SCHOOL TRUST

GIRLS-ONLY EDUCATION

THE GDST PERSPECTIVE

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- Girls, for a variety of reasons, learn differently
- Girls face pressures to conform to gender stereotypes – pressures which are stronger in the presence of boys
- Girls need and deserve space in which to develop their full potential, and to make informed and unconstrained choices about interests, subjects and careers
- In girls-only schools their needs and preferences can be fully accommodated within a dedicated learning environment
- Successful girls' schools are those in which a dedication to girls' education is reflected in their physical design, curriculum and co-curriculum offer, teaching and learning approaches, and in their whole-school culture
- GDST schools serve to subvert, rather than support, gender stereotypes and a priori assumptions, by offering an education designed for and dedicated to the development and empowerment of successful, confident and adventurous girls.

EXECUTIVE SUMMARY

Excellent schools encourage and assist pupils to realise their potential, and are designed to equip them for success and fulfilment in the world beyond. Girls' schools are founded on the principle that these aims are best achieved by educating girls separately.

There is strong evidence that girls-only education leads to higher academic achievement, greater diversity of subject choice, and enhanced career progression.

Girls differ from boys not on any substantial intellectual or cognitive dimension, but in attributes and dispositions that have their greatest impact in childhood and adolescence, and which mean that girls' learning needs and preferences are typically different from those of boys.

Typically, girls prefer cooperative, discussion-led learning environments; adapt better to coursework tasks and collaborative, project-based activities; respond to different forms of curriculum content, and have a greater propensity to disengage from co-ed sports activities.

Girls often also adapt their behaviour in the presence of boys, to their own disadvantage – for instance in adopting supporting or moderating roles in discussion, avoiding risk-taking in inquiry, and in their choice of subjects for study.

Gender stereotyping and differences in expectations and self-image tend to affect girls' behaviour, attitudes and choices, unless they are checked and challenged at school. Girls should have the opportunity to be educated separately, not because they need protection, but because they deserve a level playing field.

This is not to suggest that all girls are different to all boys, or that all girls are the same. But typical attributes, behaviours and needs differ. Single-sex settings allow teachers and schools to focus more effectively on the needs of individual girls.

There is evidence that girls achieve more when they are given their own dedicated space in which to develop. In single-sex schools, girls:

- are less likely to conform to a priori gender stereotypes,
- are less constrained in their choice of subjects,
- show a greater propensity to take risks and innovate,
- perform better in examinations,
- have more opportunities to show leadership, and
- are more successful in the job market.

These effects do not follow inevitably from the separation of the sexes in education. Single-sex education, to be successful, must be more than an organisational device – it needs to be underpinned by a set of principles, and articulated in a set of practices, whereby girls are nurtured, challenged and empowered.

GDST schools are able to offer an ideal learning environment dedicated to girls' learning needs and preferences, and free of gender-stereotyping and distraction.

In coeducational classrooms, boys tend to monopolise discussion, and take more

domineering roles in group work and in practical exercises. There is pressure on girls to conform to prejudicial gender roles. Teachers tend to adopt styles and use content that seek to maximise boys' engagement and regulate their behaviour. Girls are assumed to be less problematic: in particular, teachers tend to ignore the strong correlation between high motivation and high anxiety in many high-achieving girls. In girls-only environments, girls' needs and preferences come to the fore.

Teachers in all-girl classrooms can focus on working with, but also challenging, girls' propensities to seek security in structures and schedules. Teachers find that younger girls are particularly keen on explicit agendas (e.g. in terms of learning objectives, and for young pupils a clear schedule for the day), and gain confidence from the rehearsal of past understanding at the start of lessons, and explicit links to next steps at the end. But girls-only classrooms also provide the opportunity to push at rather than simply police these boundaries – to challenge risk-aversion and encourage adventurousness, within an affirming environment.

In co-ed settings girls often adopt roles that reflect others' views of them, and which tend to narrow their choices, both academic and non-academic. Girls at GDST schools are empowered to reject gender stereotyping, for example in sports, subject and (later) career choices. Girls in single-sex settings show a much greater propensity to choose what are otherwise seen as 'masculine' subjects – like maths, physics and (later) engineering.

In coeducational contexts, girls are more likely to participate, but less likely to assume leadership roles, in extra-curricular groups and activities. In GDST schools, girls show less reticence in adopting leadership roles, and respond well to the opportunity to explore a wider range of possible 'niches' within the school community.

GDST schools are designed to maximise opportunities for girls to realise their potential. They do this through:

- the design of the schools themselves, including not just the classrooms but also other areas, including social spaces and informal learning areas,
- the timetable (length of lessons and structure of the school day),
- curriculum content and classroom interaction,
- the pedagogical practice of teachers,
- subject choice and co-curricular opportunities,
- girls-only sports and fitness activities, and
- a whole-school culture conducive to girls' education.

Single-sex education actually serves a subversive purpose: GDST schools seek to challenge traditional gender stereotypes, give girls space to develop a strong sense of themselves and their value, and nurture the confidence to make their own choices, free of any sense that the script has been written for them. As day schools, they offer a girls-only space to complement the rest of a girl's life-world – which by all accounts does not exclude boys.

GDST all-through day schools provide a learning environment specifically designed and dedicated to the development of confident, courageous, composed and committed girls.

THE KEY INGREDIENTS OF THE LEARNING ENVIRONMENT IN GDST SCHOOLS CAN BE SUMMARISED AS:

- A commitment to excellence as schools: the non-negotiable starting point
- Design of purpose-built learning spaces with girls in mind
- Every curriculum and co-curriculum opportunity available to girls as of right
- Teaching and learning focused on girls' learning needs and preferences
- A whole-school culture that respects, nurtures, challenges and empowers girls.

The power of four

Our starting point is to set out what we want girls to be, and to be able to do, as a result of a GDST education.

Confident

GDST girls are secure in their knowledge, and unwilling to take things for granted. Motivated by a spirit of enquiry, they seek to explore and evaluate ideas and arguments in a generous, critical and constructive way. They are able to reflect on, communicate and defend their own views, and are respectful of the views of others. They are equipped to grapple with big ideas and make connections.

Courageous

GDST girls welcome new challenges, and meet them with resourcefulness and resilience. They are enterprising and adventurous, willing to take the initiative, and not afraid to aim at tough targets. They can apply their knowledge and skills in unfamiliar contexts, are creative and can adapt to situations requiring new ways of thinking. They have experience of, and aptitude for, leadership.

Composed

GDST girls are intrinsically motivated, are self-directing, and take responsibility for their own learning. They value fairness and act with integrity, are aware of themselves and their impact, and are aware of and respectful towards others. They are sensitive to and appreciative of culture, context and community. They are collaborative and supportive in team situations.

Committed

GDST girls put value on connectivity – in creating and sharing knowledge. They are receptive to new ideas and are keen to learn new things and new skills. They seek to participate critically, considerately and constructively in their community, society and environment. They tend to be engaged in life-enriching interests and activities, and are determined to see things through.

INTRODUCTION: EDUCATION, EXCELLENCE AND EMPOWERMENT

For parents choosing schools, single-sex education is not always at the top of the agenda, and for parents who themselves most likely attended mixed schools, the concept of single-sex schooling might appear rather exotic (Lee and Marks, 1992). At every stage, the key criteria are academic excellence, pastoral care, co-curricular opportunities and prospects for progression. But dedication to the development of girls is a key to the success of GDST schools in delivering absolute excellence across all of these criteria. Parent surveys in GDST schools confirm that while parents do not necessarily consider single-sex the main factor in choosing the school, they increasingly value it once their daughters have begun.

The choice is not necessarily between single-sex and mixed schools: some coeducational schools now offer single-sex classes at particular stages (in a so-called 'diamond' pattern) and/or in particular subjects (usually science, technology and mathematics). But there is evidence that the effectiveness of single-sex education is considerably diminished when it is introduced within an otherwise coeducational context.

The argument developed here is that:

- Girls, for a variety of reasons, learn differently,
- Girls face pressures to conform to gender stereotypes – pressures which are stronger in the presence of boys,
- Girls need and deserve space in which to develop their full potential and to make informed but unconstrained choices about interests, subjects and careers,
- In girls-only schools their needs and preferences can be fully accommodated, within a dedicated learning environment,
- Successful girls' schools are those in which a dedication to girls' education is reflected in their physical structure, curriculum and co-curriculum offer, teaching and learning approaches, and indeed in their whole-school culture,
- GDST schools serve to subvert gender stereotypes and a priori assumptions, by offering an education designed for and dedicated to the development and empowerment of successful, confident and adventurous girls.

A century and a half ago, girls' schools were a response to the lack of educational provision for girls; and later concern focused on girls' academic under-performance compared to boys (Bryant, 1979; Purvis, 1991; Spencer, 2000; Lahelma, 2014). The contemporary case for girls-only education is founded on the desire to offer every opportunity to girls by fashioning an environment that encourages development and realisation of their potential as individuals, by tailoring education to girls' learning needs and preferences; and by offering activities and academic opportunities free of constraints imposed by gender-stereotyping. For GDST schools, excellence in education means all of these things.

All schools seek to identify and develop the potential of individuals, and this usually involves grouping pupils according to a number of criteria – among which are age, ability and interest (e.g. subject choice). Gender is another dimension along which grouping occurs. Logically, in sorting pupils into groups in this way, teachers can concentrate on much more sharply focused differentiation in the classroom, tailoring teaching to the needs of individuals as individuals (Chadwell, 2010).

The dual emphasis on excellence in education and on the empowerment of girls come together in GDST schools to ensure outstanding academic results; but it goes much further, in nurturing each pupil's potential and in developing her as an individual.

Successful single-sex schooling is that which prioritises girls' education in an environment that strives for excellence, and which puts equal value on academic achievement, co-curricular engagement, and the formation of character.

The dual emphasis on excellence in education and on the empowerment of girls come together in GDST schools to ensure outstanding academic results

KEY CAVEATS

The argument for single-sex schooling does not rest on assumptions of gender differences in the brain's structure and function, or in cognition. It is generally accepted that such differences among girls are as important as those between boys and girls (Campbell and Sanders, 2002; Hyde, 2005).

Arguments for single-sex schooling are based on factors that affect empirically-verifiable differences in perceptions, behaviour, needs, preferences and outcomes. The argument can be made for single-sex schooling independently of any position on whether these gender differences are due to biological hard-wiring or socio-cultural conditioning[1].

Debate over single-sex versus coeducational schooling is long-running and is unlikely to be conclusively determined, not least because the protagonists often differ on the criteria for measuring success, and the time-period over which they are measured.[2]

Although single-sex schools tend to dominate exam league tables, it is difficult to come to definitive conclusions regarding the impact of single-sex schooling on academic achievement, because of the sheer number of interconnected factors, such as prior achievement, family circumstances, socio-economic status, and school type and history – all of which have an influence on individual and aggregate educational outcomes (Smith, 1984). In the UK most single-sex schools are selective or independent or both, and this inevitably skews the picture.

Not all girls' schools are found at the top of results league tables. But that does not mean that single-sex environments don't have an effect – it just means that not all of them do. But then, not all single-sex schools self-consciously seek to design and deliver a distinctive girls-only experience (in and out of the classroom); and certainly not all succeed.

[1] *Discussions among natural and social scientists on brain differences and their significance for gender identity are fraught with difficulties in the interpretation of evidence, but also in the interpretation of each others' ideologies, as a recent review of a major new study (Jordan-Young, 2010) inadvertently demonstrates: Rose, H. and Rose, S. 'Never mind the bollocks', London Review of Books, 33 (9), 28 April 2011, 17-18*

[2] *See Halpern, D., et al (2011) and see the subsequent discussion in Science 335, 165-168; see also http://www.theatlantic.com/education/archive/2014/03/the-never-ending-controversy-over-all-girls-education/284508/*

Arguments for single-sex schooling are based on factors that affect empirically-verifiable differences in perceptions, behaviour, needs, preferences and outcomes.

The criteria for success in education go well beyond immediate test scores. Successful girls' schools address girls' whole education, and are built on distinctive values and principles, curriculum and pedagogy (in other words, the overall school environment, cultural and physical).

Past decades have seen a trend towards coeducation in countries like England and Australia where single-sex education has traditionally been strong in the independent sector. Guest (2014) argues that it would be wrong to conclude that this reflects the educational superiority of one model over the other. Indeed, he suggests that the main motive for the move has not been about quality of education at all: 'Opinion from studies and anecdotal evidence from heads of schools … suggests that the majority of schools that have changed have done so to enhance enrolments, both in number and quality'. In setting out the case for his own school's transition, he states baldly that, 'The decision to be considered now for (the school) is whether to make structural adjustments for a lower enrolment future or to embrace growth through the introduction of coeducation.'

The growth of coeducation in the independent sector has most often been the result of schools needing to reinforce pupil numbers, and/or to cut off the 'tail' of academically weaker pupils by introducing bright pupils of the opposite sex. The growth of coeducation in the state sector might be thought to reflect shifts in social attitudes, but it should be noted that in the United States there has been a recent rejuvenation of single-sex education, not least in the 'public' school sector.

GIRLS-ONLY EDUCATION: SIGNIFICANT OUTCOMES

The positive impact of single-sex education can be explored with reference to several sets of outcomes, some of which can be measured:

1. ACADEMIC ACHIEVEMENT: GIRLS PERFORM BETTER IN SINGLE-SEX SCHOOLS

The outstanding examination performance of girls in single-sex schools is reflected in the disproportionate share of top league table positions taken up by girls' schools – many of which belong to the GDST. These schools are dedicated to excellence in education, but they are also dedicated to girls.

It is often argued that where girls-only schools perform more strongly (e.g. in examination league tables) this can be explained by controlling for pupils' ability, social class and income (Elwood and Gipps, 1999; Leonard, 2006). Many studies across several countries have concluded that there is no clear superiority of either coeducational or single-sex schooling for girls once other factors are controlled for (see for example, Yates, 1993; Hattie, 2009). Girls' schools that are selective will tend to do well because they have able students, irrespective of gender. But in a sense, that is precisely the point: students do better where schools can adopt a more tailored approach to individual students, and where one size doesn't have to fit all.

Research in the USA suggests that single-sex schooling has led to higher achievement for girls, and for low-income and ethnic minority boys (Datnow and Hubbard, 2002). Since the relaxation of legal constraints on single-sex 'public' (i.e. state) schools in the USA since 2006, there has been a remarkable growth of girls' charter schools aimed at raising achievement and aspiration among girls from low-income families. The Young Women's Leadership Network sponsors five schools in New York City, and has affiliates in six states.3

In 2016, the Girls Academic Leadership Academy (GALA) opened in Los Angeles as the first all-girls STEM public school in California4. Chadwell (2010) notes the growth of single-gender programs within co-ed high schools, and observes that, 'teachers, parents and community members are slowly becoming more comfortable talking about gender-specific learning'.

Riordan (2002) argued that, while single-sex schools are demonstrably effective in providing greater equality and greater achievement, there is little evidence that school type affects the academic achievement or development of middle-class pupils. However, a study of value-added between Key Stage 3 and GCSE results in England

[3] http://www.ywln.org/all-girls-school

[4] http://blog.cue.org/las-first-public-girls-stem-school-goes-global/

suggested that pupils in a selective environment do in fact record greater progress in single-sex schools (Malacova, 2007).

In a study using a cohort in Seoul that was randomly assigned to co-ed and single-sex high schools, Park, Behrman and Choi (2012) found that the positive effects of single-sex schools were substantial, even after taking into account variables such as teacher quality, the student-teacher ratio, the proportion of students receiving lunch support, and whether the schools were public or private. They found that pupils from single-sex schools scored more highly on Korean and English tests and were more likely to progress to four-year colleges.

Leonard (2006), in a wide-ranging review, observes that studies tend to demonstrate that single-sex education has a positive overall effect on girls' attainment in examinations (see also Sullivan, Joshi and Leonard, 2010). The difference is usually small, but '... some studies in the UK show clear advantages for girls in maths in single-sex schools and to some extent in science'. (See also Warrington and Younger, 2003). A recent study of physics also suggested that single-sex instruction was associated with more positive outcomes (Jurik et al, 2013).

Eisenkopf et al (2011) looked at maths achievement of Swiss high school students who had been randomly assigned to mixed and single-sex classes, and found that girls did substantially better in single-sex classes, were better able to judge their abilities, and showed greater self-confidence. Link (2012) found that single-sex schooling is beneficial for girls, though not for boys, in mathematics.

Bohnet (2016) refers to studies that show that women tend to do better on maths tests when the proportion of men around them is small. Indeed, there is accumulating evidence that both sexes do better in tests when there are more girls in a class (Hoxby, 2010; Lavy and Schlosser, 2011; Ciccone and Garcia-Fontes, 2014). The 'girl effect' suggests the conclusion that on the whole girls benefit from single-sex settings, but boys don't.

A recent meta-analysis of research into school type and academic results (Pahlke, Shibley-Hyde and Allison, 2014) found only small differences between single-sex and coeducational settings, although most of the differences were in favour of single-sex schools.

Even on the narrow ground of attainment in tests, there is a lot of debate but some evidence of a positive independent effect of single-sex schooling. The problem with most studies in this area is that they use a relatively narrow definition of achievement, whereas the impact of education goes far beyond immediate point scores or grades. Some of these sorts of study also seek to prove or disprove something that few would want to claim anyway: that positive academic effects follow simply by separating boys from girls.

2. SUBJECT CHOICE: PARTICIPATION IN MATHS, SCIENCE AND TECHNOLOGY IS GREATER AMONG GIRLS IN SINGLE-SEX SCHOOLS

Women are significantly under-represented in maths, science and technology, from upper secondary school onwards (Murphy and Whitelegg, 2006; Lynch and Feeley, 2009). A 2012 study showed that nearly half of all co-ed maintained schools in England did not have a single girl going on to study physics A level (Institute of Physics, 2012; see also ibid, 2013). This is a long-standing pattern in subject and career choices, one that is rooted, arguably, in gender-influenced subject experiences at school (Elwood, 1999; Riegle-Crumb et al, 2012). Mujtaba and Reiss (2016) point also to the tendency for girls to find less encouragement to continue with maths post-16 from families and their own social circles.

Underlying this phenomenon is the paradox that although girls' achievement in school science is as good as (and in the case of GCSE science, better than) that of boys, comparatively few girls take these subjects beyond the compulsory phase, and this is especially true of mathematics, physics, engineering and computer science (Calabrese, Barton and Brickhouse, 2006; Boaler and Sengupta-Irving, 2006). Girls thus seem to be opting out of some subjects despite strong secondary school performances in them.

Given the tendency of boys to predominate in ICT and computing science in later school years, it is worth noting that girls have been shown to have better technical skills and higher order ICT competences than boys in the primary phase (Aesaert and van Braak, 2015).

The propensity for girls to drop STEM subjects should come as no surprise, given the gendered perceptions of particular subjects. Mathematics is widely perceived as a symbolically male domain (Brandell and Staberg, 2008), and among upper secondary school students, attitudes towards ICT differ markedly by gender (Logan, 2007)5. It is interesting that other studies have suggested that the impact of ICT on learning is stronger for boys than for girls (Hattie, 2009). This tendency towards gender-stereotyping by subject appears to be stronger in co-educational settings (Smyth, 2010).

[5] *'Tech's gender and race gap starts in high school', The Atlantic Magazine:* http://www.theatlantic.com/education/archive/2014/01/techs-gender-and-race-gap-starts-in-high-school/282966/

Girls' views of particular subjects might in part be influenced by prevailing stereotypes and the perceptions of others, but they are also reflected in and reinforced by girls' own experiences within those subjects in coeducational contexts. A Dutch study looked at cooperative problem-solving among fifteen year olds in physics lessons, and at the influence of the partner's gender in students' learning outcomes, and concluded that females do better in all-female groups than in mixed-gender groups, when learning to solve physics problems (Harskamp, Ding and Suhre, 2008).

More positive experiences appear to be behind girls' greater take-up of and achievement in STEM subjects in single-sex schools (Leonard, 2006; Sullivan, Joshi and Leonard, 2010)[6].

Evidence from GDST schools tends to reinforce the finding that single-sex settings encourage greater diversity of subject choice. Of those studying A level in 2015, more than 46% of GDST students took at least one science, and 38% took mathematics. 9.1% of all GDST A level entries were in chemistry, compared with 5.5% for girls nationally. 12.5% of GDST entries were in mathematics, compared with 7.7% for girls nationally. The figures for physics were 3.6% and 1.7% respectively.

These figures do not appear sui generis: they arise because there is nothing intrinsically odd about girls doing 'hard' science subjects. These sixth-formers were among the majority (69%) of GDST girls who opted to study the three separate science subjects at GCSE.

The horizons that are widened at school continue to be explored at university. Again, science and technological subjects are most definitely not off limits to GDST pupils, 7.1% of whom went on in 2015 to read medicine or dentistry; 5.4% to read the physical sciences – including physics and chemistry; 3.7% to read engineering, and 2.6% maths or computer sciences. All of these figures are well above the national girls' participation rates in these subjects.

Up to a point of course, the figures reflect the fact that GDST girls tend to be selected from among the more academically-orientated and high-achieving of the national cohort, and a higher proportion of these might be expected to follow routes into science. But the fact is that these curriculum choices are made in a context in which girls are given every opportunity, without prejudice, to explore and fulfil their potential – there are no such things as girls' or boys' subjects in GDST schools.

[6] *Sullivan, A. (2006) Single-Sex and Co-educational Schooling: Life course consequences? Non-technical summary, Institute of Education, Centre for Longitudinal Studies:* http://www.cls.ioe.ac.uk/page.aspx?sitesectionid=363&sitesectiontitle=Single-sex+schools

3. CAREER PROGRESSION: GIRLS FROM SINGLE-SEX SCHOOLS DO BETTER IN THE JOB MARKET

Girls achieve better educationally than boys at the age of sixteen, and a higher proportion of girls continue in education to degree level; yet this early success does not translate into career or salary advantages later in life (Institute of Leadership and Management, 2011). Ofsted (2011b) puts this down to the failure of many schools to challenge gender stereotypes in choices of courses and careers. They found that the most positive attitudes were to be found in all-girls schools – although girls in these schools did not always act to realise their wider aspirations.

A longitudinal study of UK individuals born in 1958 undertaken by the Institute of Education found that girls who attended all-girls' schools went on to earn higher wages than girls from mixed schools, even allowing for socio-economic origins and abilities as measured in childhood (Sullivan, Joshi and Leonard, 2011)[7]. The study also confirmed that single-sex schooling had an impact on subject choice, self-confidence in STEM subjects, and academic outcomes for women – though not for men (Sullivan and Joshi, 2014). In the view of the editors of a book on gender differences in aspiration and attainment, 'The findings support the assumption that single-sex schooling moderates the effect of gender-stereotyping in terms of self-concept and choice of field of study' (Schoon and Eccles, 2014, 19).

Girls in single-sex schools are thus making less constrained choices based on genuine interest and ability, rather than on a priori gender stereotypes. Leonard (2006) argued that, 'Girls from mixed schools make more traditional career choices ... so in this respect ... coeducation appears to increase differentiation between the sexes'.

This refusal to conform to stereotypes goes beyond the classroom and the narrowly academic sphere. And it goes beyond merely participating in a wider range of activities. Crucially, leadership and character development opportunities for girls are more readily available in single-sex settings (Datnow and Hubbard, 2002).

[7] *The longitudinal study tracked the British Birth Cohort 1958 through to age 42, and found a positive premium (5%) on the wages of women (but not men), of having attended a single sex school. This was accounted for by the relatively good performance of girls only school students in post 16 qualifications. See Sullivan, A. (2006), op cit.*

4. WELLBEING: GIRLS ARE NOT HELD BACK SOCIALLY BY SINGLE-SEX SECONDARY ENVIRONMENTS

The longitudinal study of the 1958 birth cohort studied by Sullivan, Leonard and Joshi (2012) found a marginally significant positive association, in the case of women, between single-sex schooling and reported relationship quality. At the very least this suggests that it is not necessary to experience mixed schooling in order to prepare for a fully functional (and happy) life in later years.

The evidence on academic outcomes, subject choice and career progression suggests that girls benefit from being educated separately. Girls and boys seem to differ in ways that make it desirable to design separate educational provision for them. This section explores the possible bases for, and subsequent manifestations of, gender differences in school settings.

FACTORS UNDERPINNING GIRLS-ONLY EDUCATION

ARE GIRLS' BRAINS DIFFERENT?

Gurian (2011) and Sax (2005) have made a lot of relatively small neurological and cognitive differences between genders. Sax reviewed the evidence for sex differences in sensation and perception, arguing the need for different teaching styles for boys and girls. He suggests, for example, that the ideal ambient classroom temperature is lower for boys than for girls (Sax, 2006).

Sax (2010) claims to find significant gender-based differences in the way adolescents behave, with boys more prone to ADHD and 'oppositional-defiant disorder', whereas girls are over-represented among those prone to anxiety and depression. Boys, he says, tend to 'act out' their problems, whereas girls turn inward, on themselves. His view is that the best defence for girls is the development of a strong sense of self, but warns that this is made more difficult when sexualisation occurs at an earlier age, and social media has created additional anxieties.

Concern that school settings somehow favour girls by default has led to calls to change the educational environment in order to bring out the best in boys – to create 'calmer, easier, happier boys' (Janis-Norton, 2015).

The developmental biologist Lewis Wolpert (2014, 173) asserts that, 'the evidence … is persuasive that there are some fundamental biological differences between men and women'. While intellectual differences are small, differences in emotions are more significant, and can be ascribed to evolution. Christine Skelton (in Francis and Skelton, 2005) accepts that there is some evidence of important differences in the way that cognitive abilities are organised in the brain, but stresses that gender differences are nevertheless largely socially constructed.

Fine (2011; 2017), though, pours scorn on the idea that boys and girls have differently wired brains, and warns that differences between the sexes (and she doesn't deny their substance or their significance) should not be put down to neurological or cognitive differences. To be sure, much-publicised gender differences in national and international assessments (SATs, PISA, etc.) tend to be greater than any gender differences in IQ tests and tests of reasoning (Department for Education and Skills, 2007) –reinforcing the insistence that significant gender differences are socially constructed.

Kane and Mertz (2012), in reviewing gender differences in performance in TIMSS and PISA tests, conclude that the gender gap in maths outcomes is largely the product of a complex variety of socio-cultural factors rather than intrinsic differences between genders.

The OECD (2015, 3) report on continuing gender disparities in achievement asserts that 'Gender disparities in performance do not stem from innate differences in aptitude, but rather from students' attitudes towards learning and their behaviour in school, from how they choose to spend their leisure time, and from the confidence they have – or do not have – in their own abilities as students'.

Baron-Cohen (2004) argues against reverting to the view that all human behaviour is culturally determined. He does not dispute that culture is important in explaining sex differences, but he argues that it can't be the whole story, and asserts the need to recognise the interaction of social and biological factors. Although sex differences don't apply to all individuals of one sex, it is the case that in some traits (e.g. empathy) women do tend to be found towards one end of the spectrum, while men tend to gravitate towards the other.

The 'gender similarities hypothesis' proposes that males and females are similar on most, but not all, psychological variables, and they are more alike than they are different (Hyde, 2005). Hattie (2009) argues that this is reflected in educational studies. However, the research that he reviews does show gender differences in, for example, academic achievement in some subjects, motivational orientation, perceptions of particular subjects, self-concept, and the age at which certain developmental milestones are reached. The debate seems to be more about the size and significance of these differences. It is also clear from his review that the differences are greatest at secondary school age.

Wise counsel cautions against cherry-picking data to claim that girls and boys have differently-wired brains: 'There are many sound reasons to advocate single-sex schooling, but sex differences in children's brains or hormones are not among them ... the argument that boys and girls need different educational experiences because "their brains are different " is patently absurd. The same goes for arguments based on cognitive abilities, which differ far more within groups of boys or girls than between the average boy and girl' (Eliot, 2009).

Steven Pinker summarises the overall situation thus: 'Many psychological traits relevant to the public sphere, such as general intelligence, are the same on average for men and women, and virtually all psychological traits may be found in varying degrees among the members of each sex. No sex difference yet discovered applies to every last man compared with every last woman, so generalisations about a sex will always be untrue of many individuals.' However, he argues, 'to ignore gender would be to ignore a major part of the human condition', and asserts that the minds of men and women are not identical, giving rise to some 'reliable differences' (Pinker, 2002).

In terms of academic ability as defined by test scores, there does seem to be a basic gender effect. There is plentiful evidence that, in general and across a range of tests at the secondary stage, boys are relatively over-represented at either extreme of the ability range. This is particularly marked in mathematics. Heim (1970) coined the phrase the 'mediocrity of women' to characterise the statistical tendency for females to show a lower standard deviation on intelligence tests (see also Mellanby and Theobald, 2014). The tendency for boys to dominate the top and bottom of ability distributions appears to be a characteristic of A level results in recent years.[8]

GCSE results tend to show a more nuanced pattern: in 2014 boys' scores had a higher standard deviation, but girls' scores had a higher mean – reflecting an overall better female performance at GCSE. However, the lower mean and higher standard deviation for boys can mainly be attributed to a higher proportion of low scores. In fact girls predominated at the extreme top end of the score distribution in the vast majority of subjects (Bramley, Vidal Rodeiro and Vitello, 2015).

Gilligan (1982, 1988, 1990) puts forward the idea of gender differences in self-definition and ethical evaluation. She argues that females tend to define themselves through their relationships with others, while males follow 'traditional masculine' lines of self-definition – according to their occupational selves.[9] On the basis of a study of girls at a selective single-sex school in New York state, Gilligan asserts that women speak in a different voice, but that voice is often muted by gendered stereotypes in the dominant culture.

Psychologists at Warwick University have found marked gender differences in the way that people go about conceptual classifying or categorizing. They found that men tend to leap to black-or-white conclusions, whereas women tend to see shades of grey, or indeterminate categories.[10]

Rachel Simmons[11] takes the view that gender differences become apparent and intensify during adolescence (see also Palmer, 2013). These differences relate to self-esteem, internalising behaviours (depression, anxiety, self-questioning), stress, interpretations of failure (receipt of negative feedback and propensity to take risks) and self-objectification. Surveys show a substantial (and growing) incidence of depression and anxiety among girls.[12]

The central problem, then, is not whether there are gender differences, so much as whether these can be ascribed to nature or to nurture. O'Toole (2015, 3) concludes that '… there are small innate biological differences between men and women's psychologies, which our treatment of people in male bodies and female bodies conditions into significant and often times worrying gaps'.

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8 'Boys tend to either get top marks or fail in exams says new research', BBC news 3 August 2015: http://www.independent.co.uk/news/education/education-news/boys-tend-to-either-get-top-marks-or-fail-in-exams-says-new-research-10435842.html

9 'The new psychology of women', New York Review of Books, 38 (17), 24 October 1991, 25-32

10 'Men make quicker but more judgemental decisions', Daily Telegraph, 18 April, 2011: www.telegraph.co.uk/science/science-news/8458989/Men-make-quicker-but-more-judgmental-decisions.html

11 Comments by Rachel Simmons in a session on 'Effortless Perfectionism' at the annual conference of the National Coalition of Girls' Schools, New York City, February 2016: http://www.ncgs.org/PDFs/Forum/2016/Post Conference/4/1FeaturedSpeakers_RachelSimmons.pdf

12 'Teenagers struck by depression epidemic', The Times, 22 August 2016; for Scotland, see https://www.st-andrews.ac.uk/news/archive/2015/title,306958,en.php

A further difficulty lies in mapping any gender differences in the brain or in behaviour to differences in attitudes to learning. Neuroscientist Stephanie Burnett Heyes[13] warns that while it is possible to show gender differences in the brain (some of which link to evident gender differences in cognitive performance, such as the tendency for men to be better at motor and spatial tasks), it is not at all clear, given current knowledge, what the educational implications of these differences might be. That said, Deak (2002) asserts a link between hormonal differences and girls' predisposition towards sequential, detailed, language-based factual tasks.

These approaches tend to reassert the biological basis of some cognitive and affective gender differences, mediated in a major way by social and cultural conditions. Claims for the efficacy of single-sex education do not stand or fall on this ground, but there is one cognitive area which is of direct relevance...

13 Presentation by Stephanie Burnett Heyes, at IoP Opening Doors conference, London, October 2015: http://genderandset.open.ac.uk/index.php/genderandset/article/viewFile/443/729

GIRLS AND BOYS HAVE DIFFERENT MATURATION RATES

This might be one cause of evident motivational and interpersonal differences between the sexes at primary and secondary level, and the resulting need for protected time in the formative years, as advocated even by those otherwise sceptical of the more outré claims of single-sex schooling (cf. Eliot, 2009).

Young girls appear to be better prepared for the student 'role' than boys – they enter school with more school-relevant knowledge, and tend to be more conscientious, have higher cognitive competencies and possess a more positive social self-concept (Fabes et al, 2014). Indeed, this seems to persist – a UK government review concluded that girls and boys relate differently to schooling and learning, with girls finding it easier to succeed in school settings (Department of Education and Skills, 2007).

A US study of gender differences in creative thinking abilities found a statistically significant difference in favour of girls, in both 8th and 11th grades (Bart et al, 2015).

PISA results for 15 year olds in reading highlight significant gender gaps across OECD countries (Marks, 2008; Mateju and Smith, 2015). Burgess, et al (n.d.) examined gender differences in performance at age 16, both in terms of GCSE results and in terms of the value added between the ages of 14 and 16. The consistency of the difference – marked in English, less so in maths and science – regardless of context, in their view reflected the different cognitive demands and processes required by the subjects; and the authors suggest that the gender gap is rooted in the different pace of cognitive maturation between boys and girls. Cheema and Galluzzo (2013) argued that the gender gap in maths achievement in the 2003 PISA results disappear once self-efficacy and anxiety are controlled for – although this in itself begs the question.

Lenroot et al (2007) point out that nearly all of the disorders encountered in developmental neuropsychiatry have different ages of onset, prevalence, and symptomatology between boys and girls. In curriculum development, there is a chronic tension between age and stage when specifying appropriate content and attainment targets. 'Stage' might need to be defined at least partly in gender-specific terms.

The relationship between gender differences and single-sex education is not a straightforward one, and arguments for the latter do not rest on success in proving the former. Indeed, if we accept that there are few, if any, psychological and related gender differences, then we are left having to explain the very obvious gender disparities in, for example, the take-up of particular subjects at school and later career patterns. If there really is no difference between boys and girls in the propensity for engineering or enterprise (say), then the evidence would suggest that social and other factors are influencing girls' choices. The argument for single-sex education would then rest very firmly on the need to avoid prejudging girls' interests and trajectories, and ensuring a level playing field.

GENDER STEREOTYPING APPEARS TO BE CULTURALLY UNIVERSAL

Across cultures, gender-stereotyping appears to be near-universal, in its occurrence but also in its direction (Sternberg, 1999).

Boys are typically described or perceived as adventurous, enterprising, individualistic, inventive and progressive. Girls on the other hand tend to be described as cautious, dependent, fault-finding, shy and submissive. This is important because socialisation tends to reinforce and reproduce perceptions, and there is a danger that, in co-ed contexts, girls will be rewarded for particular styles (categorised by Sternberg as judicial, external and conservative). The tendency for behaviour and practice (including by children themselves) to reflect, reinforce and in turn to reproduce structural asymmetries, has resonances with the theory of 'structuration' propounded by the sociologist Anthony Giddens (1984).

Research suggests that the way women see themselves differs depending on the gender-composition of particular interactions, and that furthermore, 'authentic interactions' have been found to relate positively to career aspirations and cognitive performance (Garcia et al, 2015).

The tendency of young people to police (often quite ruthlessly) assumed gender differences is very marked (Skelton and Francis, 2005), as some examples provided by Nicole Allen in The Atlantic magazine make clear: in 2006 students in two NYU classes read case studies about a technology entrepreneur who in some versions was named Heidi and in others, Howard. The students rated Heidi and Howard as equally competent, but liked Heidi less and didn't want to work with her.14

This tends to link to what has been called the competence/likeability dilemma (see Bohnet, 2016). Successful women find it more difficult to achieve recognition as both competent and warm (Cuddy, Fiske and Glick, 2008).15

There is evidence that peer policing of gender norms begins very early (Gill, Esson and Yuen, 2016). Children start constructing gendered identities from the start, with gendered play being observable in pre-school and Early Years settings. Given the choice, pupils usually sit in same-gender groups and, typically, friendship groups are composed of pupils of the same gender (Skelton and Francis, 2003; Francis and Skelton, 2005; Paechter, 2007; Martin, 2010).

14 'Karen vs. Kevin', The Atlantic Magazine, May 2013, page 16.

15 'For women leaders, likeability and success hardly go hand in hand', blog post, Harvard Business Review, 30 April 2013: https://hbr.org/2013/04/for-women-leaders-likability-a

Asymmetries abound in co-ed settings, even when teachers are not consciously seeking to reinforce them. Reference has already been made to the gender bias in career aspirations and subject choices, evident in coeducational contexts. Studies reviewed by Murphy and Whitelegg (2006) suggest that teachers' a priori judgements about pupil ability are influenced by gender. Another study found that teachers tend to perceive boys as having greater ability in maths than girls (Upadyaya and Eccles, 2014; see also Gill, Esson and Yuen, 2016; Borg, 2015). A recent survey commissioned by Centrica found that almost a third of male teachers think STEM careers are more for boys than for girls[16].

Much the same could be said about gendered perceptions of behaviour, as Furedi makes clear[17]. Francis and Skelton (2005, p.113) observe that 'behaviour that teachers see as acceptable in one gender is sometimes problematised in the other'.

Students who do not fit the perceived norms tend to be the exceptions that prove the rule. With regard to engagement in reading, Scholes (2015) has characterised those who subvert perceived gender norms as 'clandestine readers'.

Jackson and Nystrom (2015) argue that boys are more likely to be positioned as 'effortless achievers', embodying a combination of nonchalance and natural brightness, compared with high-achieving girls who are more likely to be seen as diligent and hard-working: a diligent plodder who is careful, neat and lacking flair compared with someone who might be sloppy but has the necessary spark to 'pull it off' (see also Francis, Skelton and Read, 2012).

O'Toole (2015, 12) characterises gender as a kind of performance: 'I knew how to perform my female identity in the way my society deemed best. Other girls, from different nations, cultures, classes or races learn different, but intersecting, versions of this role.' Raby and Pomerantz (2015) show in a Canadian study that self-identified 'smart girls' strategically negotiate their academic identities within the 'gendered terrain' of the school; trying to balance the hazards of being seen as overly academic with the rewards of academic success. They argue that in responding to this tension, girls 'carefully and consciously perform "smart girlhood"'.

Datnow and Hubbard (2002) argue that gender bias is deeply embedded within wider systems of oppression, and that reform efforts in education therefore need to go beyond eliminating sex bias in language and curricula: educators need to strive to implement alternative pedagogies that challenge the unequal power relations inherent in traditional education and society.

Gender stereotyping appears to be deeply rooted, being reflected and reinforced by images projected in the media. Studies suggest that gendered stereotypes of STEM careers, for instance, are relatively easily triggered and sustained by exposure to one-off representations, but these are not easily undermined without sustained exposure to a more gender-neutral representation of scientists (Bond, 2016).

16 https://www.tes.com/news/school-news/breaking-news/almost-a-third-male-teachers-think-stem-careers-are-more-boys-girls

17 http://www.frankfuredi.com/site/article/842

Low-level but persistent harassment remains a problem in coeducational schools. Testifying in 2016 to the parliamentary Women and Equality Committee, the NUT's Rosamund McNeil argued that many incidents were simply not reported because the culture of sexual harassment is still acceptable – being interpreted as horse-play or banter in some schools[18] (see also Institute of Physics, 2015). Mary Bousted of the ATL also spoke out against the sexist school bullying that can prevent girls from participating fully in the classroom[19]. The columnist Laura Bates has argued that sexist bullying is part of a culture that puts girls under pressure to appear attractive and compliant rather than clever and forthright [20].

The Institute of Physics (2015) has pointed out that most teachers have had no training in gender issues and unconscious bias, and are prone to treating sexist language as an aspect of banter. The IoP report referred to confusion over the difference between treating all students the same, and removing gender bias. Rosalyn George of Goldsmith's, University of London, has worked on the particularities of girls' friendships, and observes that she was surprised that teachers did not appear aware of the gender-specific issues around how friendships are created and mediated.[21]

A girls-only environment might encourage more positive self-images, and a consequently higher uptake of science subjects, for example, as well as a more general willingness to take on and subvert gender stereotypes. Eliot (2009) asserts that, 'the strongest argument for single-sex education is that it can counteract the gender stereotyping that boys and girls impose on each other, especially during adolescence, when everyone's sorting out his or her sexual identity.'

Coeducational contexts tend to entrench culturally-universal gender stereotypes (Francis, Skelton and Read, 2012; Fuller, 2011). The crucial question is whether such stereotyping is likely to be underwritten or undermined by single-sex schools. It is worth rehearsing Leonard's (2006) observation that, 'Girls from mixed schools make more traditional career choices ... so in this respect ... co-education appears to increase differentiation between the sexes.'

18 http://www.telegraph.co.uk/education/2016/06/14/teachers-ignoring-sexual-harassment-of-girls-mps-told/

19 http://www.thetimes.co.uk/tto/education/article4724894.ece

20 https://www.theguardian.com/commentisfree/2016/mar/31/sexism-schools-department-of-education-deny-sexist-bullying

21 *'Schools must take account of girls' precarious friendships', The Guardian, 22 March, 2011:* www.guardian.co.uk/education/2011/mar/22/schools-beware-girls-frienships-precarious

GIRLS AND BOYS HAVE DIFFERENT NEEDS AND PREFERENCES

Differences between girls and boys are evident in the classroom on a day to day, lesson by lesson basis. There is general agreement on this, but much less on explaining the causes of these differences (Francis and Skelton, 2005).

1. ASSESSMENT

A gender-specific response to forms of assessment is reflected in a variety of studies and at a variety of stages. At Cambridge in 2014, 19.7% of women gained a First in 2014, compared with 29.1% of male students (University of Cambridge, 2015). One reason appears to be the tendency for the examination system to reward particular (adversarial, assertive, generalising) styles adopted in answering questions (Leman, 1999). The imbalance in the award of Firsts is apparent in arts and science subjects, and in physics it is thought to be linked to the prevalence of open-ended, un-scaffolded questions (Gibson et al, 2015).22

There is evidence that boys and girls adopt different learning strategies, which influence both subject choice and attainment at A Level. Elwood (1999) points to research on differential performance at GCSE and A Level, which has identified a connection between the ways in which assessments are structured, and gendered preferences for ways of working, knowing and communicating.

A UK government review found that 'reading assessments which focus on narrative may accentuate the gender gap compared to more factual-based assessment … (boys perform) significantly better on a reading comprehension task involving factual content compared to one based on narrative content. Girls' reading comprehension scores were less influenced by the content of the task' (Department for Education and Skills, 2007, 7).

A study of GCSE results has shown that girls had a higher mean score on 84% of written components, but scored more highly on 93% of coursework components. The gender gap was smaller on multiple-choice and short answer formats (Bramley, Vidal Rodeiro and Vitello, 2015).

Studies of the Scholastic Aptitude Test (SAT) in the United States found that female test-takers were more likely to skip questions rather than offer answers that might be wrong – reflecting an aversion to risk, given that at the time, candidates were penalised for wrong answers (Bohnet, 2016).

22 *'Cambridge firsts: why the girls aren't making the grade', Cambridge Student, 12 May 2014:* http://www.tcs.cam.ac.uk/news/0032431-cambridge-firsts-why-the-girls-aren-t-making-the-grade.html; *'Major gender gap in history tripos', ibid. 9 Feb 2015:* http://www.tcs.cam.ac.uk/news/0033788-serious-gender-gap-in-history-tripos.html

Machin and McNally (2005) identified differences in learning styles as explanatory factors in the emergence of gender gaps in pupil achievement, particularly at secondary school. They argue that boys' relative under-achievement is due to the impact of changes in the examination system. In particular, the introduction of criterion-referencing, an end to the rationing of top grades, and the establishment of coursework, all appeared to favour girls' learning styles (see also Northern Ireland Assembly, 2001).

IIt has been observed that girls are more likely to perform well on sustained tasks that are process-based and related to realistic situations, and that require pupils to think for themselves (Arnot et al, 1998). Gender differences in assessment structures were, ostensibly, behind the AQA Chief Executive's suggestion that GCSEs might in future be offered in two forms – with coursework orientated options more suited to girls23.

Research predicted that boys were more likely to benefit from changes towards a modular assessment structure (Vidal Rodeiro and Nadas, 2010; McClune, 2001). However, the widespread view that girls prefer sequential assessment methods that reward consistent application rather than 'sudden death' exams relying on last-minute revision, has been challenged (Francis and Skelton, 2005). Girls appear to outperform boys in both coursework and terminal examinations.

2. CURRICULUM CONTENT

Research suggests that 'A large part of women's progress in the educational and occupational sectors is in domains that do not violate gender roles; and even when they do enter male-typical domains, women are more likely to choose those subjects within them that seem consistent with their tacitly gendered notions of their interests and their "true selves"' (Riegle-Crumb, 2012; see also England, 2010).

Science subjects are typically perceived as 'masculine', and in policing behavioural norms peers tend to project particular characteristics onto girls who choose such subjects (Archer, 2013; Jurik et al, 2013; Watts, 2014; Danielsson and Lundin, 2014; see also Paechter, 2000). Mascret and Cury (2015) argue for a deep perception that science ability is both innate, and masculine. Hadjar and Aeschlimann (2014) discuss the diverging career aspirations that arise from the 'gender associations of school subjects'.

An Australian study found that, '… whilst girls' achievement levels are comparable with those of the boys, for many chemistry is still perceived as a masculine subject. Hence the girls in the chemistry classrooms … construct themselves, and are constructed, as outsiders in the subject' (Cousins and Mills, 2015, 187).

The percentage of girls continuing with physics to A level has declined since the

23 http://www.bbc.co.uk/news/mobile/education-11419483

1980s, despite the fact that girls do better on average in physics at GCSE, as in most other subjects (Bramley, Vidal Rodeiro and Vitello, 2015). The subject is dominated 80/20 by boys (Institute of Physics, 2013). The IoP study Closing Doors found that most schools are inadvertently reinforcing the stereotype. Girls appear to respond more positively to physics when the curriculum is context-based or humanistic, and anchored in relevant problems or case studies; whereas boys tend to prioritise the more abstract aspects of the subject (Murphy and Whitelegg, 2006; see also Kerger, Martin and Brunner, 2011).

An Ofsted (2011a) report on the teaching of design and technology pointed to the need to challenge gender stereotyping in pupils' choices of the subject and what they choose to design. At Key Stage 4, choices of design and technology options (e.g. electronics versus food technology and catering) were found to be markedly different for male and female students. The problem is that in teaching whole classes, very often choices have to be made, and typically it will be boy-friendly content that is chosen, for reasons discussed below.

The Department for Education and Skills (2007, 3) commented on the 'gender stereotypical biases' underlying the tendency for girls to prefer arts, languages and humanities in their GCSE electives, compared to boys who tended to plump for geography, PE and IT. Gender differences in subject choice become more pronounced at A level. Among the subjects that tend to be new post-16, psychology tends to markedly more popular with girls; business studies with boys.

The perception of particular subjects as 'masculine' or 'feminine' might be related to the nature of their demands on learning (Francis and Skelton, 2005). Mathematics and science might appeal to boys because of the stress on memorisation of abstract facts and rules, and the need for responses that privilege episodic, factual detail. By contrast, English, languages and the humanities might be more appealing to girls because of their focus on open-ended tasks related to realistic situations, and their dependence on an elaborative, broader context in responses.

3. LEARNING PREFERENCES

Francis and Skelton (2005, p. 83) assert that '... there is a recognition of gendered tendencies in pupils' preferred ways of learning'.

Warrington and Younger, in a series of papers, looked at the effect of single-sex classes within co-educational comprehensive school environments (Warrington and Younger, 2001; 2003; Younger and Warrington, 2002). They found that girls and boys benefit from having their own learning spaces, and that single-sex modes of teaching are effective in contributing to higher achievement levels, but only where the teaching reflects the gender differences in learning styles.

A review of research into reading comprehension attainment identified gender differences in reading strategies and learning styles, concluding that the 'ideal learning environment' will be different for boys and girls (Logan and Johnston, 2010). A UK government review of the evidence concluded that girls and boys tend to use different styles of learning, with girls showing greater levels of motivation and responding differently to the materials and tasks given to them (Department for Education and Skills, 2007, 7).

A Swedish study (Samuelsson and Samuelsson, 2016) looked at the relationship between gendered perceptions of the learning environment and achievement in maths. Boys feel that they have more influence over the learning environment, feel greater involvement in lessons, and perceive maths to be more important. The authors observe that this might be due to girls getting less attention than boys, on account of assumptions that they are self-regulating and more likely to be on-task. The study found that girls' achievement tended to be more strongly associated with their perceptions about the level of participation, the communication of clear objectives, and the existence of a supportive group environment.

Jo Boaler studied approaches to maths education at two otherwise nearly-identical schools in England. One of the schools approached maths the traditional way — students copied down formulas from the board, completed worksheets, and were split up into ability groups. At this school, boys did better in maths than girls. At the second school students learned maths through collaboration, working together with their classmates to solve complex, multi-dimensional, open-ended problems. There, boys and girls performed equally well in maths.[24] (See also James, 2009).

24 'Sugar and spice … and math underachievement? Why classrooms, not girls, need fixing', Clayman Institute for Gender Research, Stanford University, blog, 28 March 2012: http://gender.stanford.edu/news/2012/sugar-and-spice-and%E2%80%A6-math-under-achievement

There is evidence of gender differences in 'ways of knowing'. In the mathematical sciences, for instance, boys more strongly identify with 'separate knowing' (logic, rigour, abstraction, deduction), while girls tend to identify with 'connected knowing' (intuition, creativity, hypothesising, induction) (for mathematics, see Bevan, 2004). These differences are closely connected with particular learning approaches: girls often prefer cooperative and discussion-based learning environments, rather than individualised or competitive environments (Boaler and Sengupta-Irving, 2006; Northern Ireland Assembly, 2001; see also Phoenix, 2004). In terms of learning objectives, it has been observed that boys typically appreciate 'big picture' introductions, whereas girls often prefer more disaggregated, stepwise instructions (Bevan, 2004).

A Cambridge Assessment report analysed the evidence of gendered attitudes to learning to be found in the PISA 2012 data. 38% of boys reported playing online collaborative games every day, compared with 6% of girls. 20% of girls (and only 10% of boys) reported reading for pleasure an hour a day or more.[25]

Biddulph (2017) has written about some gender-specific issues related to the parenting of girls, pointing to the perhaps obvious fact that girls typically do not respond well to 'put-down' parenting.

As Elwood (1999) observes, the existence of gendered styles and preferences itself says nothing about whether they are 'hard-wired', or are themselves a response to gendered socialization. The fact is, though, that without doubt these differences affect and influence what and how girls learn.

4. PARTICIPATION IN SPORTS AND FITNESS ACTIVITIES

A recent study found that two thirds of girls give up on exercise by the age of nine (Jago et al, 2017). Another survey reported that the fall-off in physical activity happens very early – around age seven, and is steeper among girls (Farooq et al, 2017).

Girls show a tendency to disengage from sport as a consequence of negative experiences at school: 'Social norms related to being female and feminine are still affecting girls' attitudes and behaviour … being "sporty" is still widely seen as a masculine trait' (Women's Sport and Fitness Foundation, 2012). Girls, it is claimed, are put off by too much focus on traditional competitive sport, and by the tendency to reserve attention for the very sporty elite. The WSFF report recommends, inter alia, a greater choice of activities and the opportunity to take part in girls-only groups.

Paechter (2007) found that the way playing spaces are occupied and used tends to reinforce a stereotype of games being a male activity, with all but the self-identified 'tomboys' being relegated to inactivity and spatial marginality in the school playground.

25 Benton, T. (2015) 'Attitudes to learning: questioning the PISA data', conference presentation: http://www.cambridgeassessment.org.uk/Images/gender-differences-tom-benton.pdf

5. PEDAGOGICAL PRACTICE

There is general agreement on the existence of gendered learning preferences, with girls typically preferring collaborative group-work, reflection and discussion, and teaching in small groups; while boys typically prefer competitive situations and whole-class teaching (Francis and Skelton, 2005).

Teachers in co-ed classes generally agree that boys are more likely to dominate verbal interaction: 'In the classroom, boys quite simply take up more space than girls' (Francis and Skelton, 2005, p. 115; see also Francis, 2004). Bohnet (2016) observes that women are less likely to speak up or offer opinions. Even in primary school boys tend to adopt a more active, dynamic, assertive role, while girls are observed to adopt facilitating roles, like sorting out arguments or helping with homework. The challenge for teachers is to resist reinforcing this tendency by expecting and rewarding the behaviour of 'good, sensible girls' – behaviour which leads to girls deferring to boys in the classroom and beyond; and to avoid a self-fulfilling expectation of different behaviour of boys and girls (see Jackson and Nystrom, 2015).

Studies confirm that boys are more apt to cause disruption in the classroom, and that boys receive both more negative and more positive attention from teachers. Girls appear to be consistently under-represented in classroom interactions, a disproportionate amount of attention going to a small subset of more demanding boys (Beaman, Wheldall and Kemp, 2006; Kelly, 1988; see also Gherasim, Butnara and Mairean, 2013). This appears to continue into higher education, where the culture of 'laddism' has become a focus of concern (Jackson, Dempster and Pollard, 2015).

The evidence suggests that differentiated teaching approaches need to be systematically planned and explicitly implemented, monitored and evaluated, as Warrington and Younger's work makes very clear. But in a coeducational context, this is easier said than done. Whyte (1985) looked in detail at the 'Girls into Science and Technology' (GIST) project, pointing out that 'the GIST teachers managed to interact for equal amounts of time with girls and boys, but only with effort'.

Boys' and girls' learning needs and preferences differ at any given age. Notwithstanding the success of girls in tests, it would also appear that the educational agenda in coeducational settings is set by the needs of boys, with teachers' pedagogical strategies necessarily being calibrated towards the learning approaches and curriculum preferences of boys.

GIRLS BEHAVE DIFFERENTLY IN THE PRESENCE OF BOYS

ANXIETIES OVER IMAGE

Skelton (2010) argues that the recent trend of girls doing better than boys in school is not a result of any change in girls' behaviour over time. Gendered classroom expectations and the performance of girls seem to have been translated from 'failure' to 'victory' without any actual change in behaviours on the part of girls. Amongst even the highest achieving pupils, girls remain anxious about doing well, and concerned about their relationships with other pupils.

Writers have variously pointed to the 'curse of the good girl', whereby girls are pressured to be nice, polite, modest and selfless – which tends to curtail girls' potential. Girls are encouraged to be compliant, accomplished and driven – to project a kind of 'effortless perfection'. Commonly, girls are expected to behave non-confrontationally and to be sensitive to the needs of others. They don't like to be wrong or to make mistakes, and they avoid situations where they have to defend opinions. Many argue that at around age 12, girls go from being 'real' to being 'good' – giving up a connection with their full range of feelings in favour of fitting in (Simmons, 2009; Flanagan, 2012; Palmer, 2013).[26]

Professor Suniyar Luthar has pointed to the perceived 'need to be smart, maintain good grades while remaining well-rounded, pretty and desirable while well-liked … polite and nice … and to accomplish all this without any visible effort.'[27]

Girls' self-image is also subject, from potentially young ages, to influence from marketing and merchandising campaigns that perpetuate gender stereotypes, as suggested by U.S. author Peggy Orenstein in Cinderella ate my daughter (2011). Orenstein cites the ubiquitous pinkness of products targeted at girls and the roles given to Disney princesses in films as examples of the pervasive, unavoidable but ultimately undermining stereotypes with which girls have to contend.

26 Robert, C. 'Little miss perfect', Sunday Times, 19 February 2012

27 Quoted by Rachel Simmons in a session at the annual conference of the National Coalition of Girls' Schools, New York City, February 2016: http://www.ncgs.org/PDFs/Forum/2016/Post Conference/4/1FeaturedSpeakers_RachelSimmons.pdf

Skelton (2010) argues that trying to balance academic achievement with being seen as a 'proper girl' presents girls with difficult challenges, particularly in terms of being accepted and approved of by classmates, and securing the attention of teachers. She explored the views of a group of high achieving 12- to 13-year-old girls, who implied that being regarded as 'clever' continues to be negotiated within acceptable frameworks of femininity.

Studies of girls who are both high-achieving and popular suggest that they tend to adopt stereotypically 'girl' behaviours, effectively underplaying their academic ability (Francis, Skelton and Read, 2012; Fuller, 2011). This leads Francis and Skelton (2005, 108) to assert that for girls, 'the route to "success" is less a path than a tight-rope'. O'Reilly (2013) speaks of girls 'giving up self for safety'.

There is evidence that girls are put off choosing science subjects because of the possible negative judgement of others: '… women in male-dominated environments are confronted with a double-bind dilemma because being identified as technically competent is contradictory to being identified as feminine or as a woman' (Saavedra, et al, 2014, 332; see also Erchick, 2013).

The digital environment provides challenges in the development of an individual's identity and self-image. There is plenty of evidence that some of these issues are gender-specific (Sales, 2016; Chen and Chen, 2017). Research conducted by the Institute of Education has found that physical and digital harassment of girls as girls is routine in many co-ed schools.28 Sue Palmer (2013) argues that the effects of 'toxic childhood' tend to hit girls harder. A survey by the Schools and Students Health Education Unit found that online activity has caused a significant drop in confidence among adolescent girls in particular.[29]

The proliferation of social networking means that individuals have less control over their social image. According to Paechter (2013, page 124), 'Schools do need to support young women to think more carefully about their self-representation online, and in particular, to find ways of resisting the pervasive sexualisation that seems to be the norm for girls in many SNS contexts.' The pressure to appear sexy and flirtatious on one's home page is felt by girls who continue to maintain a 'nice girl' image face to face. Laura Bates (2016) discusses the pressures and stereotypes faced by young women on social media.

28 Bloom, A. 'Shoved, groped and pestered for sex: a typical day for girls', TES, 18 May 2012, 10; see also http://www.telegraph.co.uk/education/2017/08/13/nearly-half-girls-have-blocked-social-media-users-sufferingabuse/

29 https://www.theguardian.com/society/2014/nov/09/teenage-girls-self-esteem-plunges

SELF-CONCEPT (RELATING TO ABILITY AND STRENGTHS, AND INFORMING SUBJECT CHOICE)

Studies suggest that boys' and girls' aspirations, similar during the primary phase, tend to diverge between Year 6 and Year 11, with girls' aspirations falling below those of boys in comparable contexts (Richards and Posnett, 2012).

Students' views of their own abilities ('academic self-concept') are highly gendered (Sullivan, 2009), with girls more likely to see themselves as good at English, while boys see themselves as good at maths and science – even controlling for prior test scores. Villalon, Mateos and Cuevas (2015) report an interesting variant on this: in their study, they found no gender-difference in self-efficacy beliefs, despite the fact that female students had more sophisticated writing conceptions.

Bian et al (2017), in a U.S. study of gender attitudes to intellectual ability, found that 5-year-old children tend to judge boys and girls equally in terms of aptitude, but from the age of six, gendered notions of 'brilliance' were already in evidence, and beginning to affect children's interests: girls being less likely than boys to believe that they are 'really, really smart', and more likely to avoid exercises said to be for those who are really, really smart.

Confidence appears to be one of the strong factors affecting the evident disparity found in PISA tests – where high-performing fifteen year old girls still under-achieve in maths, science and problem-solving when compared with high-performing boys (OECD, 2015). A Scottish study suggests that the gender gap in attainment is greatest among higher-achieving pupils (Corry, 2017).

There is a tendency for boys consistently to over-estimate their ability and performance, while girls lack confidence and tend to underestimate their academic ability (Bevan, 2004; Plieninger and Dickhauser, 2015). This is marked among very able girls, on whom expectations are particularly pressing, and for whom the achievement of anything other than 'excellent' grades can be perceived as failure. This is associated with high levels of anxiety and self-doubt (Francis and Skelton, 2005). Gender differences in confidence in learning seem to appear as early as the first years of primary school (Gill, Esson and Yuen, 2016). The tendency for girls to underestimate their aptitude for STEM subjects seems to be one reason for their under-representation in STEM subjects and careers (Perez-Felkner, Nix and Thomas, 2017)[30].

30 See also https://www.tes.com/news/school-news/breaking-news/girls-downplay-their-maths-ability-even-when-theyre-good-boys

In a study of girls' participation and achievement in American high school mathematics competitions, Ellison and Swanson (2010) found that not only were girls under-represented, but that their under-representation was most marked among the highest-achievers. They concluded that almost all girls with the ability to reach high maths achievement levels were not doing so. Indeed, they found that the highest-achieving girls were concentrated in a very small number of elite schools.

Rachel Simmons points to the toxic message of the myth of 'effortless perfectionism' – the insidious self-doubt of you are not enough as you are; you can't keep it up; and there is always someone better. In Simmons's view, the highest-achieving girls are the most debilitated by fear of failure.[31] There is a long-standing consensus that 'smart' girls tend to be more vulnerable and less confident than smart boys, and as a result tend to deal with challenge in a different way[32].

A gap also exists between girls' own perceptions and those of their teachers. Girls tend to rank themselves lower in ability than do their teachers (Leonard, 2006). This tendency of boys to overestimate and girls to underestimate their respective abilities, has worrying implications for differentiation in co-ed classes. Bohnet (2016) refers to the 'stereotype threat', whereby situational factors lead people to confirm negative stereotypes about their particular groups: in studies where girls were reminded of their gender before a test, they tended to perform significantly worse (see also Davies et al, 2002).

Research suggests that female students tend to be more extrinsically motivated (i.e. undertaking tasks in order to obtain reward) and mastery-orientated (a desire to increase skill and competence, and master new material), compared with male students who tend to be more performance-orientated (desiring to surpass their peers and gain positive judgements) (D'Lima et al, 2014). Male first year college students were found to tend towards greater academic self-efficacy – rating themselves higher in terms of estimated capacity.

There is a complex relationship between attainment, self-concept and motivation. Logan and Medford's (2011) study of children aged 7-11 found that boys' beliefs about their own competence in reading and their motivation were found to be more closely associated with their actual level of skill. Less able boys are more likely to 'give up' when results don't follow, setting up a vicious circle of under-achievement. By implication, girls on the whole are more likely to be motivated to learn even when results are not encouraging (see also van de Gaer, et al, 2007). Korhonen et al (2016) have shown that interest in maths tends to predict girls' educational aspirations, while maths achievement tends to be more predictive of boys' aspirations.

Gendered self-concept partly explains the phenomenon known as the 'leaky pipeline', whereby girls tend to achieve more highly in school, yet males predominate in career progression. Hadjar et al (2014, 119) express it thus: 'Gendered interests and life plans – being related to socialised gender stereotypes – still reinforce workplace separation in terms of women more often becoming nurses, teachers or engaging in other service professions, and men being more likely to choose professions that are characterised by higher authority, prestige or status.'

31 Comments made by Rachel Simmons at the annual conference of the National Coalition of Girls' Schools, New York City, February 2016: http://www.ncgs.org/PDFs/Forum/2016/Post Conference/4/1FeaturedSpeakers_RachelSimmons.pdf

32 https://www.psychologytoday.com/blog/the-science-success/201101/the-trouble-bright-girls

CLASSROOM BEHAVIOURS

Girls tend to defer to boys in whole-class interaction, desk-based group work, group work around computers, and oral assessment (Howe, 1997):

- Contributions from boys tend to predominate both physically and verbally during classroom interaction. This is attributable to boys' tendencies towards hand-raising, restlessness and possibly their reputation for misbehaviour – all of which tends to encourage teachers to give more air-time to boys. Boys ensure their dominance by establishing themselves as a source of help. Boys are asked for help more than girls are.
- In small-group work independent of direct teacher moderation, boys typically have the upper hand. This is evident in the control of mouse and keyboard in computing, and in oral discussion – where boys tend to interrupt more (see also Riordan, 2002; Harskamp, Ding and Suhre, 2008).
- Boys are more likely to contribute to discussion, and to volunteer for demonstrations and role-plays. They appear to have more experience than girls of having their contributions evaluated during classroom interaction.

These research findings are supported anecdotally by Eliot (2009): 'In some mixed-sex lab groups, boys take over the fiddling that's inevitably required to get an experiment to work. Girls stand back, reading the instructions or acting as scribes but less often handling the chemicals, equipment or slimy specimens – which impairs their confidence. So while girls understand the scientific concepts, they don't actually do science, a big handicap when it comes to exploring technical fields down the road.'

Myhill (2002) suggests that high-achieving girls typically show a tendency to be compliant, conformist and willing to please. Cornwell et al (2012) observe that girls show more positive behaviours with respect to learning (attentiveness, task persistence, eagerness, independence, flexibility, organisation) – all of which might explain why teachers do not feel the need to spend as much time on them – a connection made explicit by Beaman, Wheldall and Kemp (2006, 354): 'it may be that compliant girls are more of a benefit to their teachers than they are to themselves'.

In co-ed contexts, research suggests that girls are expected to exert a civilising influence on boys – moderating the boys' behaviour, softening the classroom atmosphere, being 'good girls' (Jackson, Dempster and Pollard, 2015). Jones and Myhill (2004) confirm that beliefs about gender identity inform teachers' perceptions. High-achieving girls tend to conform to teachers' perceptions, but under-achieving girls tend to be largely overlooked.

The tendency for girls and boys to behave differently in mixed classrooms is a well-known one – girls being discouraged from speaking up or taking the initiative out of fear of looking either stupid or too smart (Campbell and Sanders, 2002)33.

33 See also an article by Kara Lawrie-Plews in TES, 27 Jan 2017: https://www.tes.com/news/school-news/breaking-views/give-girls-space-just-be-themselves

Many teachers in co-educational contexts make huge efforts to give a fair crack of the whip to girls. But giving due attention to the range of needs and preferences in mixed classrooms puts huge onus on the teacher, as Sadker and Sadker (1990) identified in their discussion of the inequalities implicit in college classroom interactions (see also Whyte, 1985).

Reticence around adopting or assuming leadership roles

It is not just in classroom activities that boys tend, on the whole, to assert themselves over girls, and thus to set the agenda. Girls are more likely than boys to participate in extra-curricular activities, but boys are more likely to assume leadership positions in those activities (Campbell and Sanders, 2002; Datnow and Hubbard, 2002). It is self-evident that more comprehensive leadership and character development opportunities are made available to girls in girls-only schools.

Risk-taking and risk-avoidance

Part of the 'curse of the good girl' (Simmons, 2009) is the tendency to strive for perfection in everything, which in itself militates against the taking of risks34. A study by a teacher in a GDST school focused on the central problem that 'students are reticent during class discussions and reluctant to give opinions on historical issues, particularly when unsure of the "correct" answer'.35

An OECD report considered the implications of the mixture of attributes typical of female students – lower self-efficacy and self-concept, but high motivation to do well in school. In maths and science in particular, lower self-confidence combined with a wish to succeed were seen as reasons for the higher proportion of high-achieving girls who 'choke under (often self-imposed) pressure' (OECD, 2015, 32). Gill, Esson and Yuen (2016) go further, and refer to dynamic of this 'closed mindset' leading to 'culturally-induced self-sabotage'.

While risk aversion might be another way of describing fear of failure, others have suggested that female students sometimes exhibit a 'fear of success' – or anxiety about not being able to repeat an achievement, leading to holding back or avoidance in a task (Gill, Esson and Yuen, 2016).

34 Barker, I. 'The cost of striving for perfection for girls', TES, 16 November 2012, 20-21

35 Gibbons, H. (2012) 'Enhancing girls' performance in history by encouraging greater academic risk-taking', unpublished MA dissertation, Durham University

Girls are more likely than boys to participate in extra-curricular activities, but boys are more likely to assume leadership positions in those activities

THE TROUBLE WITH GIRLS

Academic studies suggest that girls have a range of learning needs and preferences, as well as needs, which are best addressed on their own terms. Yet in innumerable classrooms the focus has tended to be on 'the problem with boys' – e.g. in perceived under-achievement, and the need to engage and motivate boys (Gill, Esson and Yuen, 2016).

Educational policy has concentrated on the problem of boys' underachievement, frequently contrasting it with the academic success of girls. This has encouraged a perception of girls as the 'winners' in the educational stakes, and assumes that they no longer experience the kinds of gender inequalities identified in earlier decades (Skelton, Francis and Read, 2010).

Girls are often treated as unproblematic, whereas there is plenty of evidence that girls' achievement – and indeed their health and happiness – are differently affected by, for example, anxieties about their performance, their ability, how they interact in mixed groups, how they perceive particular subjects, how they perceive themselves and how they are perceived by teachers and by their peers. Among girls, typically, academic motivation tends to be higher, but so too are levels of anxiety (Bugler, McGeown and St Clair, 2015). Raby and Pomerantz (2015) argue that, 'girls' academic success is neither easily embraced nor unambiguously accepted'.

Schools routinely encourage girls to reject gendered limitations on their aspirations, and to adopt a 'no limits' view. But while traditional stereotypes have been successfully dispatched, there remains a lot of pressure and expectation for female pupils to conform to more nuanced gendered type. As Gill, Esson and Yuen (2016) make clear, this in fact sets up new tensions: 'Part of being an adolescent girl … is to negotiate a path between confident self-expression, ambition and action, and a more accommodating, conforming approach to others.'

'In recent times, girls have shed the quiet image of being on the side-lines and have emerged as first-class students, top performers in … examinations, credited with being reliable in school-related tasks such as homework, neat writing, excellent bookwork, along with being well-behaved in class … They are model pupils whose achievements are expected to lead into high-profile positions and professions in any walk of life they choose.' (ibid, 2)

In coeducational classrooms, as in national policy, the agenda is dominated by the need to raise boys' achievement through encouraging their greater engagement (Francis and Skelton, 2005). It could be argued that teaching styles, classroom tasks, curriculum content and assessment form and content, are all being used to address the needs of boys in particular. There have, for example, been criticisms of SATs tests in English at Key Stage 2, where the texts used and the nature of the questions seem to have been part of a self-conscious attempt to re-engage boys in reading[36].

36 Boys' Reading Commission (2012) Report of the all-party parliamentary literacy group. National Literacy Trust: https://www.literacytrust.org.uk/assets/0001/4056/Boys_Commission_Report.pdf

Concerns about the need to engage and motivate boys have tended to dominate the agenda in terms of curriculum content, assessment forms, and teaching styles in co-educational contexts. More classroom time and attention is given to boys; higher expectations are made of boys; exams are re-structured to put more emphasis on 'sudden-death' tests; curricula are skewed to keep boys' interested. As a result, boys tend to monopolise teachers and resources. This has an impact in affecting what girls are allowed to do in the classroom and what they are encouraged to study in the curriculum. Ironically, the educational strategies adopted to keep boys on side tend to reinforce gender stereotypes and fail to challenge chronic issues faced in the classroom by girls – including low-level harassment: 'The "distraction" provided by the presence of the opposite sex in co-education is not just a question of romantic interest' (Leonard, 2006).

This seems to be implicitly understood by girls themselves, who tend to favour single-sex classes, whereas boys evidently prefer mixed-sex classes (Leonard, 2006). Girls seem to understand and appreciate the advantages of single-sex environments (Elwood and Gipps, 1999).

In 2012-13 three GDST schools participated in a research project led by Mike Younger from the University of Cambridge[37]. Students in Years 9 and 11 were surveyed, and they were clear on the advantages of single-sex settings, pointing to the absence of distractions and the freedom from boys' perceived tendencies to monopolise teachers' time. This was connected to the understanding that girls tend to be more mature, age for age. The result was perceived as a quieter, more focused learning environment.

Girls in the survey felt that they were more comfortable, less awkward and more able to relax and be free in the absence of boys. On one level, it meant that they could be less pressured about appearance, but more fundamentally they felt freer to ask questions, suggest answers and participate in discussions without the fear of 'looking stupid'. This was associated with a growing confidence and self-esteem. They also felt that they were able to discuss problems more effectively.

37 *Mike Younger (2016) Effective Pedagogies for Girls' Learning: A review of recent research. Girls' Day School Trust:* https://www.gdst.net/article/effective-pedagogies-girls-learning-report

DETERMINANTS OF SUCCESS IN SINGLE-SEX SCHOOLING

A recent report by Equate Scotland (2016) recommended that single-sex classes and clubs might help address the gender disparities in recruitment and retention around STEM subjects at school. Their survey found considerable support for this among female students[38].

Merely separating boys from girls does not guarantee success (Francis and Skelton, 2005). Indeed, many would argue that segregation without other changes, in culture and pedagogy for example, tends to reinforce rather than challenge the gender stereotypes and limited horizons that constituted part of the original problem (Fabes et al, 2013). Harris (2004, 103) warns that 'schools '… have always been sites for the production of normative femininity and 'appropriate' young women'. She argues that, 'the space of schools is still designed to produce and regulate notions of appropriate young womanhood'. Iris Bohnet (2016) argues that designing gender equality should start with debiasing organisations instead of individuals.

It is therefore necessary to isolate and analyse the range of factors that, together, constitute a convincing and credible single-sex offer in GDST schools.

1. THE PHYSICAL DESIGN OF GIRLS-ONLY SPACES

Individual thought and behaviour, group interaction, indeed all kinds of learning, take place within a series of physical spaces, that may or may not reflect and reward particular modes of being and particular learning approaches.

Attention needs therefore to be given to the design of social spaces such as common rooms and study areas, but it also extends to landscaping. An example would be amphitheatre areas with small groups of seats – for use in spontaneous play by small groups of girls.

Play equipment in junior schools should be designed to encourage adventure (going for for pirate ships rather than fairy castles) and controlled risk (modern climbing frames with modern safety nets).

The girls themselves need to be closely involved in designing their own environment, and usually have high expectations with regard to environmental impact. Girls at several GDST schools have worked closely with teachers and architects to design new facilities – and environmental sensitivity has been a high priority.

Lang (2010) refers to Brisbane Girls' Grammar School, with its new Creative Learning Centre, designed by Michael Banney to group arts studies, and to serve all students as a meeting place and technology hub. The building was

38 *http://www.heraldscotland.com/politics/14773820.Girls_only_science_lessons_could___39_help_reverse_gender_gap__39__in_crucial_industries/*

specifically designed to provide an environment adapted to teenage girls, and reflects their ways of learning and social interaction (see also Bell, 2007). Designs for new buildings in GDST schools currently seek to find spaces with supporting technologies for collaborative learning and small-group work.

Consultation with pupils has been a key part of the process of designing new sixth form centres, and the result is that they tend to act as a focal point in the social as well as the educational life of the girls in the sixth form. A notable feature has been the way that girls have taken ownership of new spaces, spontaneously defining through everyday practice a gradation of learning and recreation 'zones' of different levels of formality.

2. CLASS TIME AND CLASSROOM INTERACTION

Belfi et al (2012) found that single-sex classes are advantageous for girls' well-being and academic self-concept (the results are more inconclusive for boys). They reviewed evidence that girls tend to behave differently, and indeed are treated differently, in different settings; and found that girls are more likely to conform to gender stereotypes in mixed classes: 'Gender is more salient in mixed sex groups than in single-sex groups'. Cribb and Haase (2016) studied levels of concern over personal appearance (the 'thin ideal') and self-esteem, and concluded that, 'the presence of the opposite sex may inflate appearance concerns and lower self-esteem'.

Girls-only schools can reflect girls' learning needs and preferences in the ways in which timetables are constructed, with schools adopting lesson lengths that are calibrated to the 'learning arc' that tends to be slightly longer for girls. Some GDST schools have moved to lessons of an hour – which appears to be the ideal length of time to encourage deep learning. Forty minutes is too short, and the traditional 'double period' too long. Recent research certainly suggests that, typically, girls and boys function on different settings of biological clock (Lusher and Yasenov, 2016).

The debate about the effect of school and class size on educational outcomes has, perhaps surprisingly, a gender dimension. Humlum and Smith (2015) review the evidence showing that boys rather than girls benefit from smaller classes and smaller schools.

Classroom interactions tend to be different in girls-only environments, and teachers are able to give greater equality of air-time to individuals across the whole class. In single-sex classes there tends to be less peer-pressure, and consequent fear of failure – and correspondingly a greater willingness to explore, ask questions and take intellectual risks. Francis and Skelton (2005, p.142) argue that, '… single-sex classes provide girls a space away from the distractions of boys and they can provide opportunities for teachers to redress stereotypical constructions of particular subjects.'

Some studies suggest that girls' interest in science can be increased by choosing particular topics over others; by presenting topics in a female-friendly manner, and even by asking questions in particular ways (Kerger, Martin and Brunner, 2011; Murphy and Whitelegg, 2006)39. In girls-only classrooms procedures and interactions are very different. In lab classes, for instance, the pace can be dictated by girls' tendency to reflect and deliberate in planning an experiment, rather than by boys' preferences for leaping in and getting started.

Bohnet (2016) refers to studies showing that fifteen year old girls in single-sex UK schools are just as willing to take risks as their male counterparts. This is supported by the findings of Booth and Nolen (2009) that single-sex environments tend to modify students' risk-taking preferences, with girls from single-sex schools as likely to adopt higher risk strategies as boys, and more likely than girls from co-ed schools.40

Gibbons41 and others have stressed the importance of providing an environment in which girls are encouraged to take intellectual risks, challenging answers which are prefaced by things like, 'I'm probably wrong but…'

In a study by three Essex University economists (Booth et al, 2011), undergraduates were put in a situation where they could choose between a safe and a risky choice (the latter potentially bearing greater reward). They found that after a period of time, females in all-female groups tended to act more adventurously than their counterparts in mixed groups.

The quality of classroom interactions depends on the pedagogical response, and therefore on the ability of teachers to recognise and respond to different learning preferences. Any group of girls will exhibit a range of approaches, and clearly a girls-only environment does not invite, nor will it benefit from a 'one-size fits all' approach. The purpose of any form of setting or segregation, by ability or by gender, is not to negate differentiation, but to gain a purchase on it. In single-sex classrooms, girls can be treated as individual girls, and differentiation can be far more focused.

Teachers in GDST junior schools observe that girls in Key Stages 1 and 2 tend to exhibit distinctive behaviours, for example in seeking the reassurance of a clear plan. This might involve having the day's timetable clearly displayed, or in lessons, and in individual lessons, girls engage very positively when teachers set out a summary of prior learning at the beginning, and conclude with an indication of the next steps. There is a dark side to this, of course, of which teachers are well aware: girls tend to be more risk-averse, and will often want to start again if things go wrong. With groups of girls, teachers can address these issues, and exploit the opportunities, more directly. Teachers tend to argue that there is nothing really 'lost' by not having boys around, because in the primary phase boys and girls tend to play alongside, rather than with, each other.

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39 Stannard, K. 'Getting girls to stick with STEM subjects', TES, 6 December

40 See also 'Doing gender in classroom discourse', research report Laurel Center for Research on Girls: https://www.tes.com/news/school-news/breaking-news/sixth-form-girls-are-far-more-anxious-about-career-prospects-boys

41 Gibbons, H. (2012) 'Enhancing girls' performance in history by encouraging greater academic risk-taking', unpublished MA dissertation, Durham University

The principal of Brisbane Girls' Grammar School observes that, 'What the teachers understand is that girls need to feel secure in their environment, they must be encouraged to feel confident about taking risks with their learning and, perhaps most importantly, they like to feel connected to each other' (Bell, 2007). In all-girls classrooms, girls can be appropriately challenged and encouraged to take risks and be adventurous in their views, attitudes, approaches and choices.

A US graduate reflected on her own experience in moving to a single-sex educational college environment (a college which has since become co-ed): 'Suddenly, no one in class called girls whores, sluts, slags. Nobody yelled 'faggot' at each other. All of the women and the teachers wanted to hear everybody's opinion. We all wanted to have discussions, not just 'be right' and 'win' the conversation. The airspace wasn't dominated with pointless vocal noise. Women spoke up, instead of being quiet to be popular.'[42]

3. TEACHERS AND THEIR ROLES

Eliot (2009) is generally sceptical of the claims made for single-sex education, but she argues that the greatest asset of successful single-sex schools is the gender composition of their staff: 'At all-girls' schools, one finds strong, dedicated women serving as role models in maths and science.' Campbell and Sanders (2002) argue that at college level, benefits follow from having a greater proportion of teachers who are female, and a positive learning environment which validates women's scholarship and women's issues: 'The content, practice and organisation of an educational setting matter greatly when student achievement is being assessed'.

Eliot argues that even in coeducational schools, subjects like ICT and science might be better taught in single-sex settings, by teachers of the same sex as the students. For pupils in primary school, the teacher's gender matters in terms of the construction of pupils' own gender identities (Skelton et al, 2006).

While there is no doubt of the potency of female role models, the issue is less critical in schools that focus exclusively on the education of girls, and where the overall ethos of the school is focused on affirming and empowering women. Male teachers in such environments add balance and make a significant contribution in supporting the ethos of girls-only schools.

However, there is evidence that merely teaching girls apart from boys is limited in its effect if teachers, of whatever gender, make no other (pedagogical) adjustments. Chambers (2005) studied single-sex language teaching in a coeducational comprehensive school, and stressed the importance of the training of staff, to avoid the tendency to regard boys and girls as homogeneous groups each with common needs rather than individuals with specific needs. Teachers need an enhanced awareness of the challenges and opportunities of single-sex teaching (see Chadwell, 2010).

42 Quoted in blog on Forbes online, 2014: http://www.forbes.com/sites/jmaureenhenderson/2014/04/24/is-single-sex-education-still-relevant-these-alumnae-say-yes-and-are-willing-to-fight-for-it/#88bcb683063b

Warrington and Younger (2001; 2003; Younger and Warrington, 2002) also found that single-sex teaching within co-ed schools had little impact on achievement levels in the absence of any pedagogical adjustments. This supports John Hattie's assertion that the impact of single-sex classes, like that of many other factors, tends to be mediated substantially by the quality of teaching per se (Hattie, 2009). Hahn and Wang (2012) concluded that the otherwise positive effect of single-sex schooling on academic outcomes is very context-dependent.

An Australian study concluded that single-sex groupings create environments in which teachers can implement gender-inclusive science instructional strategies more readily and effectively than in mixed-sex settings (Parker and Rennie, 2002). However, they found that the extent to which teachers were successful in implementing gender-inclusive instructional strategies depended on their prior commitment to the project as a whole.

Lesson observations and interviews with teachers, conducted as part of the GDST Cambridge study referred to earlier, revealed that while most teachers do not self-consciously adjust their pedagogy to the teaching of girls (and therefore do not recognise girls as having distinctive learning 'styles'), they do nevertheless calibrate their techniques to respond to girls' learning 'needs' – thereby developing a form of 'girl-friendly' pedagogy that exploits the advantages of a single-sex setting.

'At one level, teachers' reflections suggested that they had not developed girls'-specific pedagogies, did not teach differently in a girls'-only classroom, or acknowledge that girls had different learning styles from those of boys. Classroom observations confirmed that a gender specific, girls'-orientated pedagogy was not explicit, and that – on the whole – classroom content and curricular focus was not gender specific. At the same time, however, teachers seemed to recognise that the girls they taught needed both more security and more challenge if they were to maximise their potential as learners. Whether this is gender-specific or not is arguable, since many boys of similar abilities need challenge and some of them certainly need more security than they might care to admit publicly. What seems unarguable, however, is that many of the observed teachers in these schools had adjusted their pedagogy, whether explicitly or implicitly, to context, to provide secure environment for learning whilst at the same time building in challenges which increased girls' resilience and criticality…

What emerges here, then, in the practice and voices of the observed teachers is that the pedagogy which has developed– almost organically - within these schools, might not acknowledge that girls learn differently or have different learning styles to boys per se, but that teachers have developed and evolved a style of teaching and approaches to learning, sometimes almost sub-consciously, which has optimised the context of girls'-only classes. "The feel of the lessons is different … the way the girls act, the teachers interact, the rapport established between girls and teachers all have emerged through time … enabled by the single-sex environment", and that practice has become implicit, based on experiences and on "what works, when, with whom".[43]

43 Younger, M. (2016) 'Effective pedagogies for girls' learning'. Forthcoming: www.gdst.net

4. CURRICULUM CHOICES, LEADERSHIP AND CO-CURRICULAR OPPORTUNITIES

Subject choice, according to the Institute of Physics (2012) is strongly associated with and influenced by students' own developing sense of identity, and how they see themselves in relation to a particular subject – something that is influenced by the context: in the maintained sector girls are almost two and a half times more likely to go on to do A-level physics if they come from a girls' school rather than a co-ed school. The Closing Doors report (Institute of Physics, 2013) finds that 'single-sex schools are significantly better than co-educational schools at countering the gender imbalances in progression' across a range of subjects, including physics.

Even those sceptical of the academic advantages of all-girls schools tend to accept that by eliminating the boy-girl contrasts that inevitably arise in mixed classrooms, each sex might be freer to excel in a wider range of pursuits (Eliot, 2009). GDST schools' refusal to allow girls to typecast themselves according to others' perceptions is reflected in the distinctive and wide-ranging subject choices, and subsequent degree course choices, of GDST girls, when compared with girls nationally.

With respect to curriculum, arguments for single-sex education do not fall back on (questionable) assumptions or assertions about gender differences in attainment or interest in particular subjects, nor or any assumed underlying cognitive differences. It actually isn't very important whether we think that girls are typically less interested in mathematics or science, or whether we think that more of them should be. The essential thing is that every opportunity is provided for girls to make up their minds freed from the undue influence of prejudice – their own and other people's.

Co-curricular and leadership opportunities in girls-only schools reflect the fact that, across the curriculum and outside the classroom, roles are not pre-determined, and girls don't play second fiddle to anyone – in fact in the absence of boys they are just as likely to take up the trumpet. Meehan (2007, xvi) observes of single-sex schools, 'In the best of these schools, girls make most of the rules. In all of them, girls play all the roles: girls are the clowns, the chemists, the classical scholars…' She argues that, free from the judgement of boys, girls are active, not reactive. She also argues that in a single-sex environment, the pressure to 'grow up' is reduced, and girls are able to remain longer in the 'in-between years'.

A single-sex education only seems artificial if one assumes that girls are one-dimensional, and that formal schooling constitutes the totality of their lives. Girls have lives outside school. Balancing social life and study is itself a skill, and girls-only educational environments help pupils to achieve a balance by creating spaces for girls to learn without the continuous imposition of social pressures and distractions.

That said, many GDST schools organise joint co-curricular activities with local boys' schools – including plays, debates, fashion shows and careers fairs.

5. THE WHOLE-SCHOOL ENVIRONMENT

Eliot (2009) is sceptical of most arguments for single-sex schooling, but she concedes that their proponents are on firm ground when they base their arguments on some of the motivational and interpersonal differences between the sexes – particularly the idea that individuals might benefit from some protected time away from the other sex during their formative years. Boys, she conjectures, might thrive in a more disciplined, competitive atmosphere; while girls are more likely to thrive in a more supportive, nurturing environment.

The effect of single-sex education is marked for whole schools, but not necessarily for segregated classrooms in co-ed schools. Riordan (2002) stresses the importance of 'an academic culture that is endemic to single-sex schools and cannot be produced in one or two classrooms within an otherwise coeducational school.' Murphy and Whitelegg (2006) suggest that single-sex teaching in coeducational schools might even run the risk of reinforcing gender stereotypes – possibly by implying that girls have difficulty with particular subjects (see also Gill, Esson and Yuen, 2016). Limited separation by subject would indeed tend to ignore the whole-school dimension, including co-curricular activities and leadership opportunities. Smith (1984) outlines the difficulties involved in ensuring equal opportunities in coeducational classes and schools.

Outcomes for girls in single-sex settings within co-ed schools might be questionable not least because such initiatives have been mostly driven by the need to raise the standards of boys. Francis and Skelton (2005, 142) argue that 'single-sex classrooms are only effective in those schools with a whole-school approach to gender and not in those establishments which had adopted it on an ad hoc basis.' This is a view that is strongly supported by Leonard Sax, the US psychologist.[44]

But even whole-school single-sex environments alone don't guarantee success: they might still serve to underwrite rather than challenge gender stereotypes. They need to provide a culture and a set of structures that serve to challenge risk-aversion, and encourage a sense of adventure. Kruse argues that, 'sex-segregated education can be used for emancipation or oppression. As a method, it does not guarantee an outcome. The intentions, the understanding of people and their gender, their pedagogical attitudes and practices, are crucial, as in all pedagogical work' (quoted in Datnow and Hubbard, 2002).

Segregation might conceivably leave structural inequalities intact, with academic outcomes depending more on school factors than on gender separation; and single-sex educational settings might promote stereotypical gender roles and attitudes towards the opposite sex (Datnow and Hubbard, 2002). Whyte (1985) argues that 'it is probably true that many single-sex schools have a tendency to reinforce the traditional aspirations of boys and girls.'

44b 'Is single-sex the recipe for success?' TES, 23 August 2013, 10.

The issue here is the need to balance recognition of gender differences with avoidance of gender stereotyping – something which schools of all kinds have to address. Boaler and Sengupta-Irving (2006) argue that, '...while the 'dichotomous' argument carries the danger of essentialism and stereotyping, the counter-argument, that gender differences do not exist, runs a different risk – that of overlooking the harsh inequalities that prevail in many places and that cause unequal achievement and participation.'

There is no a priori reason why single-sex schooling should fail to challenge gender stereotypes, except insofar as it is bound up with social and/or academic selection. The Single-Sex Strategy in Australia was associated with private schools, with the result that outcomes were vulnerable to class-specific gendered subjectivities rather than non-sexist schooling (Kenway and Willis, 1986). A New Zealand study found that selective single-sex schools are chosen not just because of access to academic achievement, but for the type of girls they are seen to be able to produce. Parents, and the girls themselves, have ideas about femininity which they seek to have reinforced by the school (Watson, 1997).

Fee-charging (and therefore to an extent socially-selective) girls' schools face a particular challenge in avoiding the reproduction of the very gender inequalities they seek to subvert. Halpern et al (2011) ask whether 'segregation' reinforces or subverts stereotypes and gendered behaviour. This links in very clearly with the proposition that sex selection in and of itself changes nothing, without concomitant commitments reflected in the principles and articulated in the practices of the school. Indeed there might be a danger of legitimising striving for perfection across the board, associated with intensive pressure, and overscheduled, stressful lives (Maxwell and Aggleton, 2013)[45]. Lee, Marks and Byrd (1994) stress the need for girls-only schools to actively discourage academic dependence in their pupils.

The GDST Cambridge study, referred to previously, stressed the importance of the cultural milieu created and maintained from the top down – with strong and empowering messages coming from the head and senior leadership team, and carried through in practice, in assemblies, presentations, displays, and co-curricular programmes.

The role of girls' schools in this context goes well beyond gender, of course. It involves educating pupils within an ethical framework of self and society – and as such schools are not cut off from the wider world. Core curriculum components and extra-curricular activities are often focused on developing this aspect of a pupil's whole education. An explicit purpose of GDST schools is thus to challenge and subvert stereotypes per se, and to empower their pupils to make informed, unconstrained and responsible choices.

45 Barker, I. 'The cost of striving for perfection for girls', TES, 16 November 2012, 20-21

THE COROLLARIES OF SUCCESS AT SCHOOL

Statistics showing a persistent gap in academic achievement between boys and girls, with girls over-represented in top grades and access to prestigious university places, might suggest that battles over gender equality have been won. But Harris (2004) stresses that while women are sometimes represented as the winners, they are living more complex lives than the dominant images of girls' freedom, power and success might suggest (see also Jackson, Paechter and Renold, 2010; Raby and Pomerantz, 2015; Gill, Esson and Yuen, 2016).

It has been suggested that in the context of persistent gender disparities in career trajectories and incomes, gains by women in the academic sphere might represent a 'stalled gender revolution' (Schoon and Eccles, 2014; see also Ezzedeen et al, 2015).

There is a growing realisation that girls' success at school has not reduced the wide gender imbalance in terms of progression to the top of careers. Across the world women are outperforming men at school and at university, but this superiority is not translating into sustained success in the world of work. Men continue to outstrip women in terms of salaries and representation at the top of management structures.[46]

Part of the reason for gendered earnings disparities is the pattern of take-up of particular professions, itself traceable to subject choices at school and university (Mechtenberg, 2009)47. Girls' persistent under-estimation of their abilities in maths and science serves as a critical filter regulating access to higher status occupations Earnings disparities, though, exist even at the same levels in the same professions.

A lot has been written about the 'confidence gap' between genders when it comes to assumptions about the relationship between ability and progression. Women, it is argued, tend to be less self-assured, which is self-limiting because "success correlates just as closely with confidence as it does with competence"48.

Aspirations and self-concept form and develop early on. A survey commissioned by Girlguiding49 found that the confidence gained by girls at school is more easily eroded in later years. 90% of nine- and 10-year-old girls felt they would have the same chance as boys at succeeding in their chosen jobs. This dropped to 54% among 11- to 16-year-olds, and to 35% among 17 to 21-year-olds. Girlguiding argues that girls' attitudes to themselves change as they become more aware of the barriers

46 Franke-Ruta, G. 'Miss education: why women's success in higher education hasn't led to more female leaders', The Atlantic Magazine, April, 28 2013; see also Boffey, D. and Stewart, H. 'Parents to be offered guide to help boost girls' ambition', The Observer, 2 June 2013, 1

47 https://www.thetimes.co.uk/article/maths-for-girls-is-the-way-to-close-the-pay-gap-mqzxccl8j

48 http://www.abc.net.au/news/2017-05-28/confessions-of-a-confident-mediocre-man/8562708

49 'Girls less confident as they grow older, says Girlguiding', BBC news: http://www.bbc.co.uk/news/education-36869186

facing women in the workplace. Research by Oxford University's Careers Service confirms that sixth form girls are more anxious than boys about their ability to land a good job (Black and Turner, 2016).[50]

It is possible that success at school might actually help create the conditions for less effective performance at work. Garance Franke-Ruta[51] argues that, '... the behaviours that school rewards – studying, careful preparation, patient climbing from one level to the next – seem to give women an advantage academically, judging by the fact that they get higher grades than men do ... yet ... out in the work world, people hire and promote based on personality as much as on formal qualifications, and very often networking can trump grinding away.'

Diprete and Buchmann (2013) observe that 'girls derive more intrinsic gratification from performing well on a day to day basis, a crucial advantage in the learning process'; yet according to Johnson and Mohr[52], 'the very skills that propel women to the top of the classroom are earning us middle-of-the-pack marks in the workplace.' Decades of female over-achievement in academic terms have not resulted in a substantial closure of the 'confidence gap'.[53]

There is a possible link between girls being over-praised at school and later underperformance at work. There is some evidence that teachers give inflated grades in recognition, not just of achievement, but also of attitude and classroom characteristics (Mateju and Smith, 2015). Mechtenberg (2009) sought to develop a unified explanation for three related phenomena: test scores and grades at school; subject choice at university and earnings at work.

This raises an awkward question: are we doing girls a long-term disservice by defining their performance in terms of their compliance to the expectations of behaviour and work patterns that reflect, reinforce and reproduce differences between the genders?[54]

Inspection reports on girls' schools betray gendered judgements when they commend girls' manners and politeness, and even the neatness of their work, in terms that would be unusual if applied to boys. As testing in schools becomes ever more standardised and tick-box in form, are we inadvertently encouraging girls in their typically more measured, step-wise approach to tasks? When we give higher marks to essays that show balance and equal weighting to arguments, and place laurels on the heads of those who shine in set-piece performances, recitations and productions, are we not setting them up to

50 https://www.tes.com/news/school-news/breaking-news/sixth-form-girls-are-far-more-anxious-about-career-prospects-boys

51 Franke-Ruta, G. op cit.

52 Johnson, W. and Mohr, T. 'Women need to realise work isn't school', Harvard Business Review Blog, 11 January 2013: http://blogs.hbr.org/cs/2013/01/women_need_to_realize_work_isnt_schol.html

53 Kay, K. and Shipman, C. 'The confidence gap', The Atlantic Magazine, May 2014: http://www.theatlantic.com/magazine/archive/2014/05/the-confidence-gap/359815/

54 Stannard, K. 'A woman's place is in the boardrooom', TES, 19 July 2013, 26-27

fail when they come up against spontaneous, competitive, combative situations such as prevail in interviews for selective universities and for jobs?[55]

The suggestion is that schools risk over-praising and underwriting compliant behaviour in girls. To counteract this, Johnson and Mohr[56] recommend five key ways of subverting gender stereotypes:

1. Figure out how to challenge/influence authority
2. Prepare, but also learn to improvise
3. Find effective forms of self-promotion
4. Welcome a less-prescribed career path
5. Go for being respected, not just liked.

This approach has been fleshed out in the Women's School to Work Guide, by Tara Mohr[57], and in her book, Playing Big (Mohr, 2014).

There is evidence that these strategies are more effective when schooling takes place in single-sex settings. Tara Christie Kinsey, principal of the Hewitt School, New York, had previously been dean at Princeton: she has observed that after entering the university, women's confidence generally fell – with two exceptions: female athletes, and women who had been at single-sex schools.[58] Lee and Marks (1990) undertook a longitudinal study of students who reached their college senior year in 1986. They found that the single-sex educational experience produced sustained advantages in terms of raised academic aspirations, enhanced self-concept, and reduced propensity to gender-role stereotyping.

Across GDST schools, there is a strong focus on challenging the stereotype of the risk-averse, over-cautious, meticulously prepared pupil who excels in set-piece situations, but who finds herself on the back foot when faced with the challenges intrinsic to debates and interviews. Schools teach the educative and experiential value of failure; they have encouraged girls to celebrate successes and 'blow their own trumpet'; and coached them to develop techniques that lie at the heart of improvisation and stand-up comedy. Cross-Trust events such as the Young Leaders and junior young leaders conferences have given girls new opportunities and broader platforms for developing the dispositions likely to be highly effective beyond school.

There are two crucial considerations here:

First, a balance has to be struck between showing girls that all options are open, encouraging them to be aspirational, and challenging gender stereotypes on the one hand; while, on the other, giving them the skills of resilience required to deal with situations where they come up against stereotyping, unfairness and inequality. As Graff (2013, page 70) makes clear, 'It is a challenge to conceptualise a pedagogy for girls with its implicit dramatisation of difference in order to deconstruct constraints of gender stereotypes.'

Carinci and Wong (2009) found that young people tend typically to be more supportive of gender equality than their elders, but often lack the skills to realise those ideals. They argue the need for students to be taught the history of gender relations, and for schools to equip them with the appropriate tools for understanding and action, through an awareness of civil rights.

Second, some have questioned whether girls should be encouraged to adopt the 'masculine' traits of competitiveness, ambition and drive, rather than being encouraged to question and challenge the hegemonic power of those very traits, values and practices (cf. Francis and Skelton, 2005). But there are strong voices speaking up in favour of schools working purposefully to increase women's self-assurance and assertiveness, thereby enabling them to aspire to and then secure a wider range of prestige occupations (Black and Turner, 2016).

55 See 'The perils of being little miss perfect', Daily Telegraph 17/08/17, pages 19-20

56 Johnson, W. and Mohr, T. 'Women need to realise work isn't school', Harvard Business Review Blog, 11 January 2013: http://blogs.hbr.org/cs/2013/01/women_need_to_realize_work_isnt_schol.html

57 The Women's School to Work Guide: http://www.taramohr.com/gettheguide/

58 Comments made by Tara Christie Kinsey at the annual conference of the National Coalition of Girls' Schools, New York City, February 2016

CONCLUSION: SUBVERSIVE SCHOOLS

Girls differ from boys not along any substantive intellectual or cognitive dimensions, but in attributes and dispositions that have their greatest impact in childhood and adolescence; and which mean that girls' learning needs and preferences are typically different from those of boys.

GDST schools offer an environment in which girls' distinctive learning needs and preferences can be addressed as a principle and as a priority.

Added to this is the influence of environment: in particular, gender stereotyping and gender differences in expectations and, often, self-definition, remain issues that need to be checked and challenged, not least at school. Girls should have the opportunity to be educated separately, not because they need protection as such, but because they deserve a level playing field.

GDST schools offer an environment free of the prejudice of gender-stereotyping, and free of distraction and harassment. In this liberating environment, girls are encouraged to be ambitious and to take intellectual risks.

All of this points to the necessity for girls-only educational spaces – and not just in terms of separate provision in otherwise mixed environments. 'Merely' separating girls from boys has little impact in itself – beneficial results flow only if this goes in lock-step with a self-conscious and sustained attention to girls' learning needs and preferences; through attention to, among other things, physical design, curriculum and co-curriculum opportunities and expectations, and teaching and learning strategies – in short, the whole-school culture.

GDST schools provide an environment, a set of values, a pedagogy and a practice which cannot easily be simulated in single-sex classes within co-educational schools, and which are not simply the product of separation of the sexes.

The best girls' schools succeed because, in striving to be excellent schools, and by delivering an outstanding education to their pupils, they understand that girls succeed wherever their particular learning and development needs and preferences are fully and specifically addressed, and where choices and opportunities are unconstrained by a priori assumptions about what girls like and can do.

GDST schools are girls' schools not just in intake and organisation, but in culture, vision and practice.

GDST schools are characterised by:

1. A commitment to excellence as schools: the non-negotiable starting point
2. Design of purpose-built learning spaces with girls in mind
3. Every curriculum and co-curriculum opportunity available to girls as a matter of course
4. Teaching and learning focusing on girls' learning needs and preferences
5. A whole-school culture which respects, nurtures, challenges and empowers girls.

GDST all-through day schools provide a learning environment specifically designed for and dedicated to the development and empowerment of successful, confident and adventurous girls.

REFERENCES

Aesaert, K. and van Braak, J. (2015) 'Gender and socio-economic related differences in performance-based ICT competences', Computers and Education 84, 8-25

Archer, L., et al (2013) 'Not girly, not sexy, not glamorous: primary school girls' and parents' constructions of science aspirations', Pedagogy, Culture and Society 21 (1), 171-194

Arnot, M., Gray, J., James, M. and Ruddock, J. (1998) A Review of Recent Research on Gender and Educational Performance. London: Ofsted Research Series, Stationery Office

Baron-Cohen, S. (2004) The Essential Difference. London: Penguin

Bart, W. et al (2015) 'An investigation of the gender differences in creative thinking abilities among 8th and 11th grade students', Thinking Skills and Creativity 17, 17-24

Bates, L. (2016) Girl Up, London: Simon and Schuster

Beaman, R., Wheldall, K. and Kemp, C. (2006) 'Differential teacher attention to boys in the classroom', Educational Review 58 (3), 339-366

Belfi, B. et al (2012) 'The effect of class composition by gender and ability on secondary school students' school well-being and academic self-concept: a literature review', Educational Research Review 7 (1), 62-74

Bell, A. (2007) A New Creative Learning Centre at a Girls' School in Australia. PEB Exchange, Programme on Educational Building, No. 2007/05. Paris: OECD Publishing Paris.

Bevan, R. (2004) 'Gender and mathematics: what can research tell us about how we teach mathematics to boys and girls?' National Teacher Research Panel, conference summary: http://collections-r.europarchive.org/tna/20040105040008/http://www.standards.dfes.gov.uk/ntrp/lib/pdf/Bevan1.pdf

Bian, L., Leslie, S-J., and Cimpian, A. (2017) 'Gender stereotypes about intellectual ability emerge early and influence children's interests', Science 355, 389-391

Biddulph, S. (2017) 10 Things Girls Need Most: To grow up strong and free. London: HarperCollins

Black, J. and Turner, M. (2016) 'Why are fewer women than men from top UK universities still not securing graduate level jobs?' Oxford Review of Education 42 (1), 55-70

Boaler, J. and Sengupta-Irving, T. (2006) 'Nature, neglect and nuance: changing accounts of sex, gender and mathematics', in Skelton, C., Francis, B. and Smulyan, L. (2006) Sage Handbook of Gender and Education. London: Sage, 207-220

Bohnet, I. (2016) What Works: Gender equality by design. Cambridge, MA: Belknap Press

Bond, B. (2016) 'Fairy godmothers > robots: the influence of televised gender stereotypes and counter-stereotypes on girls' perceptions of STEM' Bulletin of Science, Technology and Society June

Booth, A. and Nolen, P. (2009) 'Gender differences in risk behaviour: does nurture matter?' Discussion Paper 4026. Bonn: Institute for the Study of Labour

Booth, A., et al (2011) 'Gender differences in risk aversion: do single-sex environments affect their development?' Centre for Economic Policy Research, Discussion Paper 8690, Dec 2011

Borg, E. (2015) 'Classroom behaviour and academic achievement: how classroom behaviour categories relate to gender and academic performance', British Journal of Sociology of Education 36 (8), 1127-1148

Bradley, H. (2007) Gender. Oxford: Polity

Bramley, T., Vidal Rodeiro, C. and & Vitello, S. (2015) 'Gender differences in GCSE', Cambridge Assessment Research Report. Cambridge: Cambridge Assessment

Brandell, G. and Staberg, E-M. (2008) 'Mathematics: a female, male or gender-neutral domain? A study of attitudes among students at secondary level', Gender and Education 20 (5), 495-509

Bryant, M. (1979) The Unexpected Revolution: A study in the history of the education of women and girls in the nineteenth century. London: Institute of Education

Bugler, M, McGeown, S. and St Clair-Thompson, H. (2015) 'Gender differences in adolescents' academic motivation and classroom behaviour', Educational Psychology 35 (5), 541-556

Burgess, S., et al (no date) 'Girls rock, boys roll: an analysis of the age 14-16 gender gap in English schools', University of Bristol, CMPO Working Paper Series 3 (84)

Calabrese Barton, A. and Brickhouse, N. (2006) 'Engaging girls in science', in Skelton, C., Francis, B. and Smulyan, L. (2006) Sage Handbook of Gender and Education. London: Sage, 221-235

Campbell, P. and Sanders, J. (2002) 'Challenging the system: assumptions and data behind the push for single-sex schooling', in Datnow, A. and Hubbard, L. (eds) Gender in Policy and Practice: Perspectives on single-sex and coeducational schooling, Abingdon: Routledge

Carinci, S. and Wong, P. (2009) 'Does gender matter? An exploratory study of perspectives across genders, age and education' International Review of Education 55 (5/6), 523-540

Chadwell, D. (2010) A Gendered Choice: designing and implementing single-sex programs and schools. Thousand Oaks, CA: Corwin

Chambers, G. (2005) 'Teaching modern foreign languages in single-sex classes in a co-educational context – review of a project in a North Yorkshire comprehensive school', Language Learning Journal 32 (Winter), 45-54

Chambers, E. and Schreiber, J. (2004) 'Girls' academic achievement: varying associations of extracurricular activities', Gender and Education 16 (3), 327-346

Cheema, J. and Galluzzo, G. (2013) 'Analysing the gender gap in math achievement: evidence from a large-scale US example', Research in Education 90, 98-112

Chen, L-M and Cheng, Y-Y (2017) 'Perceived severity of cyberbullying behaviour: differences between genders, grades and participant roles', Educational Psychology 37 (5), 599-610

Ciccone, A. and Garcia-Fontes, W. (2014) 'Gender peer effects in school: a birth cohort approach', Centre for Economic policy Research: Discussion Paper 10042

Cone, S. (2001) 'Technically-speaking: girls and computers', in O'Reilly, P. et al (eds) Educating Young, Adolescent Girls, Mahwah, NJ: Lawrence Erlbaum Associates, 171-188

Cornwell, C., Mustard, D., and Van Parys, J. (2012) 'Non-cognitive skills and the gender disparities in test scores and teacher assessments: evidence from primary school', Journal of Human Resources, 48 (1), 236-264

Corry, V. (2017) 'The gender 'gap' in attainment: the Scottish policy perspective', Scottish Educational Review 49 (1), 33-50

Cousins, A. and Mills, M. (2015) 'Gender and high school chemistry: student perceptions on achievement in a selective setting', Cambridge Journal of Education 45 (2), 187-204

Cribb, V. and Haase, A. (2016) 'Girls feeling good at school: school gender environment, internalization and awareness of socio-cultural attitudes associations with self-esteem in adolescent girls', Journal of Adolescence 46, 107-114

Cuddy, A., Fiske, S. and Glick. P. (2008) 'Warmth and competence as universal dimensions of social perception: the stereotype content model and the BIAS map', Advances in Experimental Social Psychology, 40, 61–149

Danielsson, A. and Lundin, M. (2014) 'Gender performativity in physics: affordances or only constraints?' Cultural Studies of Science Education 9 (2), 523-529

Datnow, A. Hubbard, L. (2002) 'Introduction', in Datnow, A. and Hubbard, L. (eds) Gender in Policy and Practice: Perspectives on single-sex and coeducational schooling. Abingdon: Routledge

Davies, P. et al (2002) 'consuming images: how television commercials that elicit stereotype threat can restrain women academically and professionally', Personality and Social Psychology Bulletin 28 (12), 1615-1628

Deak, J. (2002) Girls Will Be Girls: Raising confident and courageous daughters. New York: Hyperion

Department for Education and Skills (2007) Gender and Education: The evidence on pupils in England. London: HMSO

Diprete, T. and Buchmann, C. (2013) The Rise of Women: The growing gender gap in education and what it means for American schools. New York: Russell Sage Foundation

D'Lima, G., Winsler, A. and Kitsantas, A. (2014) 'Ethnic and gender differences in first-year college students' goal-orientation, self-efficacy, and extrinsic and intrinsic motivation', Journal of Educational Research 107, 341-356

Eisenkopf, G. et al (2011) 'Academic performance and single-sex schooling: evidence from a natural experiment in Switzerland', University of Konstanz, Department of Economics Working Paper 35

Eliot, L. (2009) Pink Brain, Blue Brain: How small differences grow into troublesome gaps – and what we can do about it. Oxford: One World

Ellison, G. and Swanson, A. (2010) 'The gender gap in secondary school mathematics at high achievement levels: evidence from the American mathematics competitions', Journal of Economic Perspectives 24 (2), 109-128

Elwood, J. (1999) 'Gender, achievement and the "Gold Standard": differential performance in the GCE A level examination', Curriculum Journal 10 (2), 189-208

Elwood, J. and Gipps, C. (1999) Review of Recent Research on the Achievement of Girls in Single-Sex Schools. London: Institute of Education

England, P. (2010) 'The gender revolution: uneven and stalled', Gender and Society 24, 149-165

Erkut, S. (2001) 'A delicate balance: how teachers can support middle school girls' confidence and competence', in O'Reilly, P. et al (eds) Educating Young, Adolescent Girls. Mahwah, NJ: Lawrence Erlbaum Associates, 83-102

Erchick, D. (2013) 'Developing mathematical voice: women reflecting on the adolescent years', in O'Reilly, P. et al. Educating Young Adolescent Girls, op cit, 149-170

Equate Scotland (2016) Ten Years of Equate Scotland: Rising to the challenge – how Scotland can recruit, retain and support women in STEM. Available at: http://www.equatescotland.org.uk/wp-content/uploads/2016/09/10-Years-of-Equate.pdf

Ezzedeen, S. et al (2015) 'The glass ceiling and executive careers: still an issue for pre-career women', Journal of Career Development 42 (5), 355-369

Fabes, R. et al (2013) 'Gender-segregated schooling and gender stereotyping', Educational Studies 39 (3), 315-319

Fabes, R. et al (2014) 'Peer influences on gender differences in educational aspiration and attainment', in Schoon and Eccles (eds) op cit, 29-52

Farooq, M. et al (2017) 'Timing of the decline in physical activity in childhood and adolescence: Gateshead Millennium Cohort Study', British Journal of Sports Medicine 21 August. Published online at: http://bjsm.bmj.com/content/bjsports/early/2017/02/05/bjsports-2016-096933.full.pdf

Fine, C. (2011) Delusions of Gender, London: Icon Books

Fine, C. (2017) Testosterone Rex: Unmaking the myths of our gendered minds. London: Icon

Flanagan, C. (2012) Girl Land. New York: Reagan Arthur

Francis, B. (2004) 'Classroom interaction and access: whose space is it?' in Claire, H. (ed) Gender in Education 3-19: A fresh approach. London: Association of Teachers and Lecturers, 42-49

Francis, B. and Skelton, C. (2005) Reassessing Gender and Achievement: Questioning contemporary key debates. London: Routledge

Francis, B., Skelton, C. and Read, B. (2012) The identities and Practices of High Achieving Pupils: Negotiating achievement and peer cultures. London: Continuum

Fuller, C. (2011) Sociology, Gender and educational Aspiration: Girls and their ambitions. London: Continuum

Garcia, R. et al (2015) 'Objectification in action: self- and other-objectification in mixed-sex interpersonal interactions', Psychology of Women Quarterly 40 (2), 213-228

Gherasim, L., Butnaru, S. and Mairean, C. (2013) 'classroom environment, achievement goals and maths performance: gender differences', Educational Studies 39 (1), 1-12

Gibb, S. et al (2008) 'Effects of single-sex and coeducational schooling on the gender gap in educational achievement', Australian Journal of Education 52 (3), 301-317

Gibson, V., Jardine-Wright, L. and Bateman, E. (2015) 'An investigation into the impact of question structure on the performance of first year physics undergraduate students at the University of Cambridge', European Journal of Physics 36: http://iopscience.iop.org/article/10.1088/0143-0807/36/4/045014/pdf

Giddens, A. (1984) The Constitution of Society: Outline of a theory of structuration. Cambridge: Polity Press

Gill, J., Esson, K. and Yuen, R. (2016) A Girl's Education: Schooling and the formation of gender, identities and future visions. London: Palgrave Macmillan

Gilligan, C. (1982) In a Different Voice: Women's conceptions of the self and of morality. Cambridge, MA: Harvard University Press

Gilligan, C., Ward, J., Taylor, J. and Bardige, B. (1988) Mapping the moral domain. Cambridge, MA: Harvard University Press

Gilligan, C., Lyons, N. and Hanmer, T. (eds) (1990) Making Connections: The relational worlds of adolescent girls at Emma Willard School. Cambridge, MA: Harvard University Press

Graff, U. (2013) 'Too pretty to do math! Young women in movement and pedagogical challenges', Pedagogy, Culture and Society 21 (1), 57-73

Guest, M. (2014) Analysis and research into Co-education in Australia and the UK: and the experience of those schools that change status. Armidale, NSW: The Armidale School

Gurian, M. (2011) Boys and Girls Learn Differently: A guide for teachers and parents. San Francisco: Jossey-Bass

Hadjar, A. et al (2014) 'Editorial: gender and educational achievement', Educational Research 56 (2), 117-125

Hadjar, A. and Aeschlimann, B. (2014) 'Gender stereotypes and gendered vocational aspirations among Swiss secondary school students', Educational Research 57 (1), 22-42

Halpern, D., et al (2011) 'The pseudoscience of single-sex schooling', Science 333, 1706-1707; but see the subsequent discussion in Science 335, 165-168

Hahn, Y. and Wang, L. C. (2012) 'Comment on causal effects of single-sex schools on college entrance exams and college attendance: random assignment in Seoul high schools': http://ssrn.com/abstract=2194336

Harris, A. (2004) Future Girl: Young women in the twenty-first century. New York: Routledge

Harskamp, E., Ding, N. and Suhre, C. (2008) 'Group composition and its effect on female and male problem-solving in science education', Educational Research 50 (4), 307-318

Hattie, J. (2009) Visible Learning: A synthesis of over 800 meta-analyses relating to achievement. Abingdon: Routledge

Heim (1970) Intelligence and Personality. Harmondsworth: Penguin

Howe, C. (1997) Gender and Classroom Interaction: A research review. Edinburgh: Scottish Council for Research in Education

Hoxby, C. (2000) 'Peer effects in the classroom: learning from gender and race variation', National Bureau of Economic Research Working Paper 7867

Humlum, M. and Smith, N. (2015) 'Long-term effects of school size on students' outcomes', Economics of Education Review 45, 28-43

Hyde, J. (2005) 'The gender similarities hypothesis', American Psychologist 60 (6), 581-592

Institute of Leadership and Management (2011) Ambition and Gender at Work. London: ILM

Institute of Physics (2012) It's Different for Girls: the influence of schools. London: Institute of Physics

Institute of Physics (2013) Closing Doors: Exploring gender and subject choice in schools. London: IoP

Institute of Physics (2015) Opening Doors: A guide to good practice in countering gender stereotyping in schools. London: Institute of Physics

Ivinson, G. and Murphy, P (2007) Rethinking Single-Sex Teaching. Maidenhead: Open University Press

Jackson, C., Dempster, S. and Pollard, L. (2015) '"They just don't seem to really care, they just think it's cool to sit there and talk": laddism in university teaching-learning contexts', Educational Review 67 (3), 300-314

Jago, R. et al (2017) 'Change in children's physical activity and sedentary time between Year 1 and Year 4 of primary school', International Journal of Behavioral Nutrition and Physical Activity 14 (33)

Janis-Norton, N. (2015) Calmer, Easier, Happier Boys. London: Yellow Kite Books

Jackson, C., Paechter, C. and Renold, E. (eds) (2010) Girls and Education 3-16: Continuing concerns, new agendas. Maidenhead: Open University Press

Jackson, C. and Nystrom, A-S. (2015) 'Smart students get perfect scores without studying much: why is an effortless achiever identity attractive, and for whom is it possible?' Research Papers in Education 30 (4), 393-410

James, A. (2009) Teaching the Female Brain. Thousand Oaks, CA: Corwin

Jones, S. and Myhill, D. (2004) 'Troublesome boys and compliant girls: gender identity and perceptions of achievement and underachievement ', British Journal of Sociology of Education 25 (5), 547-561

Jordan-Young, R. (2010) Brain Storm: The flaws in the science of sex differences. Cambridge: Harvard University Press

Jurik, V., Groschner, A. and Seidel, T. (2013) 'How student characteristics affect girls' and boys' verbal engagements in physics instruction', Learning and Instruction 23, 33-42

Kane, J. and Mertz, J. (2012) 'Debunking myths about gender and mathematics performance', Notices of the American Mathematical Society 59 (1), 10-21

Kelly, A. (1988) 'Gender differences in teacher-pupil interactions: a meta-analytical review', Research in Education 39, 1-24

Kenway, J. and Willis, S. (1986) 'Countering sexism the single-sex way: a flawed proposition', in Porter, P. (ed) Gender and Education. Victoria: Deakin University, EED 423, 116-138

Kerger, S., Martin, R. and Brunner, M. (2011) 'How can we enhance girls' interest in scientific topics?' British Journal of Educational Psychology 81(4), 606-628

Korhonen, J., Aunio, P., and Linnanmaki, K. (2016) 'Gendered pathways to educational aspirations: the role of academic self-concept, school burnout, achievement and interest in mathematics and reading', Learning and Instruction 46, 21-33

Lahelma, E. (2014) 'Troubling discourses on gender and education', Educational Research 56 (2), 171-183

Lang, S. (2010) A Gender Perspective on Educational Facilities. OECD Centre for Effective Learning Environments

Lavy, V. and Schlosser, A. (2011) 'Mechanisms and impacts of gender peer effects at school', American Economic Journal: Applied Economics 3, 1-33

Lee, V. and Marks, H. (1990) 'Sustained effects of the single-sex secondary school experience on attitudes, behaviors and values in college', Journal of Educational Psychology 82 (3). 578-592

Lee, V. and Marks, H. (1992) 'Who goes where? Choice of single-sex and coeducational independent secondary schools', Sociology of Education 65 (3), 226-253

Lee, V., Marks, H. and Byrd, T. (1994) 'Sexism in single-sex and coeducational independent secondary school classrooms', Sociology of Education 67 (2), 92-120

Leman, P. (1999) 'The role of subject area, gender, ethnicity and school background in the degree results of Cambridge University undergraduates', Curriculum Journal 10 (2), 231-252

Lenroot, R., et al (2007) 'Sexual dimorphism of brain developmental trajectories during childhood and adolescence', NeuroImage 36, 1065-1073

Leonard, D. (2006) 'Single-sex schooling', in Skelton, C., Francis, B. and Smulyan, L. (2006) Sage Handbook of Gender and Education. London: Sage, 190-204

Link, S. (2012) 'Single-sex schooling and student performance: quasi-experimental evidence from South Korea', Leibniz Institute for Economic Research Ifo Working Paper 146

Logan, K. (2007) 'Should computing be taught in single-sex environments? An analysis of the computing learning environment of upper secondary students', Educational Studies 33 (2), 233-248

Logan, S. and Johnston, R. (2010) 'Investigating gender differences in reading', Educational Review 62 (2), 175-187

Logan, S. and Medford, E. (2011) 'Gender differences in the strength of association between motivation, competency beliefs and reading skill', Educational Research 53 (1), 85-94

Lusher, L. and Yazenov, V. (2016) 'Gender performance gaps: quasi-experimental evidence on the role of gender differences in sleep cycles' Discussion Paper 10012. Bonn: Institute for the Study of Labour

Lynch, K. and Feeley, M. (2009) Gender and Education (and employment): Gendered imperatives and their implications for women and men: lessons from research for policy makers, NESSE Network of Experts, 2009-07.

Machin, S. and McNally, S. (2005) Gender and Student Achievement in English Schools. London: LSE Centre for the Economics of Education

Malacova, E. (2007) 'Effect of single-sex education on progress in GCSE', Oxford Review of Education 33 (2), 233-259

Marks, G. (2008) 'Accounting for the gender gaps in student performance in reading and mathematics: evidence from 31 countries', Oxford Review of Education 34 (1), 89-109

Martin, B. (2010) 'You've got to have the pink one because you're a girl!: exploring young girls' understanding of femininities and masculinities in preschool', in Jackson, C. et al, Girls and education 3-16, op cit, 129-141

Mascret, N. and Cury, F. (2015) 'I'm not scientifically gifted, I'm a girl: implicit measures of gender-science stereotypes – preliminary evidence', Educational Studies 41 (4), 262-465

Mateju, P. and Smith, M. (2015) 'Are boys that bad? Gender gaps in measured skills, grades and aspirations in Czech elementary schools', British Journal of Sociology of Education 36 (6), 871-895

Maxwell, C. and Aggleton, P. (2013) 'Becoming accomplished: concerted cultivation among privately educated young women', Pedagogy, Culture and Society 21 (1), 75-93

McClune, B. (2001) 'Modular A levels – who are the winners and losers? A comparison of Lower Sixth and Upper Sixth students' performances in linear and modular A level physics examinations', Educational Research 43 (1), 78-89

Mechtenberg, L. (2009) 'Cheap talk in the classroom: how biased grading at school explains gender differences in achievements, career choices and wages', Review of Economic Studies 76, 1431-1459

Meehan, D. (2007) Learning Like a Girl: educating our daughters in schools of their own. New York: PublicAffairs

Mellanby, J. and Theobald, K. (2014) Education and Learning: An evidence-based approach. Chichester: Wiley-Blackwell

Mohr, T. (2014) Playing Big: Find your voice, your vision and make things happen. London: Hutchinson

Mujtaba, T. and Reiss, M. (2016) 'Girls in the UK have similar reasons to boys for intending to study maths post-16 thanks to the support and encouragement they receive', London Review of Education 14 (2), 66-82

Murphy, P. and Whitelegg, E. (2006) Girls in the Physics Classroom: A review of the research into the participation of girls in physics. London: Institute of Physics

Myhill, D. (2002) 'Bad boys and good girls: patterns of interaction and response in whole class teaching', British Educational Research Journal 28, 340-352

Northern Ireland Assembly (2001) 'Selected current research in gender and educational attainment', Research and Library Services, Research Paper 06/01

OECD (2015) The ABC of Gender Equality in Education: Aptitude, behaviour, confidence. Paris: OECD

Ofsted (2011a) Meeting Technological Challenges? Design and technology in schools 2007-10. Manchester: Office for Standards in Education, Children's Services and Skills

Ofsted (2011b) Girls' Career Aspirations. Manchester: Office for Standards in Education, Children's Services and Skills

O'Reilly, P. (2013) 'Learning to be a girl', in O'Reilly, P., et al. Educating Young Adolescent Girls, op cit., 11-27

O'Reilly, P., Penn, E. and deMarrais, K. (eds) (2013) Educating Young Adolescent Girls. New York: Routledge

Orenstein, P. (2011) Cinderella Ate My Daughter: Dispatches from the front lines of the new girlie-girl culture. New York: HarperCollins

O'Toole, E. (2015) Girls Will Be Girls: Dressing up, playing parts and daring to act differently. London: Orion

Paechter, C. (2000) Changing School Subjects: Power, gender and curriculum. Buckingham: Open University Press

Paechter, C. (2007) Being Boys, Being Girls: Learning masculinities and femininities. Maidenhead: Open University press

Paechter, C. (2013) 'Young women online: collaboratively constructing identities', Pedagogy, Culture and Society 21 (1), 111-127

Pahlke, E., Shibley Hyde, J. and Allison, C. (2014) 'The effects of single-sex compared with coeducational schooling on students' performance and attitudes: a meta-analysis, Psychological Bulletin, 140 (4), 1042-1072

Palmer, S. (2013) 21st Century Girls. London: Orion

Park, H., Behrman, J. and Choi, J.(2012) 'Causal effects of single-sex schools on college entrance exams and college attendance: random assignment in Seoul high schools', PSC Working Paper Series 10-01. Philadelphia: University of Pennsylvania Population Studies Center

Parker, L . and Rennie, L. (2002) 'Teachers' implementation of gender-inclusive instructional strategies in single-sex and mixed-sex classrooms', International Journal of Science Education 24 (9), 881-897

Perez-Felkner, L., Nix, S. and Thomas, K. (2017) 'Gendered pathways: how mathematics ability beliefs shape secondary and postsecondary course and degree field choices', Frontiers in Psychology 8, 386. Published online at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5382838/pdf/fpsyg-08-00386.pdf

Phoenix, A. (2004) 'Gender in education 3-19: a fresh approach', in Claire, H. (ed) Gender in Education 3-19: A fresh approach. London: Association of Teachers and Lecturers, 33-41

Pinker, S. (2002) The Blank Slate. London: Allen Lane

Plieninger, H. and Dickhauser, D. (2015) 'The female fish is more responsive: gender moderates the BFLP effect in the domain of science', Educational Psychology 35 (2), 213-227

Purvis, J. (1991) A History of Women's Education in England. Buckingham: Open University Press

Raby, R. and Pomerantz, S. (2015) 'Playing it down/playing it up: girls' strategic negotiations of academic success', British Journal of Sociology of Education 36 (4), 507-525

Richards, G., and Posnett, C. (2012) 'Aspiring girls: great expectations or impossible dreams?' Educational Studies 38 (3), 249-259

Riegle-Crumb, C., King, B., Grodsky, E. and Muller, C. (2012) 'The more things change, the more they stay the same: prior achievement fails to explain gender inequality in entry into STEM college majors over time', American Educational Research Journal 49 (6), 1048-1073

Riordan, C. (2002) 'What do we know about the effects of single-sex schools in the private sector? Implications for public schools', in Datnow, A. and Hubbard, L. (eds) Gender in Policy and Practice: Perspectives on single-sex and coeducational schooling. Abingdon: Routledge

Saavedra, L. et al (2014) 'Dilemmas of girls and women in engineering: a study in Portugal', Educational Review 66 (3), 330-344

Sadker, M. and Sadker, D. (1990) 'Confronting sexism in the college classroom', in Gabriel, S. and Smithson, I. (eds) Gender in the Classroom: Power and pedagogy. Urbana: University of Illinois Press, 176-187

Sales, N. (2016) American Girls: Social media and the secret lives of teenagers. New York: Vintage

Samuelsson, M. and Samuelsson, J. (2016) 'Gender differences in boys' and girls' perceptions of teaching and learning mathematics', Open Review of Educational Research 3 (1), 18-34

Sax, L. (2005) Why Gender Matters. New York: Basic Books

Sax, L. (2006) 'Six degrees of separation: what teachers need to know about the emerging science of sex differences,' Educational Horizons Spring, 190-200

Sax, L. (2010) Girls On the Edge: The four factors driving the new crisis for girls. New York: Basic Books

Scholes, L. (2015) 'Clandestine readers: boys and girls going "undercover" in school spaces', British Journal of Sociology of Education 36 (3), 395-374

Schoon, I. and Eccles, J. (eds) (2014) Gender Differences in Aspirations and Attainment: A life course perspective. Cambridge: Cambridge University press

Simmons, R. (2009) The Curse of the Good Girl: Raising authentic girls with courage and confidence. New York: Penguin

Skelton, C. and Francis, B. (eds) (2003) Boys and Girls in the Primary Classroom. Maidenhead: Open University Press

Skelton, C., et al (2006) 'Gender "matters" in the primary classroom: pupils' and teachers' perspectives', British Educational Research Journal 35 (2), 187-204

Skelton, C. (2010) 'Gender and achievement: are girls the 'success stories' of restructured education systems?' Educational Review 62 (2), 131-142

Skelton, C., Francis, B. and Read, B. (2010) 'Brains before beauty'? High achieving girls, school and gender identities', Educational Studies 36 (2), 185-194

Smith, S. (1984) 'Single-sex setting', in Deem, R. (ed) Co-Education Reconsidered. Milton Keynes: OUP Press, 75-88

Smyth, E. (2010) 'Single-sex education: what does the research tell us?' Revue Francaise de Pedagogie 171 (avril-juin), 47-55

Spencer, S. (2000) 'Advice and ambition in a girls' public day school: the case of Sutton High School, 1884-1924', Women's History Review 9 (1), 75-94

Sternberg, R. (1999) Thinking Styles. Cambridge: Cambridge University Press

Sullivan, A. (2009) 'Academic self-concept, gender and single-sex schooling', British Educational Research Journal 35 (2), 259-288

Sullivan, A., Joshi, H. and Leonard, D. (2010) 'Single-sex schooling and academic attainment at school and through the lifecourse', American Education Research Journal 47(1), 6-36

Sullivan, A., Joshi, H. and Leonard, D. (2011) 'Single-sex schooling and labour market outcomes', Oxford Review of Education 37 (3), 311-332

Sullivan, A., Leonard, D. and Joshi, H. (2012) 'Single-sex and co-educational schooling: what are the social and family outcomes?' Longitudinal and Life Course Studies 3 (1), 137-157

Sullivan, A. and Joshi, H. (2014) 'The life course consequences of single-sex and co-educational schooling', in Schoon and Eccles (eds) op cit, 365-388

University of Cambridge (2015) 2013/14 Equality & Diversity Information Report. Cambridge

Upadyaya, K. and Eccles, J. (2014) 'Gender differences in teachers' perceptions and children's ability self-concepts', in Schoon and Eccles (eds) op cit, 79-100

US Department of Education (2005) Single-sex versus coeducational schooling: a systematic review. Washington, DC: American Institute for Research, Policy and Program Study Service

Van De Gaer, E., Pustjens, H., Van Damme, J. and De Munter, A. (2007) 'Impact of attitudes of peers on language achievement: gender differences', Journal of Educational Research 101 (2), 78-90

Vidal Rodeiro, C. and Nadas, R. (2010) Effects of Modularisation. Cambridge: Cambridge Assessment

Villalon, R., Mateos, M. and Cuevas, I. (2015) 'High school boys' and girls' writing conceptions and writing self-efficacy beliefs: what is their role in writing performance?' Educational Psychology 35 (6), 653-674

Warrington, M. and Younger, M. (2001) 'Single-sex classes and equal opportunities for girls and boys: perspectives through time from a mixed comprehensive school in England', Oxford Review of Education 27 (3), 339-356

Warrington, M. and Younger, M. (2003) '"We decided to give it a twirl": single-sex teaching in English comprehensive schools', Gender and Education 15 (4), 339-350

Watermeyer, R. (2012) 'Confirming the legitimacy of female participation in science, technology, engineering and maths (STEM): evaluation of a UK STEM initiative for girls,' British Journal of the Sociology of Education 35 (5), 679-700

Watson, S. (1997) 'Single-sex education for girls: heterosexuality, gendered subjectivity and school choice', British Journal of Sociology of Education 18 (3), 371-283

Watts, R. (2014) 'Females in science: a contradictory concept?' Educational Research 56 (2), 126-136

Whyte, J. et al (1985) Girl Friendly Schooling. London: Methuen

Wolpert, L. (2014) Why Can't a Woman Be More Like a Man? The evolution of sex and gender. London: Faber and Faber

Women's Sport and Fitness Foundation (2012) Changing the Game for Girls. London: WSFF

Wrigley, J. (1992) Education and Gender Equality. London: The Falmer Press

Yates, L. (1993) 'The education of girls: policy, research and the question of gender', Australian Education Review 35

Younger, M. and Warrington, M. (2002) 'Single-sex teaching in a co-educational comprehensive school in England: an evaluation based upon students' performance and classroom interactions', British Educational Research Journal 28 (3), 353-373

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