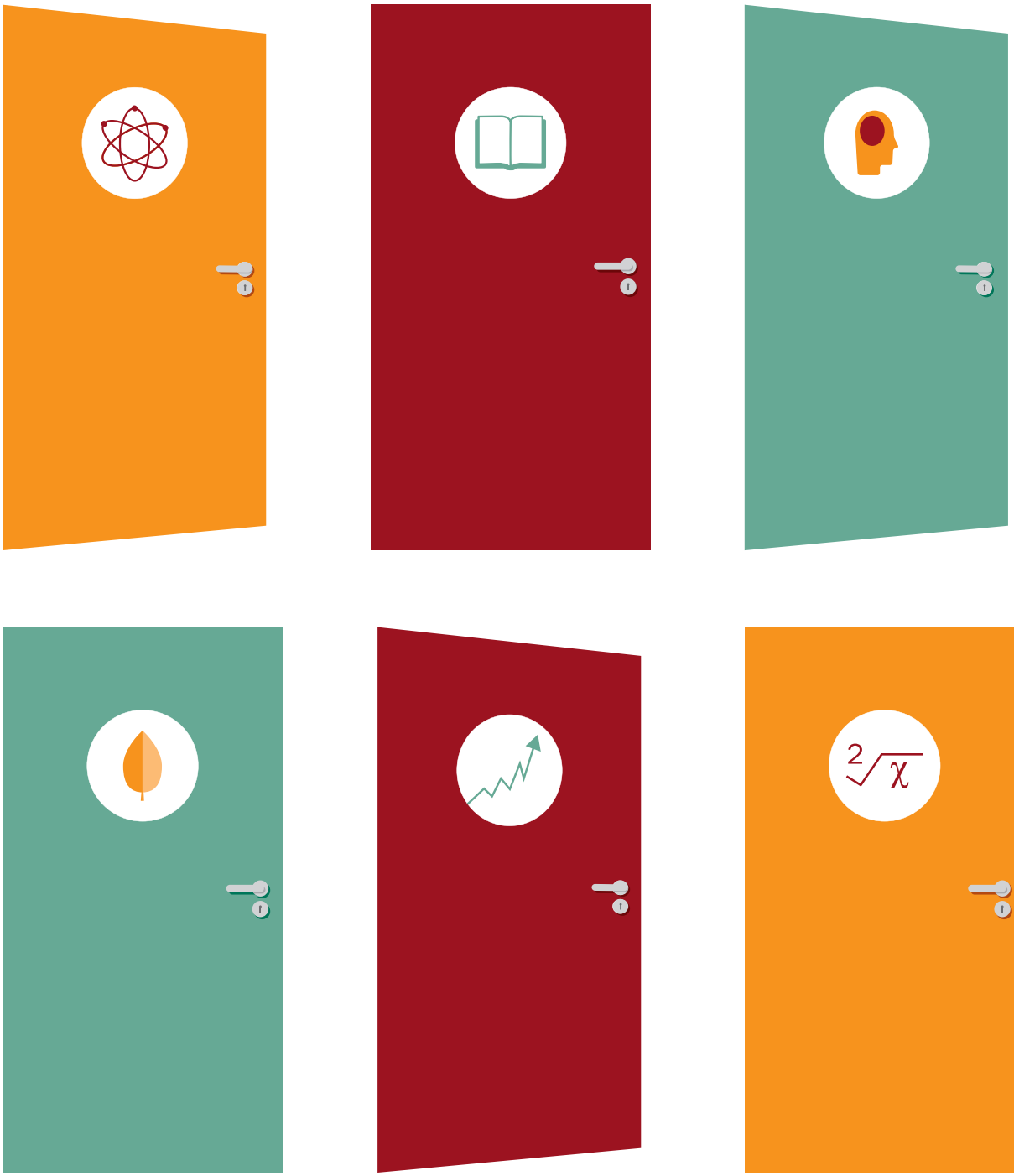
An Institute of Physics Report | **December 2013**

Closing Doors

Exploring gender and subject choice in schools



IOP Institute of Physics

The Institute of Physics is a leading scientific society. We are a charitable organisation with a worldwide membership of more than 50,000, working together to advance physics education, research and application. We engage with policymakers and the general public to develop awareness and understanding of the value of physics and, through IOP Publishing, we are world leaders in professional scientific communications.

Acknowledgements
The Institute would like to thank all those who have contributed to the development of this report, and particularly Frances Ling for her data analysis skills

Foreword

In 2012 the Institute published *It's Different for Girls*, which used the National Pupil Database to explore progression to A-level physics for both boys and girls from different types of school. The headline from the report, which has been widely quoted during the last year, was that, in 2011, 49% of state-funded, co-educational schools sent no girls on to take A-level physics.

My predecessor as president promised that the Institute would look further at the issues raised and seek to address them. Physics is not the only subject that has a substantial difference in participation according to gender and we have explored whether there are common patterns with other gendered subjects. In this report we look at six such subjects, three with a male bias and three with a female bias. For each co-educational school in England we look at how the school compares in terms of its gender progression relative to the national figures. In general, we find a woeful picture, with the majority of schools failing to counter whatever external factors drive school children to make such gendered choices.

As the Institute of Physics, we are naturally most concerned with the participation of girls in physics and we find a strong correlation between the relative progression of girls to A-level physics and the degree to which a school counters the trend towards gendered participation. Our schools are closing doors to both male and female students by apparently failing to challenge external factors that are causing many students to limit their choice of A-levels.

Frances Saunders
President, Institute of Physics

Contents

Main points

1. The gender balance in progression to A-level physics in co-educational state-funded schools correlates strongly with the gender balance in progression to all six A-level subjects investigated for this report. It follows that whatever factors limit the progression of girls to A-level physics in a school are likely to depend on the whole school environment.

2. More than four out of five state-funded co-educational schools, on average, do no better than national gender ratios, which are themselves very imbalanced. Almost half the schools (49%) have imbalances greater than the national figures.

3. Schools with sixth forms have smaller gender imbalances in progression to these six A-level subjects than those without a sixth form, with 46% of schools with a sixth form doing worse than the national ratios, compared with 55% of schools without a sixth form.

4. An implicit finding is that single-sex schools are significantly better than co-educational schools at countering the gender imbalances in progression to these six subjects. *It's Different for Girls* (October 2012) showed this effect clearly in relation to physics and the other sciences.

5. The co-educational independent sector, although small, performs better than the state-funded sector, with 33% of schools having better than average gender imbalances in progression to these six A-level subjects, compared with only 19% of state-funded schools.

6. There are significant differences between regions and between local authorities. Further work is required to understand these differences.

7. There appears to be no strong correlation between gender imbalance in progression to A-levels and the percentage of students on free school meals, or the school's size as measured by the number of pupils at the end of Key Stage 4.

8. Despite the general picture painted by this report, a small number of schools do show that it is possible to counteract gender imbalances in progression to A-levels and that schools that actively address the issues can reduce the impact of gender stereotyping.

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Recommendations

1. School accountability measures should include an indicator of gender imbalance in progression to A-level and other post-16 qualifications. Ofsted should require schools to monitor and counter gender imbalance in progression, participation and achievement.

2. Schools should reflect on their own statistics and put in place whole-school measures to counter gender stereotyping.

3. School governors should ask to see an analysis of gender-based progression ratios in subjects compared with the national ratios and ensure that the school is addressing any significant imbalances.

4. Parents should ask schools about the gender imbalances in progression to major subjects at A-level and other post-16 qualifications.

5. Curriculum developers in gendered subjects should reflect on the curriculum content and the types of assessment to ensure meaningful access for all.

6. Careers advisors should be aware of school statistics on gender imbalance and the consequences of gendered choices for students.

7. Primary schools should reflect on the gender messages they may be giving to pupils, which may unwittingly reinforce gender stereotypes, and work to remove them.

8. Organisations interested in gender equity, including the Institute, should work in partnership to produce materials to help schools combat gender stereotyping and the restriction of choices that this produces.

9. Further research is required to understand the origin of the differences between regions and between local authorities.

Introduction

The purpose of this statistical study was to ascertain whether there are any patterns of bias in subject choices and whether schools tend to conform to traditional perceptions of some subjects being "girls" subjects and others "boys" subjects. One of the questions we wanted to answer is whether schools that send relatively more girls on to A-level physics also have a smaller gender imbalance in other subjects (both for boys and girls), perhaps reflecting the school culture.

From our previous report we know that the percentages of girls and boys progressing to A-level physics vary significantly by type of school (**figure 1**). Looking at all state-funded schools, we found that, in 2011, single sex schools sent on proportionately 2.4 times as many girls to study A-level physics than did co-educational schools. This report looks more closely at the data for co-educational schools in England to try to understand whether similar patterns apply across a range of subjects.

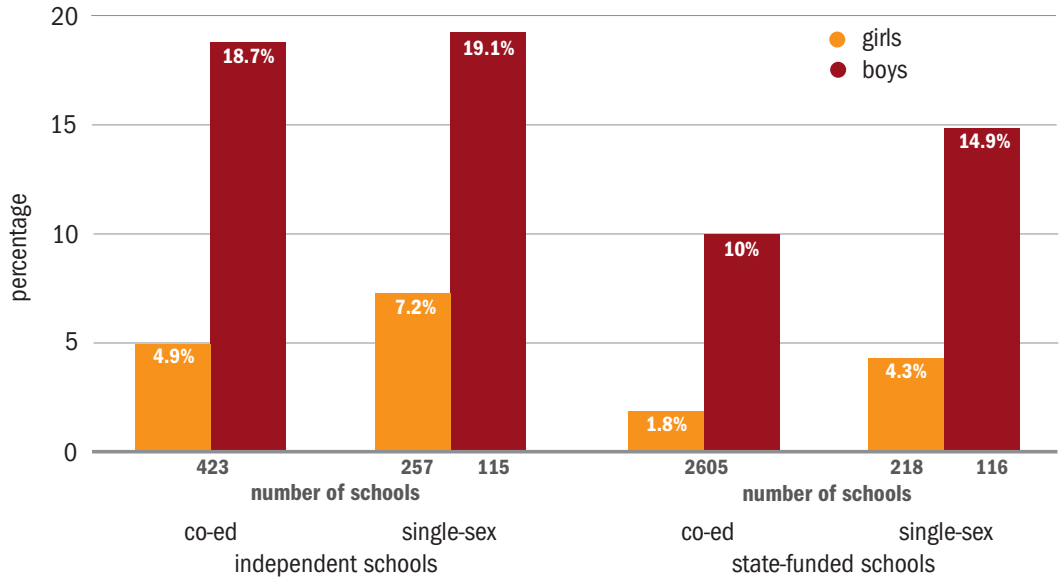
This is a report on statistical patterns and the comparative language refers to the data rather than the behaviour of schools.

We have chosen to look at progression to six A-level subjects, all of which are taken by relatively large numbers of students and have an entry with a significant gender imbalance.

The six chosen subjects form comparable pairs:

- English and mathematics – both core subjects at GCSE;
- biology and physics – two of the sciences;
- psychology and economics – A-level subjects not normally taught in earlier years.

Figure 1: Percentages of girls and boys who went on to take A-level physics in 2011 by type of school (*It's Different for Girls*, IOP October 2012)



Gender imbalance

In each pair there is a "girls" subject and "boys" subject, as identified by the current gender imbalance in national entries to A-level. **Figure 2** shows that English, biology and psychology have a balance towards "girls" and physics, mathematics and economics towards "boys".

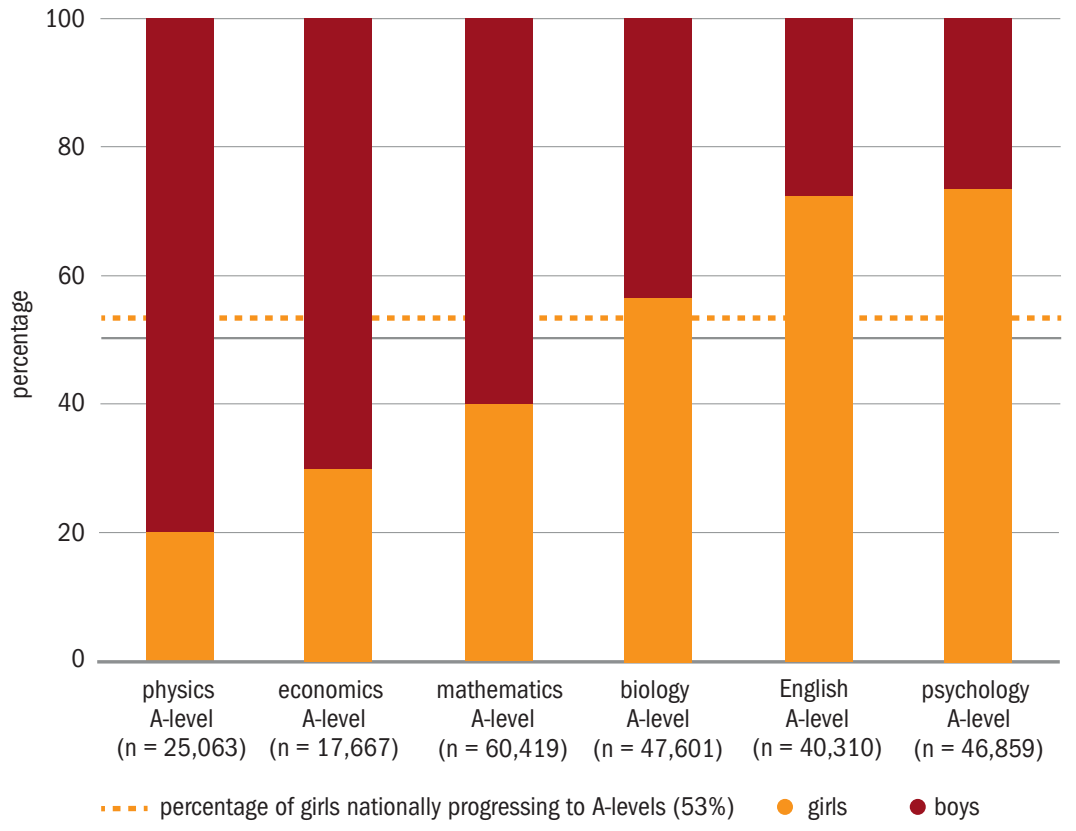
It is likely that the gender imbalance has different origins in different subjects. For example, boys choose the three sciences (biology, chemistry, physics) in roughly equal proportions, whereas far more girls choose biology than physics. Therefore, for biology, the imbalance is likely due to an excess of the majority gender (girls) but in physics it is due to a shortage of the minority gender (also girls, in this case).

While students should always be able to choose subjects freely, we are concerned that many students may be influenced by the stereotypical reputation of the subject. And in those cases, the reputation – along with the fact that it might not be appropriately addressed – means that students are being denied opportunities that they might otherwise have taken.

Methodology

- The National Pupil Database was used to look at the gender breakdown of progression from GCSE to A-level in the six subjects.
- The data for individual students were linked back to the school where they received their Key Stage 4 education, because it is assumed that the A-level subject choices made by students were mediated by the culture and expectations of that school.
- We used data from all co-educational schools in England, taking a three-year average of progression, between 2010 and 2012.
- The analysis omitted schools with fewer than 10 students in total progressing to year 13.
- In general, for progression to A-levels, the male to female ratio for schools is not equal to the national ratio for progression to

Figure 2: National ratios of male and female entries to the six selected A-level subjects averaged over the years 2010 to 2012 in England (JCQ)



A-levels. To remove any effects due to this difference, we made a correction for each school according to their actual ratio.

- For each subject, the national ratio we used for comparison is illustrated in **figure 2**. These numbers are also based on three-year averages.

For each subject in each school the gender progression ratio was compared with the national ratio. Each subject was then allocated a gender progression index based on whether the school's progression rates were countering the existing imbalance in that subject or reinforcing it. The subject index is +1 if the school's ratio is closer to parity than the national ratio (countering the imbalance) and −1 if their ratio is more extreme than the national ratio (reinforcing the imbalance). For example, if a school has 25% girls in the number progressing to A-level physics, then they would have an index of +1 for physics, and if they had only 15% girls, then they would have an index of −1.

These indices were then combined across all six subjects to provide a net "gender progression" (GP) score for the school, as a measure of how many subjects (from the six) were above or below the national ratio. To take account of instances where there was not progression to all six subjects, an adjusted score was calculated. Schools with students progressing to fewer than four of the six subjects were omitted.

The GP score for a school, therefore, can vary from −6, where the relative proportions of girls or boys progressing to all six subjects are more extreme than the national ratio, to +6, where the relative proportions of girls or boys progressing are less extreme than the national ratio in all six subjects. Note that we are comparing schools against already dismal gender imbalances in most of these subjects. In the long-term, we hope that these subjects will lose their reputation as being more suitable for one gender than the other, and that something closer to gender parity for entries to these subjects will be achieved.

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Findings

Q. Do schools differ significantly in gender progression to the six A-level subjects?

Figure 3 shows the breakdown of the GP score for all schools in the survey. Note that the few schools that have an odd GP score are those where there was not progression to all six subjects.

For the purpose of this report, we have put the gender progression scores into three bands:

- **GP score of ≤ −2:** these schools (red) have at least twice as many subjects with −1 as with +1, and are considered to be increasing the gender imbalance;
- **GP score of −1 to +1:** these schools (orange) are, on average, sustaining the national gender imbalance; that is, they have as many subject indices with +1 as with −1;
- **GP score of ≥ 2:** these schools (green) are countering the national ratios.

Figure 4 and subsequent figures show the same data in a different form to ease comparison, but retaining the same colour coding. Some figures may have percentages that do not add up to 100, due to rounding to whole numbers.

Figure 3: The frequency of the gender progression score for state-funded co-educational schools averaged over the three years 2010 to 2012 ($n = 2465$)

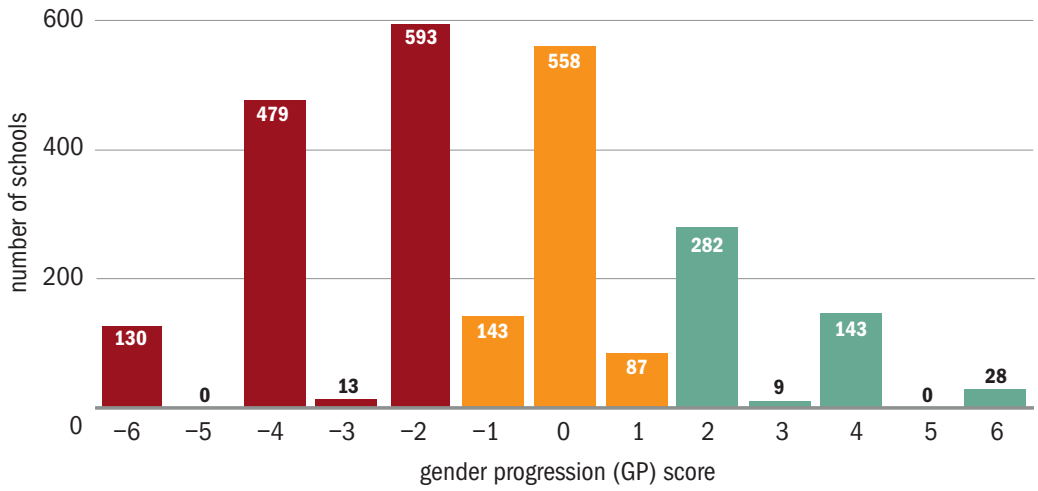
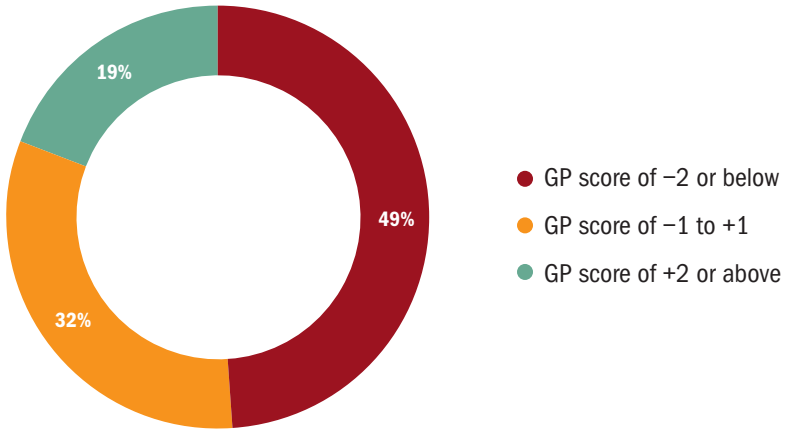


Figure 4: The percentages of state-funded co-educational schools with gender progression scores of −2 and below, −1 to +1, and +2 and above ($n = 2465$)



A. Only 19% of state-funded co-educational schools have a net gender progression score of +2 or greater, which would indicate that they are, on average, doing better than the national ratios for these subjects. Almost half of the schools have a greater imbalance than the national figures, and more than four out of five schools (81%) are reinforcing the gender imbalances by sustaining the national ratios or making them worse.

We have only explicitly looked at co-educational schools in this analysis, although the national ratios for overall progression to A-levels includes single-sex schools. The observation that so many co-educational schools can be at or below average indicates that the single-sex schools are *less* likely to exacerbate gender imbalances.

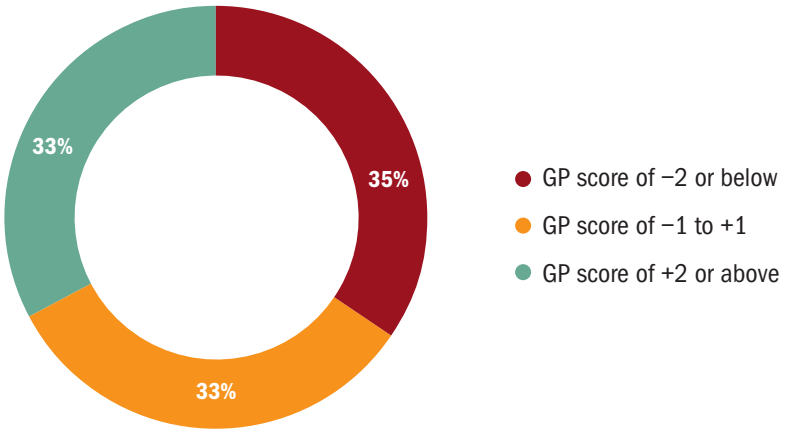
However, the fact that 171 schools (7%) are achieving gender progression scores of +4 and above shows that schools can make and are making a positive difference.

Q. Are there differences between state-funded and independent schools?

A. Independent schools are more likely than state-funded schools to counter gender imbalance, with 33% of them having a gender progression score of +2 or above, compared with only 19% of state-funded schools.

Although the number of co-educational independent schools is small, **figure 5** suggests that some schools are able to provide a better balance in the gender progression ratios in the subjects in this study. There are no obvious reasons why independent schools should be better than state-funded schools in this area.

Figure 5: The percentages of independent co-educational schools with gender progression scores of −2 and below, −1 to +1, and +2 and above ($n = 343$)



Q. Is there a difference between schools with and without a sixth form?

A. **Figures 6** and **7** show that state-funded schools with sixth forms are more likely to counter gender imbalance than those without a sixth form. 46% of schools with a sixth form have a gender progression score of –2 or below, compared with 55% of schools without a sixth form. This means that students are far less likely to progress to subjects outside the normal stereotypical choices if they are in a school without a sixth form.

Figure 6: The percentages of state-funded co-educational schools with sixth forms with gender progression scores of –2 and below, –1 to +1, and +2 and above (*n* = 1558)

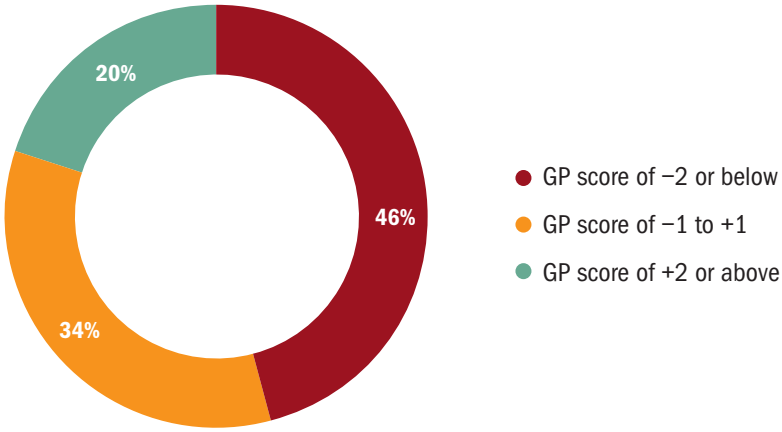
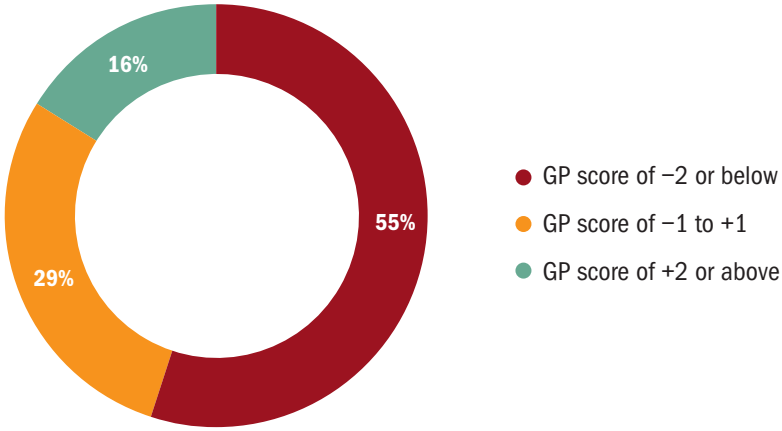


Figure 7: The percentages of state-funded co-educational schools without sixth forms with gender progression scores of –2 and below, –1 to +1, and +2 and above (*n* = 861)



Q. Are there any regional differences or differences between local authorities?

A. **Figure 8** shows that there are large regional differences, with schools in London and the East Midlands region doing best and schools in the South West region doing worst in terms of countering gender imbalance, with 27% of state-funded co-educational schools in London having a gender progression score of +2 and above, compared with only 14% of similar schools in the South West.

When we look at the breakdown of mean gender score per school by local authority (**figure 9**), we can see that there is huge variation. In some local authorities, the mean GP score has gender imbalance being increased in five of the six subjects. It is not clear why these differences exist, and more work needs to be done to understand better the reasons for such variation.

Figure 8: Breakdown of gender progression scores for co-educational state-funded schools by region

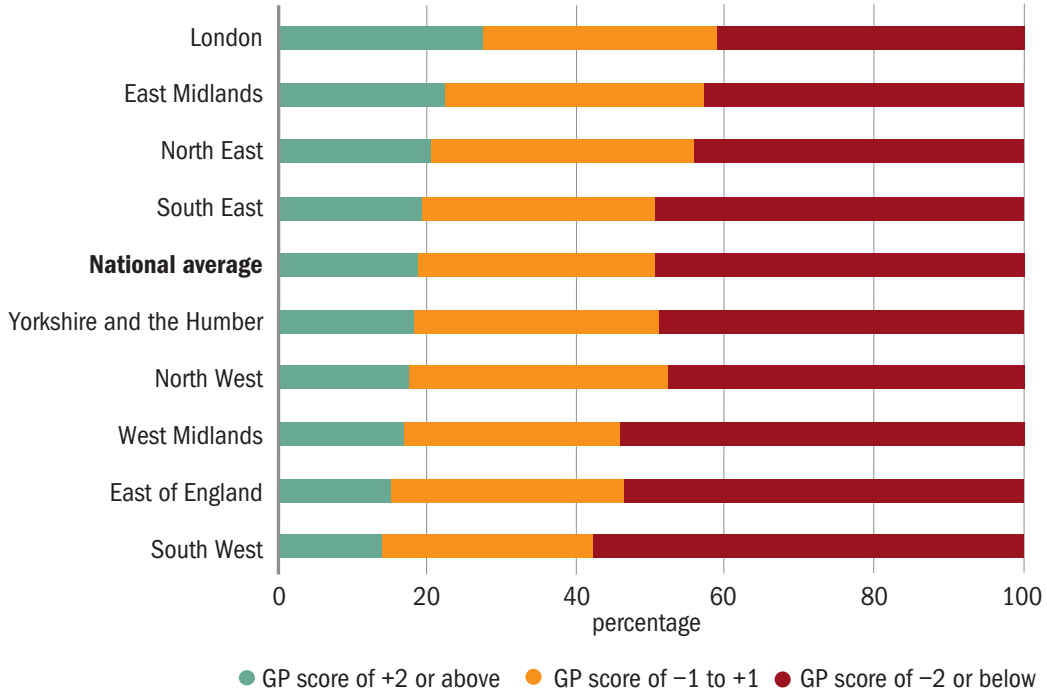
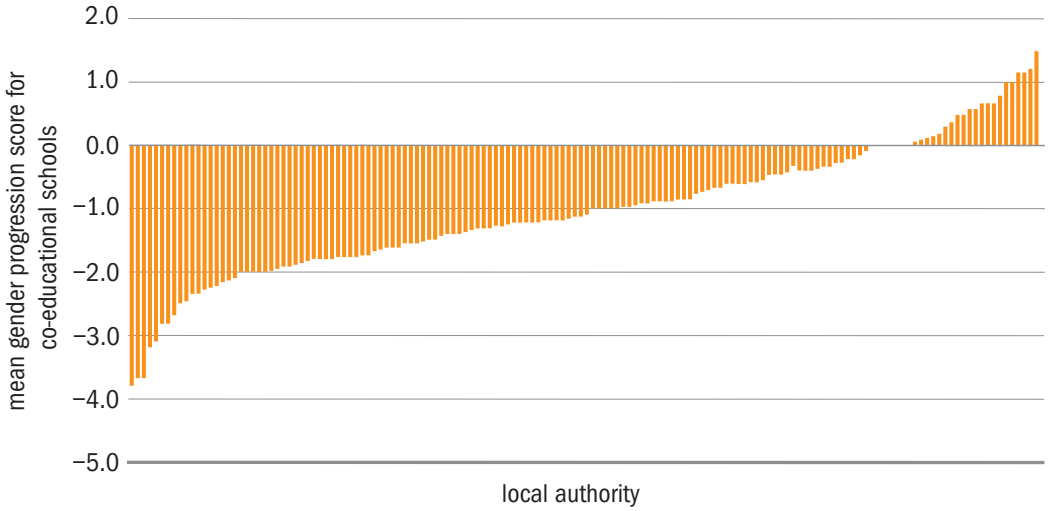


Figure 9: The distribution of mean gender progression score for co-educational schools by local authority in England (*n* = 150)



Q. What gender progression score would a school have to achieve for girls' progression to physics to reach the national average?

A. **Figure 10** shows the correlation between the percentage of girls progressing to A-level physics as a function of the GP score. Schools need to have a gender progression score of at least +2 even for them to reach the national ratio of 20.2% girls progressing to A-level physics, compared with a score of +1 to reach the national ratio for boys progressing to A-level English, as seen in **figure 11**.

These data suggest that improvement in the progression of girls to A-level physics is linked to progression to other gendered subjects; it follows that any attempt to increase the number of girls taking A-level physics will require changes not only to physics classes but also to whole-school culture.

Figure 10: The median percentage of girls progressing to A-level physics against gender progression score for state-funded co-educational schools

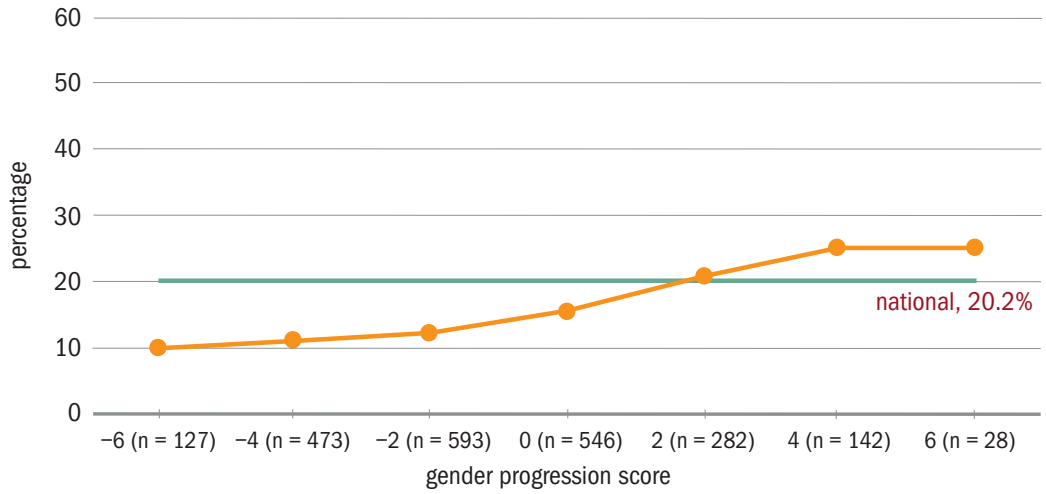
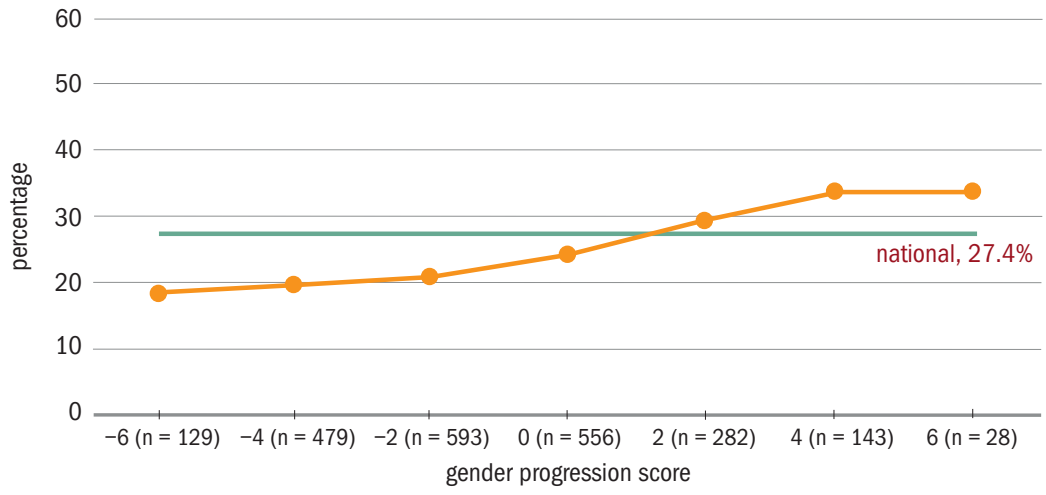


Figure 11: The median percentage of boys progressing to A-level English against gender progression score for state-funded co-educational schools



Q. Does the socio-economic background of the school have an impact on the gender progression ratio?

A. Figure 12 shows that the relative socio-economic status of a school, as measured by the proportion of those eligible for free school meals, has little effect on the overall gender progression score of the school.

A similar finding was reported in *It's Different for Girls* (2012), where it was noted that the socio-economic background of the school had a significant effect on the overall number of students progressing to A-level physics, but little effect on the proportion of girls in the cohort.

Q. Does the size of the end of Key Stage 4 cohort in the school affect its gender progression score?

A. Figure 13 shows that the median size of the cohort measured at the end of Key Stage 4 (usually year 11) is somewhere between 175 and 200 students, independent of gender progression score. Therefore, the relative size of the school, as measured by the number of pupils in the end of Key Stage 4 cohort, has little effect on the overall gender progression score of the school.

Figure 12: The median percentage of free-school-meal (FSM) students in state-funded co-educational schools (in all years) against overall gender progression score (*n* = 2211)

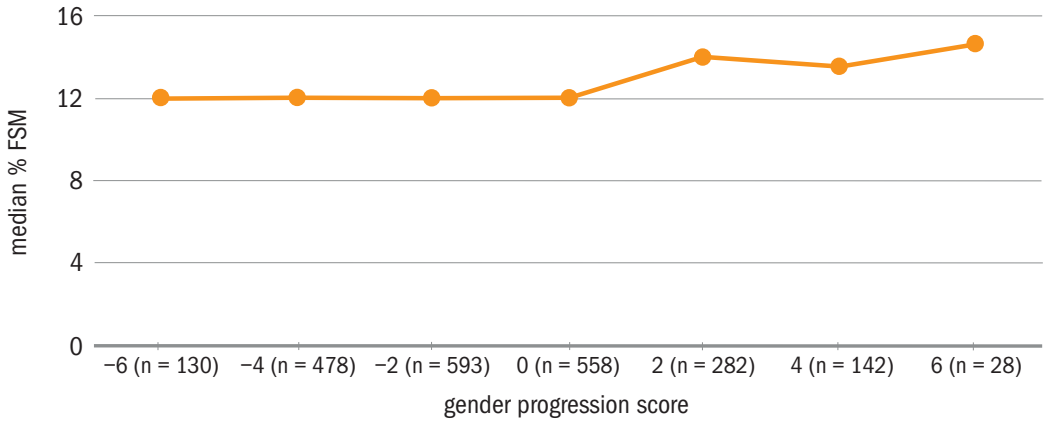
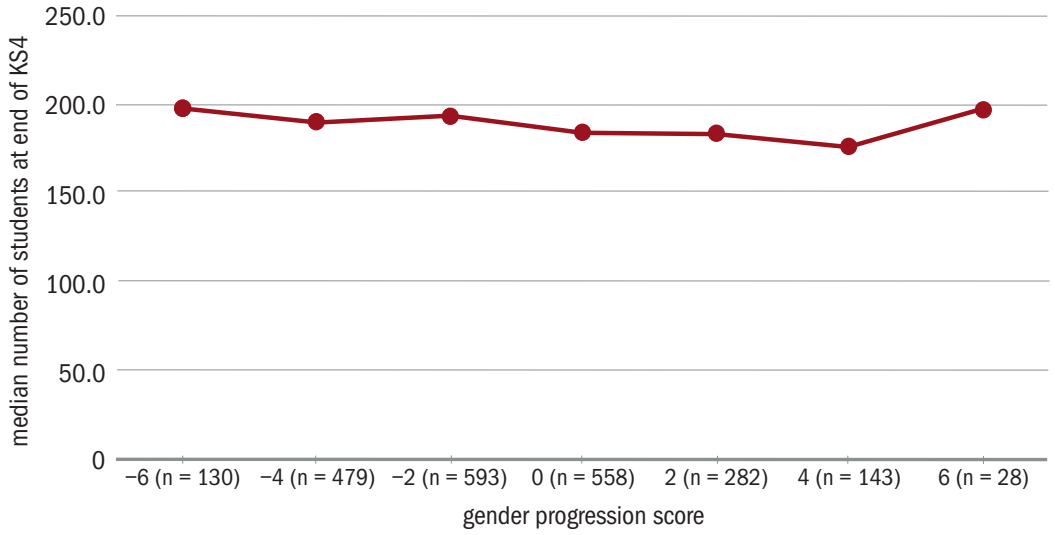


Figure 13: The median size of school against gender progression score for state-funded co-educational schools (*n* = 2213)



Q. In an ideal world, we might hope for gender parity in progression to all six subjects in our study. How far are we from real gender parity?

A. When we compare schools with the standard of gender parity in progression to these subjects, we find that 3.9% of state-funded co-educational schools do meet that standard, as do 22.5% of independent schools (orange shading). A few schools even manage to achieve gender imbalances against the stereotypes. It is clear, therefore, that it is possible to counteract gender stereotyping in subject choice and we need to look closely at these schools to see if there are lessons that can be applied more widely.

Figure 14: The proportion of state-funded co-educational schools in England that achieve gender parity in progression to the six A-level subjects (*n* = 2465)

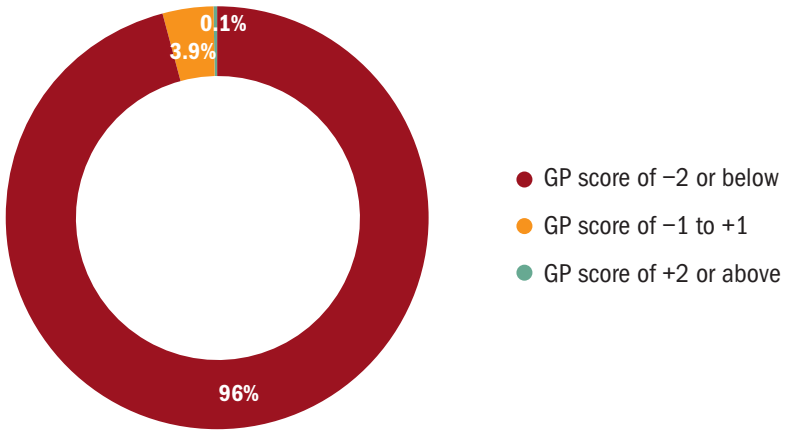
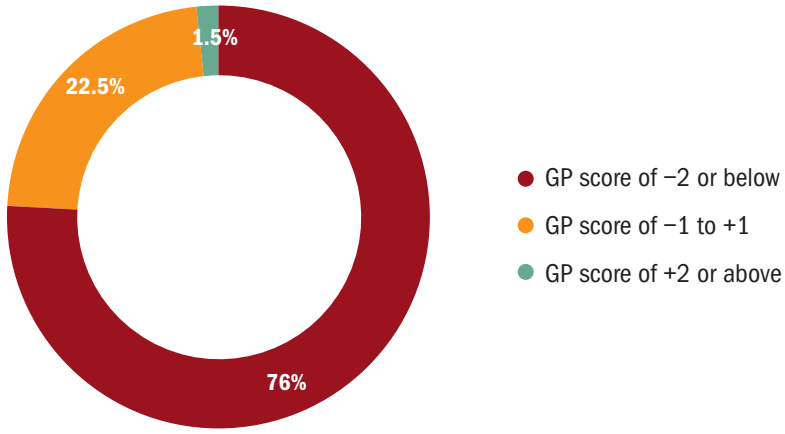


Figure 15: The proportion of independent co-educational schools in England that achieve gender parity in progression to the six A-level subjects (*n* = 343)



Further reading

- *It's Different for Girls – The influence of schools*, October 2012
  www.iop.org/publications/iop/2012/page_58292.html

- *Maintaining Curiosity: a survey of science education in schools*, Ofsted, November 2013, ref 130135
  www.ofsted.gov.uk/resources/maintaining-curiosity-survey-science-education-schools

- *Professor John Perkins' Review of Engineering Skills*, November 2013, URN BIS/13/1269
  www.engineeringuk.com/_resources/documents/BIS-Prof%20John%20Perkins%20Review_PDF.pdf?dm_i=1DRE,1YEHE,8V9HM5,714AU,1

- *The most able students: are they doing as well as they should in our non-selective secondary schools?* Ofsted, June 2013, ref 130118
  www.ofsted.gov.uk/resources/most-able-students-are-they-doing-well-they-should-our-non-selective-secondary-schools

- *Girls' career aspirations*, Ofsted, April 2011, ref 090239
  www.ofsted.gov.uk/resources/girls-career-aspirations

- *Gender issues in school – What works to improve achievement for boys and girls*, DCSF, 2009 http://dera.ioe.ac.uk/9094/1/00601-2009BKT-EN.pdf

- *Gender and Education – Mythbusters: Addressing Gender and Achievement: Myths and Realities* DCSF-00599-2009
  http://webarchive.nationalarchives.gov.uk/20130401151715/https://www.education.gov.uk/publications/standard/publicationdetail/page1/DCSF-00599-2009

- Archer L 2013 Interim Research Summary ASPIRES Project
  www.kcl.ac.uk/sspp/departments/education/research/aspires/ASPIRES-summary-spring-2013.pdf

- Reiss M J 2013 *Understanding Participation rates in post-16 Mathematics And Physics (UPMAP)* – research overview
  www.youtube.com/watch?feature=player_embedded&v=bnXfQOEWq2E

- Fine C 2010 *Delusions of Gender: the real science behind sex differences,* Icon Books, ISBN: 978-184831-220-3

- Myers K and Taylor H (eds) 2007 *Genderwatch: Still Watching...*, Trentham Books, ISBN-13: 978-1858564012

- Valian V 1999 *Why so slow: The advancement of women*, MIT Press, ISBN-13: 978-0262720311

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Other resources

Further resources with advice on how to achieve gender-inclusive teaching in physics are available from the Institute of Physics. How they can engage girls better through active classroom management, contextualised teaching and careers information, for example.

Institute of Physics "red book" series

- Murphy and Whitelegg 2006 *Girls in the Physics Classroom: A review of the research on the participation of girls in physics*
- Hollins *et al.* 2006 *Girls in the Physics Classroom: A teacher's guide for action*
- *Engaging with Girls: increasing the participation of girls in physics – an action pack for teachers* 2010. This includes: Grant, Bultitude and Daly 2010 *Girls into Physics: Action Research – a practical guide to developing and embedding good classroom practice*

Interactive careers workshop for girls

- *Science: it's a people thing – a discussion workshop for girls* 2013 – resources to facilitate a session using role models to promote discussion around gender stereotyping and career choices

For all of these, see the IOP Girls in Physics web pages at www.iop.org/girlsinphysics

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