Improving Gender Balance and Drayson Foundation pilot project evaluation, 2014-19

Report from FFT Education Datalab to the Institute of Physics

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1 Executive summary

1.1 Methodology

- This report evaluates the effect of taking part in the Improving Gender Balance (IGB) and the Drayson Foundation pilot projects, which were managed by the Institute of Physics (IOP) from 2014-16. For the purposes of this evaluation, these projects were treated as one intervention.
- We look at two outcomes: attainment at GCSE physics and the likelihood of entry in A-level in physics. We looked at the latter indicator for all pupils and separately for female pupils.
- Our analysis used data from the National Pupil Database (NPD) to compare the performance of pupils in schools that took part in the project to the performance of pupils in a matched group of comparison schools.
- Multilevel regression models were fitted to the data, with an indicator to flag whether a school had taken part in the project, or their length of participation. The models were adjusted to take account of pupil-level characteristics.
- We also provide some summary statistics comparing the performance of pupils in IGB / Drayson schools to the performance of pupils in all other schools.

1.2 Main findings

- This evaluation did not find conclusive evidence to show that the IGB / Drayson projects had a positive effect on the likelihood of entry in A-level physics, either for all pupils or for female pupils.
- However, we did find that the IGB / Drayson projects had a significant positive effect on GCSE physics grade, the equivalent of up to a third of a grade. We also found a small positive effect on the likelihood of female pupils progressing to complete an A-level in Physics in IGB schools, but these estimates were not significant.

1.3 Limitations

- Ideally, from an evaluation perspective, schools would have been randomly assigned to a treated group or a comparison group. As this was not the case, we constructed a comparison group of schools similar to the schools that took part in the projects.
- Creating a comparison group in this way means that we were unable to control for factors not observed or recorded in our data.
- The recruitment of schools into the project was carried out by a team based around the country often using local knowledge to identify suitable schools. We had no way of replicating this selection process using data.
- The results of a sensitivity analysis, while broadly similar to that found in the main analysis, did not find any consistent significant positive effects.
- The sample size (26 schools) was relatively low; a larger sample may have provided more reliable and precise estimates. The Drayson project was too small (six schools) for a separate analysis to be conducted.
- Some comparison schools may have taken part in similar projects. If this improved outcomes in comparison schools, it may have led to underestimation of effects.
- The effects observed should be considered tentative given these limitations.

2 Introduction

The Improving Gender Balance project (IGB) was a pilot project, managed by the Institute of Physics (IOP) and funded by the Department for Education (DfE), from 2014-16. It worked with twenty partner schools with a focus on one of three strands: working directly with pupils; the physics classroom and the whole school. The ultimate aim was to improve the gender balance of the students who chose to study A-level physics. The Drayson pilot project was a separate project that also ran from 2014-16. It shared the same aim, but used all three strands of the IGB project and was a larger scale intervention for the partner schools involved. For the purposes of this evaluation, the IGB and Drayson projects were treated as one intervention. As the Drayson project included just six schools, it was not possible to evaluate this separately, although section 4 does include some raw data on differences between Drayson schools, matched comparison schools and all other schools.

We considered two outcome measures: attainment at GCSE physics, from 2014-19, and the likelihood of entry in A-level in physics. We looked at the latter indicator for all pupils and separately for female pupils, for pupils who took A-levels in each year from 2016-19; these pupils would have completed Key Stage 4 between 2014 and 2017.

2.1 Methodology

This evaluation used what is known as a quasi-experimental design. This involves comparing the outcomes of pupils who went to a school that took part in the IGB / Drayson projects to those of pupils from a matched comparison group of statistically similar schools. This approach mimics what would be done in a formal experiment such as a randomised control trial.

We selected schools that were similar with respect to:

- School characteristics (government office region, selection policy, whether it has a sixth form, gender)
- Proportion of disadvantaged pupils
- Proportion of pupils with a first language other than English
- Average prior attainment of pupils at Key Stage 2
- Summary KS4 attainment in physics and rates of progression to A-Level physics for the previous 3 years
- Summary proportion of female students progressing to A-Level physics for the previous 3 years

Only mainstream state-funded schools in England were considered for the comparison group. We also excluded boys' schools and selective schools, as none of the treated schools were in these categories, and any schools that took part in Phase 4 or Phase 5 of the IOP's Stimulating Physics Network project, which also worked with schools during the period covered by this evaluation. Finally, when fitting models for physics grade, we excluded any schools in which no pupils took GCSE physics in the outcome year.

For physics grade, we used multilevel regression models (pupils within schools) to compare outcomes for pupils who went to a school that took part in one of the projects to pupils who went to a school in the matched comparison group. In each case, we used a dummy variable to indicate whether a pupil's school had taken part in the projects, and we controlled for the following pupil characteristics: prior attainment at Key Stage 2, gender, Pupil Premium status and whether English is an additional language. Confidence intervals were obtained for our estimates by using bootstrapping.

For entry in A-level physics, we used logistic regression models, with the same dummy variable to indicate treatment status and control variables as for physics grade.

2.2 Data

The IOP provided a dataset consisting of all schools that took part in the IGB / Drayson projects. This included school identifiers (school name, URN and LAESTAB) and dates in which the school joined and left the project. This data was linked to corresponding records in the National Pupil Database (NPD), and to publically available school-level data. We were then able to track pupils from their Key Stage 4 school through to A-level, allowing us to determine how many pupils from each Key Stage 4 school went on to take A-levels in any given subject.

The NPD is an administrative data resource maintained by the Department for Education and provides a history of enrolments, attendance, exclusions and attainment in national tests and public examinations (e.g. GCSE and A-level) for all pupils who have been in state-funded education since 2002. For this project, we used data on attainment at GCSE and subject choice at A-Level, as well as prior attainment during Key Stage 2. We also used some additional demographic variables.

All of the schools in the original dataset were successfully matched to records in the NPD; the final dataset used for analysis consisted of 26 IGB / Drayson schools.

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3 Mitigation of confounding effects

In this section, we will start with an overview of how schools that took part in the IGB / Drayson projects compared to other state-funded, mainstream schools in England in 2013, the year before the project began. We then go on to discuss the matching technique used and how successful it was in creating a matched comparison group.

From this point onwards, we will refer to schools that took part in the IGB / Drayson projects as *treated schools* and all other state-funded, mainstream schools as *potential comparison schools*.

3.1 Difference between treated and potential comparison schools

In this section, we review how the treated schools compared to the potential comparison schools before any matching was carried out. The summary statistics used to make the comparisons in this section are also included as an appendix to this report.

The IGB and Drayson projects sought to work with schools that had a reasonable proportion of pupils progressing to study A-level physics, but relatively few female pupils choosing to do so. In practice, the vast majority of schools send more male than female pupils on to study A-level physics; the IOP's own research shows that only around a fifth of those progressing to study the subject are female, and this has been the case for many years.[1]

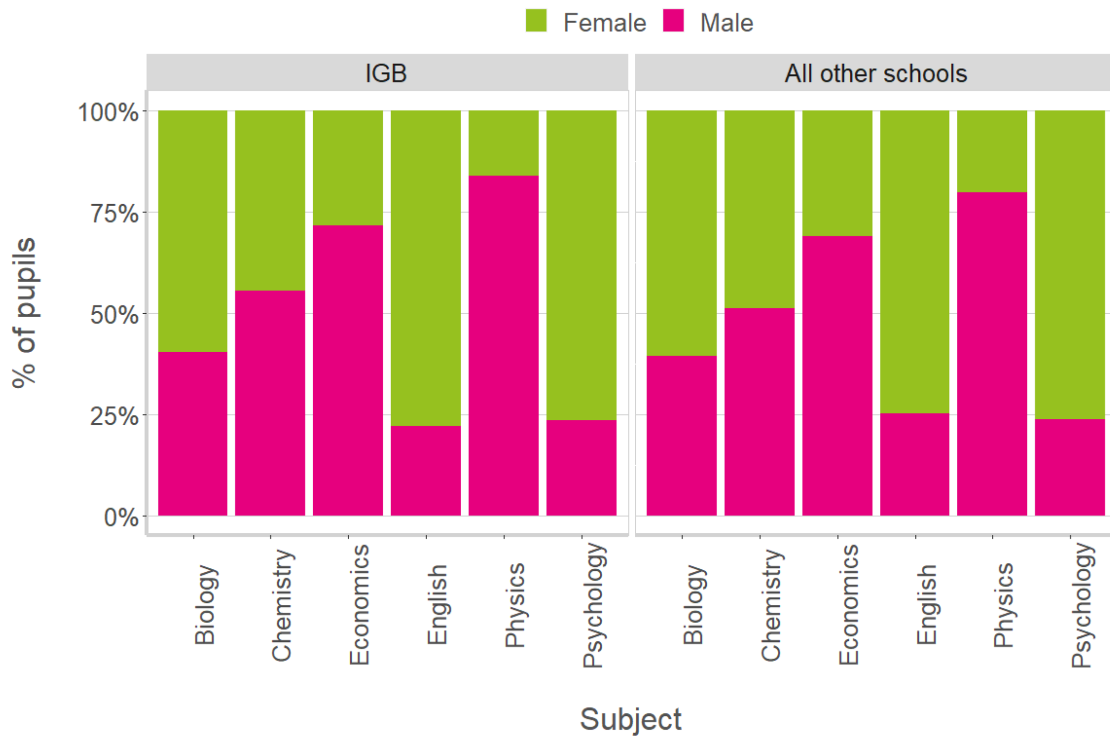
Reflecting these selection criteria, IGB / Drayson schools tended to send a slightly higher proportion of pupils on to complete an A-level in physics than other schools (4.9% of those who completed KS4 in 2013 compared to 4.3% for all other schools), and the majority of these pupils were male (83.7% in 2013, compared to 79.7% in all other schools). Their mean physics GCSE grade was also slightly above average.

Pupils at IGB / Drayson schools were less likely to be disadvantaged (18.1% were eligible for the Pupil Premium in 2013, compared to 26.5% overall) and had higher prior attainment, on average, than pupils at other schools. They were also less likely to have English as an additional language (9.9% compared to 16.4% overall) and more likely to be white British (84.7% compared to 76.1% overall). None of the schools were selective (grammar) schools and only one was single sex.

As well as progression to A-level physics, the IGB / Drayson projects were concerned with gender balance in progression to five other A-level subjects: biology, chemistry, psychology, economics and English. Figure 1 shows the gender balance of those pupils who completed an A-level in one of these five subjects, or in physics, in 2015 (these pupils would have completed KS4 in 2013). In IGB / Drayson schools, the pattern is roughly similar to that seen overall: physics and economics tend to be male-dominated, English and psychology tend to be female-dominated, as does biology to a lesser extent, and chemistry is roughly 50:50.

[1] http://iop.cld.iop.org/education/teacher/support/girls_physics/closing-doors/page_62076.html

Figure 1: Gender balance in A-level entries by school type, 2015 (pupils who completed KS4 in 2013)



3.2 Extent of success in creating matched comparisons

The initial matching process was carried out using the nearest neighbour method, pairing treated and comparison schools based on propensity scores. A propensity score can be thought of as a measure of how typical each school is of schools in the treated group. As shown in section 3.1, IGB / Drayson schools tended to have a lower proportion of disadvantaged pupils than average, to have a slightly above average proportion of pupils progressing to complete an A-level in physics, and were very unlikely to be single sex. So a girls' school with a high proportion of disadvantaged pupils and a low rate of progression to A-level physics would probably have a low propensity score, and vice versa. The nearest neighbour method begins by calculating propensity scores for all schools, both treated and potential comparison. Then it simply pairs each treated school with the potential comparison school with the nearest propensity score.

The graphs in figure 2, known as love plots[2], show how similar the treated and comparison schools were to one another, before and after matching, using a measure called the standardised mean difference. The mean difference is simply the difference between the average value of the variable for the treated schools, and the average value for the comparison schools. Standardising this measure, which is done by dividing it by its standard deviation, means that we can compare balance across different variables. Generally, a

[2] Loveplots are named for Professor Thomas E. Love, who first developed them along with colleagues (https://academic.oup.com/eurheartj/article/27/12/1431/647407)

standardised mean difference of 0.2 or below is considered to indicate good balance. This threshold is shown on the graphs as a dotted line.

As shown in figure 2, we were unable to create a closely matched comparison group using the nearest neighbour method; a number of the standardised mean differences are above the 0.2 threshold. This is common when matching is attempted using a relatively small group of treated schools. In order to create a well-balanced comparison group for the IGB / Drayson schools, we used an alternative method known as covariate balance propensity score weighting (CBPS). This method uses weighting rather than matching; the entire group of potential comparison units is used, but each observation is weighted such that the treated and comparison groups are optimally balanced with respect to the both the propensity score and the matching variables. The balance created using this technique is also shown in figure 2; it is excellent. All of the standardized mean differences are well below the 0.2 threshold: in fact, most are well below 0.1.

The results presented below were obtained using comparison groups created using CBPS. Results calculated using the nearest neighbour matching method were used as the basis of a sensitivity analysis and are shown in the appendix.

Figure 2: Loveplots showing extent of success in creating a matched comparison group

4 Raw differences between IGB / Drayson schools and comparison schools

This section compares the treated schools to the schools in the matched comparison group. We also look at how these groups compare to all other schools and at the six Drayson schools as a separate group. Comparing the groups in this way, particularly the trends in the years during and immediately after the projects, gives an indication of the effect that the projects had.

However, we should be cautious about drawing conclusions based on such a comparison. Firstly, making a comparison in this way does not take account of changes in pupil level characteristics. For example, if the prior attainment of the pupils entering the IGB / Drayson schools increased between 2015 and 2019, we might also expect that GCSE physics grades would increase, regardless of the effect of the project. Similarly, if the number of pupils entering GCSE physics increased between 2015 and 2019, it is likely that the 2019 pupils tended to have lower prior attainment then the 2015 pupils; if this is the case, then we would expect GCSE physics grades to fall. Fitting regression models that control for these differences allows us to give more robust estimates of the project's impact.

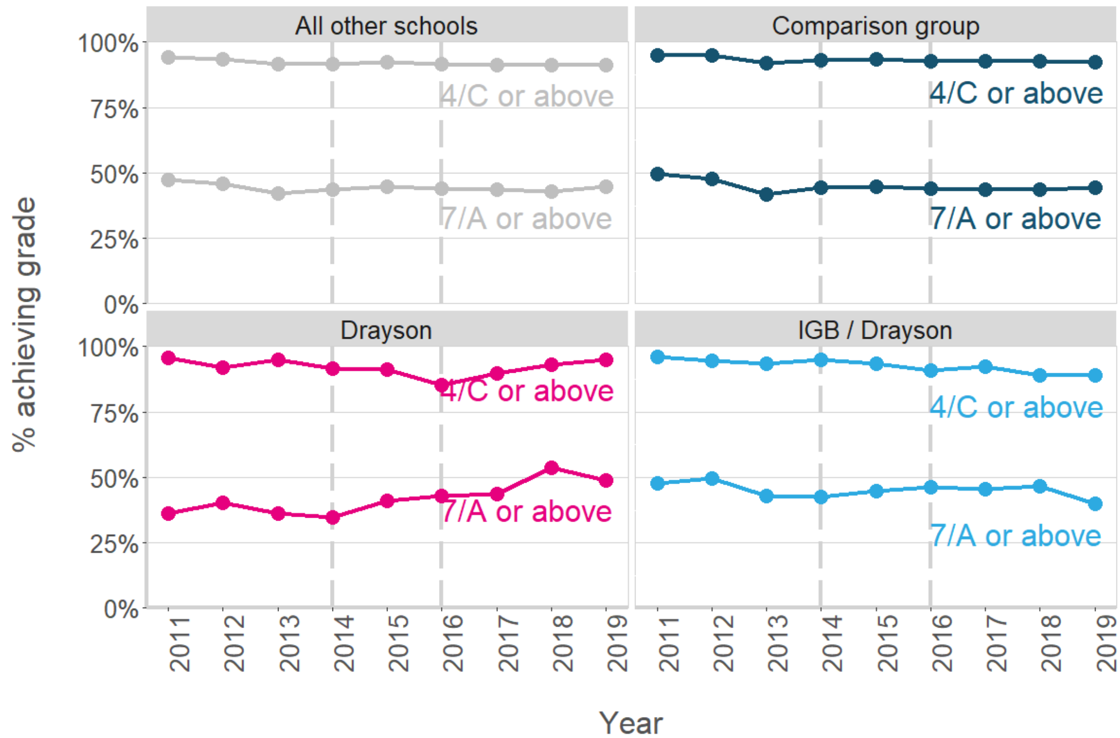
Secondly, the comparisons shown in this section do not incorporate any uncertainty. A robust evaluation needs to take account of the uncertainty inherent in the matching and modelling process to produce estimates complete with confidence intervals. The results shown in section 5 control for differences in pupil characteristics and uncertainty from the matching and modelling process by using regression models combined with bootstrapping, a technique that involves repeatedly sampling the data and reproducing the analysis.

The summary statistics used to make the comparisons in this section are also included as an appendix to this report.

4.1 GCSE grades

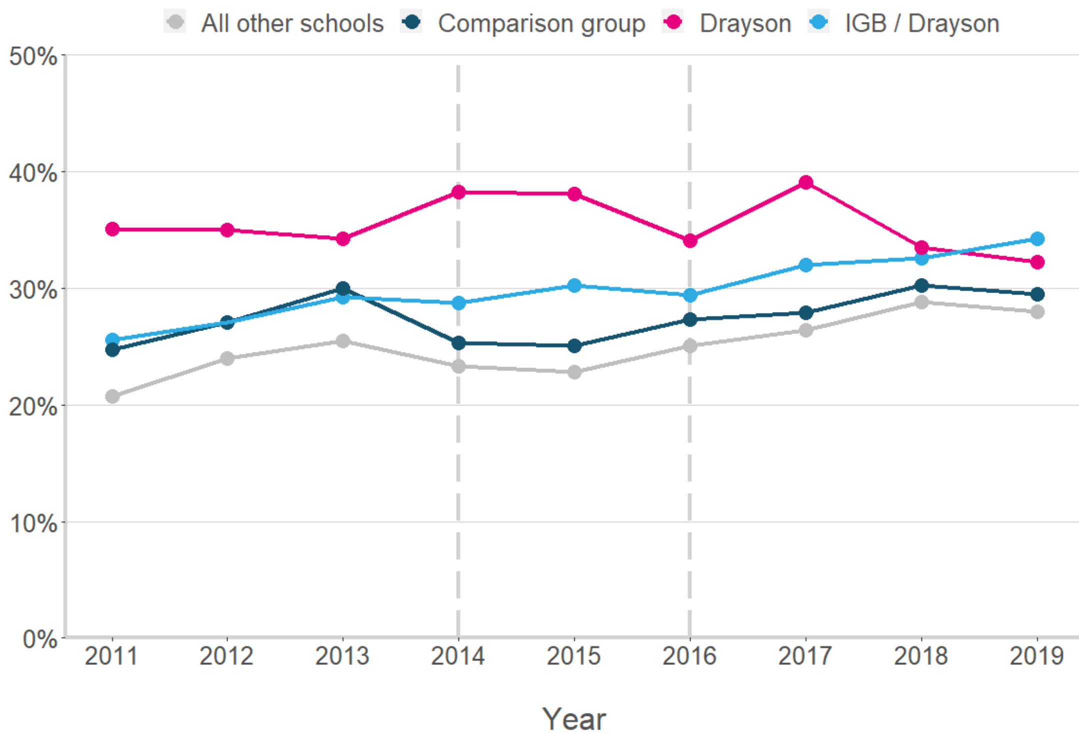
Figure 3 shows how GCSE physics grades in IGB / Drayson schools compared to the matched comparison group and to all other schools, from 2011-19. The graph also shows the figures for the six Drayson schools as a separate group. The first and last years of the IGB / Drayson projects are indicated on the graph with dotted lines.

Figure 3: Proportion of pupils achieving grade in GCSE physics, 2011-19



In every year from 2011-19, the vast majority of pupils studying GCSE physics achieved a C or above; this was the case for IGB / Drayson, the comparison group, Drayson and other schools alike. Any changes during this period should be seen in the context of a higher proportion of pupils studying the subject, as shown in figure 4. Pupils in IGB / Drayson, the comparison group and Drayson schools were more likely to study physics at GCSE than those in other schools. While schools in the comparison group, and all other schools, saw falling numbers between 2013 and 2015, IGB / Drayson schools saw a small increase (a fall from 30.0% to 25.1% in comparison schools and 25.5% to 22.8% in all other schools compares to an increase from 29.2% to 30.2%).

Figure 4: Proportion of pupils sitting GCSE physics, 2011-19



4.2 Entry to A-level physics

The years shown in this section indicate the year in which pupils completed their A-levels. The most recent data available is for 2019: these are for pupils who completed KS4 in 2017 and who would have completed A-levels in 2019.

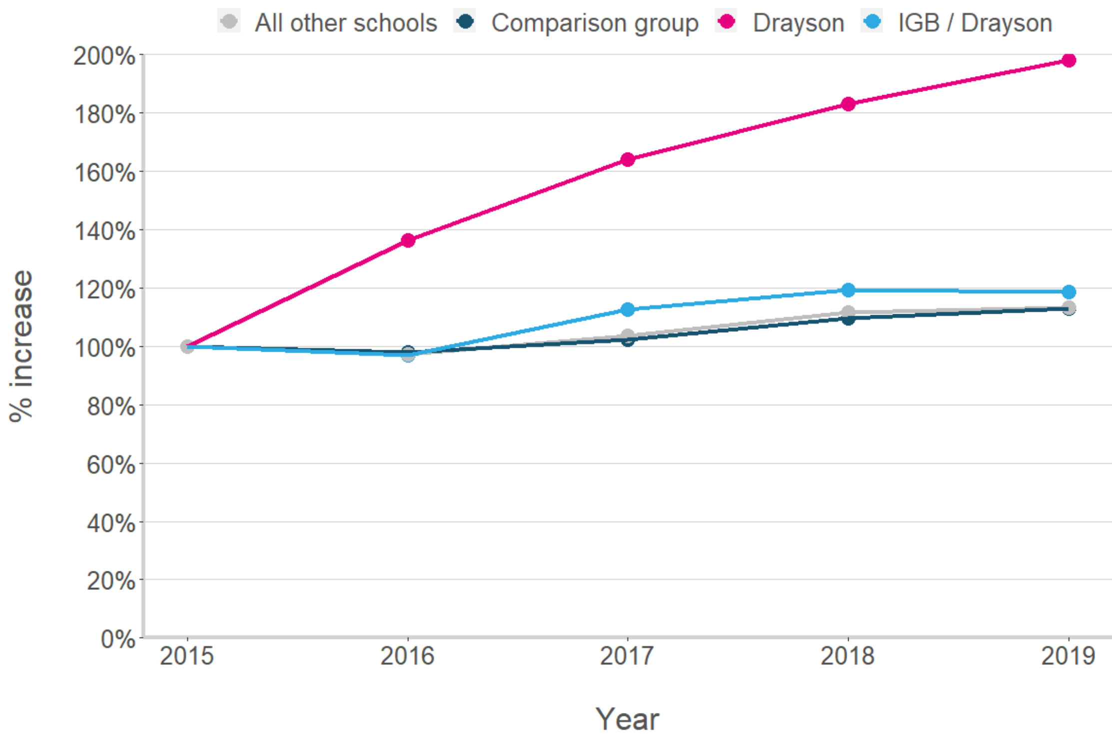
4.2.1 Overall

Comparing the number of pupils entering A-level physics in IGB / Drayson schools, matched comparison schools and all other schools does show a small relative increase in numbers for IGB / Drayson schools. Compared to the numbers in 2015, the year before the projects began, numbers in IGB / Drayson schools had increased 18.5% by 2019, compared to 13.0% for comparison schools and 13.3% for all other schools. The six Drayson schools saw a large increase, with numbers nearly doubling from 47 in 2015 to 93 in 2019; an increase of 97.5%. This data is summarized in table 1 and figure 5.

Table 1: Numbers of pupils entering A-level physics from IGB / Drayson schools, 2015-19

	2015	2016	2017	2018	2019
Number of pupils entering A-level physics	276	267	311	329	327
% change in number of pupils entering A-level physics from 2015	NA	-3.3%	12.7%	19.2%	18.5%
Total number of KS4 pupils	5639	5579	5528	5354	5226
Proportion entering A-level physics	4.9%	4.8%	5.6%	6.1%	6.3%

Figure 5: Increase in A-level entries from IGB / Drayson schools compared to 2015 (pupils who completed KS4 in 2013)

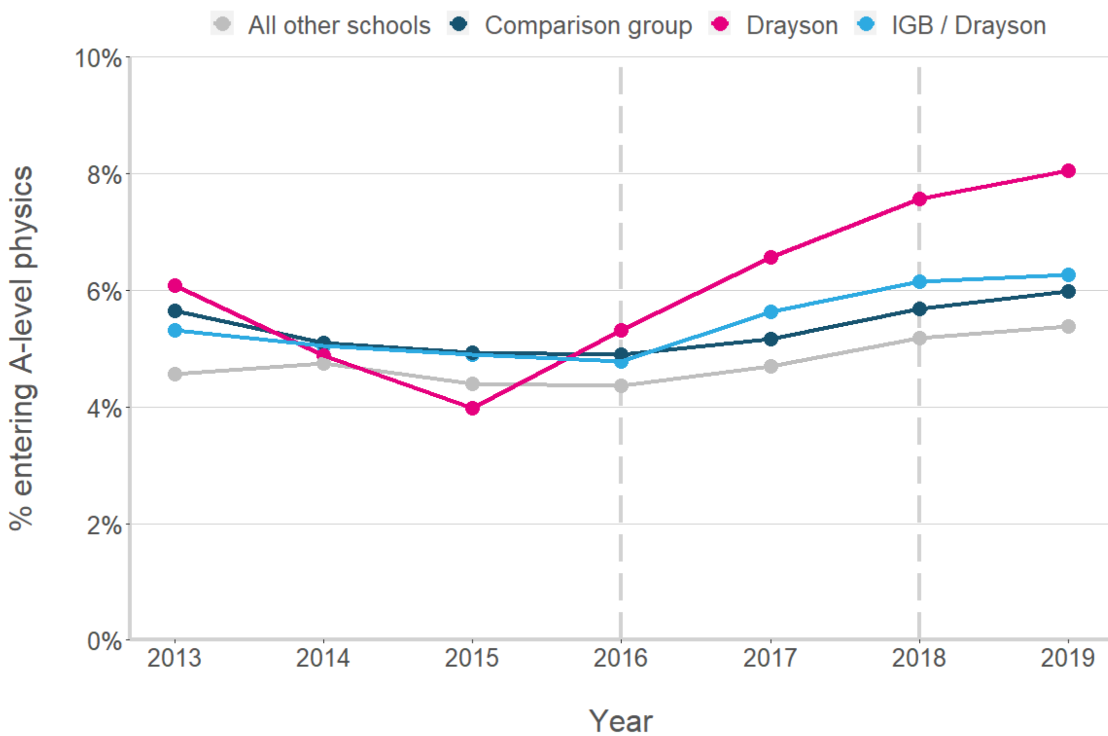


However, the changes in entry numbers should be seen in the context of the size of the pupil population. In Drayson schools, for example, the number of pupils completing Key Stage 4 was relatively stable from 2015 to 2019, a change of -2.4%, while in all other schools the number fell by -7.5%. Also, as the number of pupils entering A-level physics from IGB / Drayson schools is fairly low, quite small changes in the numbers can translate into large percentage increases, which may be misleading. For these reasons, it is useful to consider changes in the proportion of pupils who went on to enter A-level physics.

As shown in figure 6, the proportion of pupils going on to enter A-level physics was slightly higher in IGB / Drayson schools and schools in the comparison group than for other schools prior to the project. After the project began, the proportion rose in all schools. The increase in IGB / Drayson schools was slightly steeper than that in comparison schools between 2016 and 2017, rising from 4.8% to 5.6%, compared to an increase from 4.9% to 5.2% in IGB comparison schools. However, the difference remained small and by 2019 had narrowed to just 0.3 percentage points.

The six Drayson schools saw a fall in the proportion entering physics A-levels in the years before the project began, from 6.1% to 4.0% between 2013 and 2015; in 2015, the proportion entering was slightly lower than that in all other schools, which was 4.4%. This trend was reversed from 2015 onwards; the proportion entering increased each year, and in 2019 Drayson schools had a higher proportion of pupils entering physics A-level than any of the other groups (8.0% for Drayson compared to 5.4% for all other schools).

Figure 6: Proportion of students entering A-level physics, 2013-19 (pupils who completed KS4 from 2011-17)



4.2.2 Female pupils

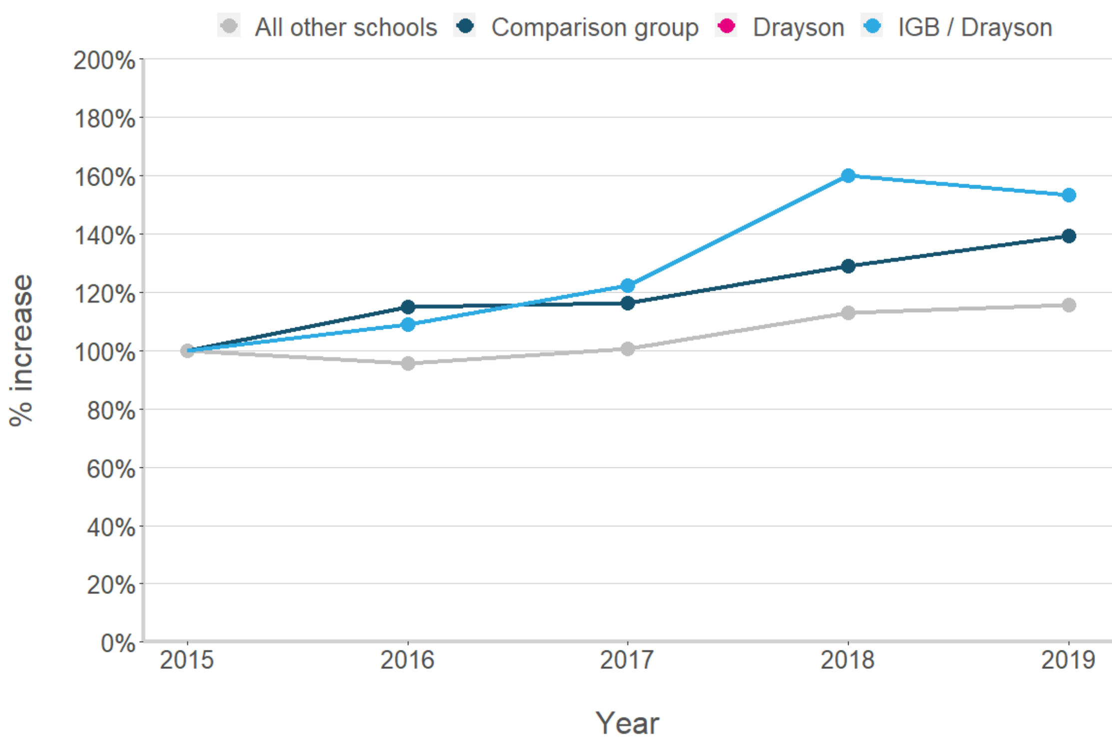
Due to low numbers, some data in this section has been suppressed. This has been done to comply with requirements for using NPD data for research; counts lower than ten, or statistics based upon them, cannot be published. Years for which data is not available are left blank on the graphs below.

As for all pupils, a comparison of the number of entries does suggest a relative increase in IGB / Drayson schools. Compared to 2015, the year before the projects began, the number of female pupils going on to enter A-level physics from IGB / Drayson schools had increased 53.3% by 2019, compared to 39.2% for IGB comparison schools and 15.7% for all other schools. The difference in 2019 is largely driven by a jump in numbers between 2017 and 2018, from 55 pupils in 2017 to 72 in 2018. In the six Drayson schools, fewer than ten female pupils went on to enter A-level physics in 2015; we are unable to publish the exact number due to restrictions in the use of NPD data. However, 29 female pupils from these schools went on to enter A-level physics in 2019, so there was a considerable increase in numbers. This data is summarized in table 2 and figure 7.

Table 2: Pupils entering A-level physics from IGB / Drayson schools, 2015-19

	2015	2016	2017	2018	2019
Number of pupils entering A-level physics	276	267	311	329	327
Number of female pupils entering A-level physics	45	49	55	72	69
Number of male pupils entering A-level physics	231	218	256	257	258
Total number of KS4 pupils	5639	5579	5528	5354	5226
% change in number of female pupils entering A-level physics from 2015	NA	8.9%	22.2%	60.0%	53.3%
% change in number of male pupils entering A-level physics from 2015	NA	-5.6%	10.8%	11.3%	11.7%
% of female students	16.3%	18.4%	17.7%	21.9%	21.1%
Progression rate of female students	1.6%	1.7%	2.0%	2.7%	2.6%

Figure 7: Increase in female A-level entries from IGB / Drayson schools compared to 2015 (pupils who completed KS4 in 2013). Data suppressed where n<10.



As before, the increase should be considered in the context of the size of the pupil population; for example, the number of female pupils completing Key Stage 4 in Drayson schools fell by a lower proportion than that in all other schools over the same time period (-4.5% compared to -7.2% in all other schools). Also, as the number of female pupils entering A-level physics from IGB / Drayson schools is relatively low (69 pupils in 26 schools in 2019), relatively small changes in numbers can lead to large percentage increases, which may be misleading. For these reasons, it is useful to consider the proportion of female pupils who go on to enter A-level physics. We also provide information on the proportion of A-level physics entrants who were female for context.

As shown in figure 8a, the proportion of female pupils entering A-level physics was similar in IGB / Drayson schools, the comparison group and all other schools for each year from 2013-19. The proportion increased in IGB / Drayson schools during and after the projects, from 1.6% in 2015 to 2.6% in 2019, but this was also the case for IGB comparison schools (1.6% to 2.4%) and all other schools (1.8% to 2.2%). Due to low numbers, we are unable to publish data for the six Drayson schools for 2014 or 2015, but the proportion of female pupils entering A-level physics increased every year from 2016, reaching 4.5% in 2019.

Turning to the proportion of A-level physics entrants who were female, figure 8b shows that the figures were very similar for IGB and IGB comparison schools; the difference was less than one percentage point for every year except 2018, when it stood at 2.6 percentage points (21.9% female in IGB schools compared to 19.3% in IGB comparison schools). Again, due to low numbers data is suppressed for Drayson schools for a number of years, but the proportion did increase every year from 2016, rising to nearly a third (31.2%) in 2019. However, we would expect the proportion to be higher for Drayson schools as one of the six schools in the project is a girls' school.

Figure 8a: Proportion of female students entering A-level physics, 2013-19 (pupils completed KS4 from 2011-17). Data suppressed where n<10.

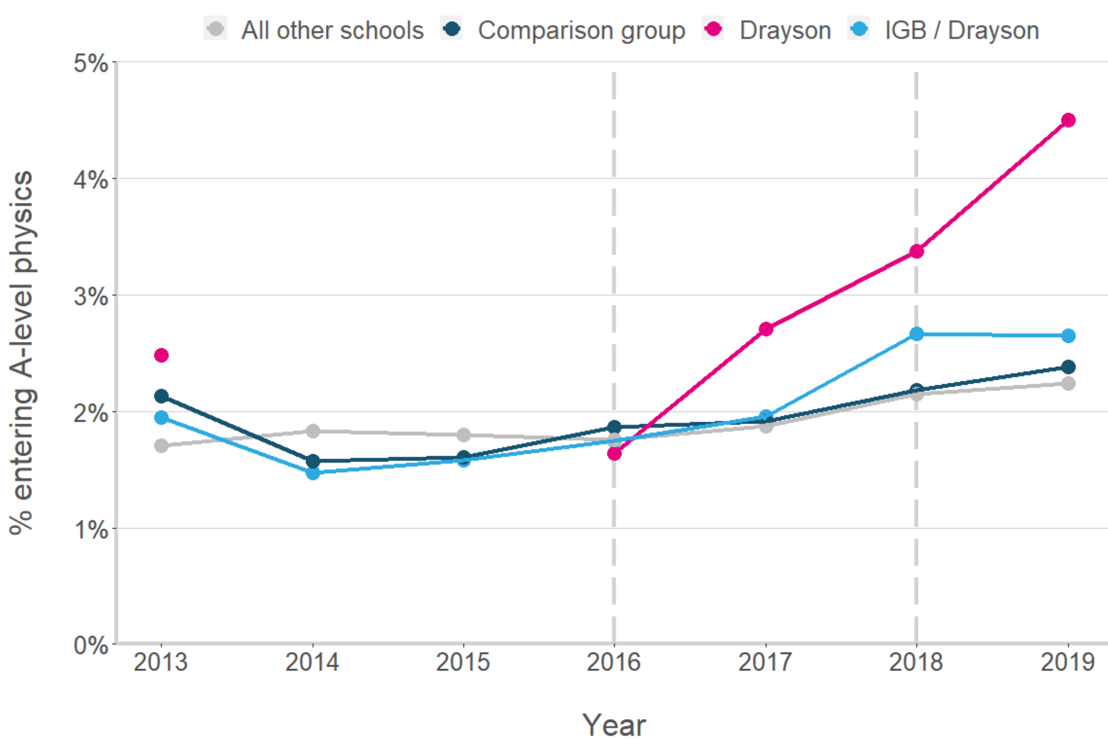
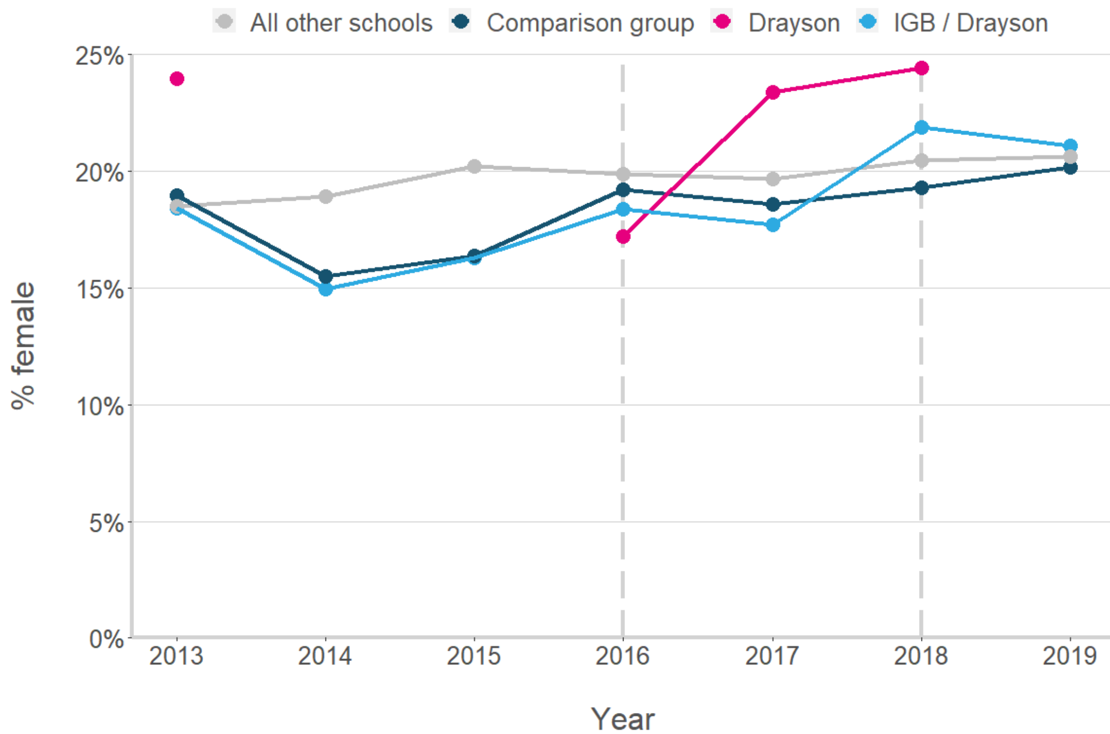


Figure 8b: Proportion of A-level physics pupils who were female, 2013-19 (pupils who completed KS4 from 2011-17). Data suppressed where n<10.



4.2.3 Disadvantaged pupils

Due to low numbers, some data in this section has been suppressed. This has been done to comply with requirements for using NPD data for research; counts lower than ten, or statistics based upon them, cannot be published. Years for which data is not available are left blank on the graphs below.

A comparison of the number of entries does suggest a relative increase in IGB / Drayson schools during the course of the project. In 2016, numbers were 27.8% higher than they were in 2015, the year before the projects began, and in 2017 they were 61.1% higher. In the comparison group, number increased by just 8.5% in 2016 and 6.8% in 2017. However, numbers fell in 2018 and 2019 in IGB / Drayson schools, but increased in comparison schools; in 2019, numbers in IGB / Drayson schools were 27.8% higher than in 2015, while in comparison schools they were 37.0% higher. We are unable to comment on the six Drayson schools; due to low numbers, we cannot publish the number of disadvantaged pupils entering A-level physics in 2015.

The changes described above should be considered in the context of the size of the pupil population; for example, the number of disadvantaged pupils fell in all schools during this period, but it fell more sharply in IGB / Drayson schools (-13.8% compared to -8.9% in all other schools). The number of disadvantaged pupils entering A-level physics from IGB / Drayson schools is low; the 61.1% increase from 2015 to 2017 represents an increase of just 11 pupils across the 26 IGB / Drayson schools. Translating these small numbers in percentage increases may be misleading. For these reasons, it is useful to consider the proportion of disadvantaged pupils who go on to enter A-level physics. We also provide information on the proportion of A-level physics entrants who were disadvantaged for context.

As shown in figure 9a, the proportion of disadvantaged pupils entering A-level physics from comparison schools and all other schools was virtually identical for every year considered. By contrast, the proportion from IGB / Drayson schools rose between 2015 and 2017 from 1.8% to 3.1%, while the proportion from the comparison group remained almost flat, rising from 1.7 to 1.8%. However, the proportion from IGB / Drayson schools fell in 2018 and 2019 while that for the comparison group increased, so that in 2019 there were very little difference in the proportion entering A-level physics (2.6% in IGB / Drayson and 2.4% in the comparison group). Small numbers make these figures difficult to interpret; data for IGB / Drayson schools and Drayson schools was suppressed for a number of years due to low numbers. It is particularly difficult to comment on the six Drayson schools; while the proportion of disadvantaged pupils entering A-level physics increased from 2016-19, we are unable to establish whether this trend began before the start of the project.

In figure 9b, we can see that the proportion of A-level physics students who were disadvantaged was lower among pupils from IGB / Drayson schools and schools in the comparison group than for all other schools, for every year considered. However, the gap between IGB / Drayson schools and all other schools narrowed between 2015 and 2017. In 2017, 9.3% of physics entrants from IGB / Drayson schools were disadvantaged, compared to 6.1% from comparison schools and 10.0% from all other schools. However, the proportion in IGB / Drayson schools then fell to 7.0% in 2019, compared to 7.1% in comparison schools and 10.5% for all other schools. Again, low numbers mean that it is difficult to comment on Drayson schools, but the proportion of A-level physics students who were disadvantaged was considerably above average in 2016, the first year for which non-suppressed data is available, at 15.6%, but it fell every year until 2019, when it stood at 11.8%, just 1.3 percentage points above the figure for all other schools.

Figure 9a: Proportion of disadvantaged pupils entering A-level physics, 2014-19. Data suppressed where n<10.

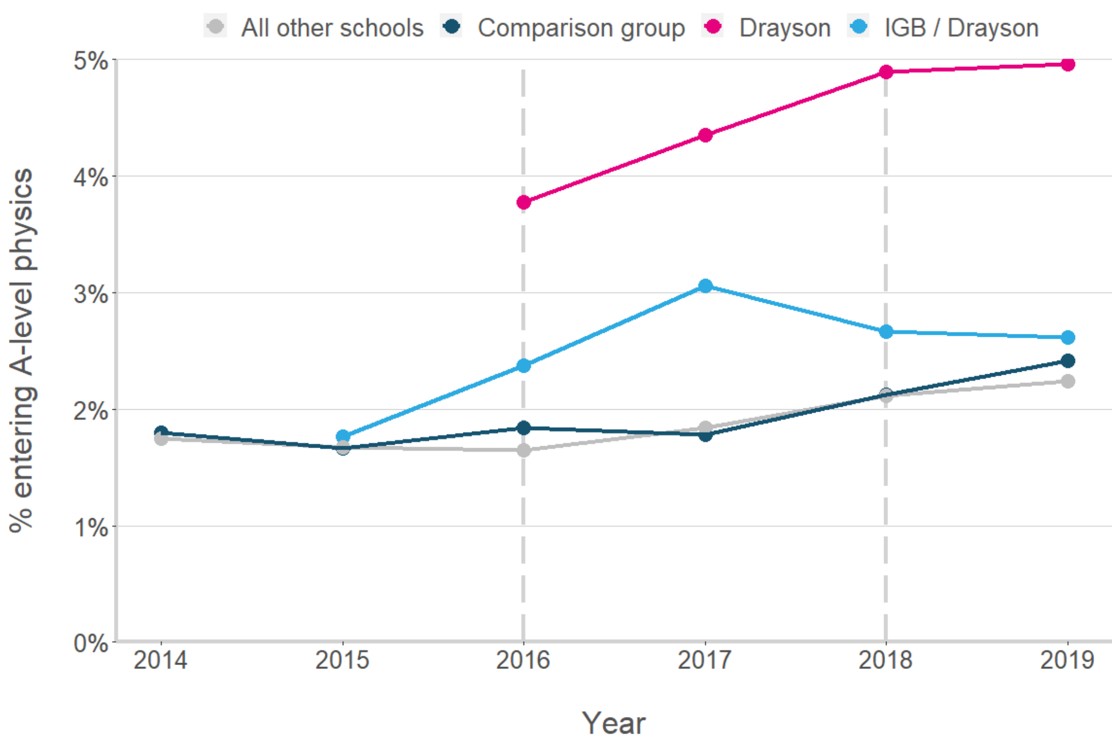
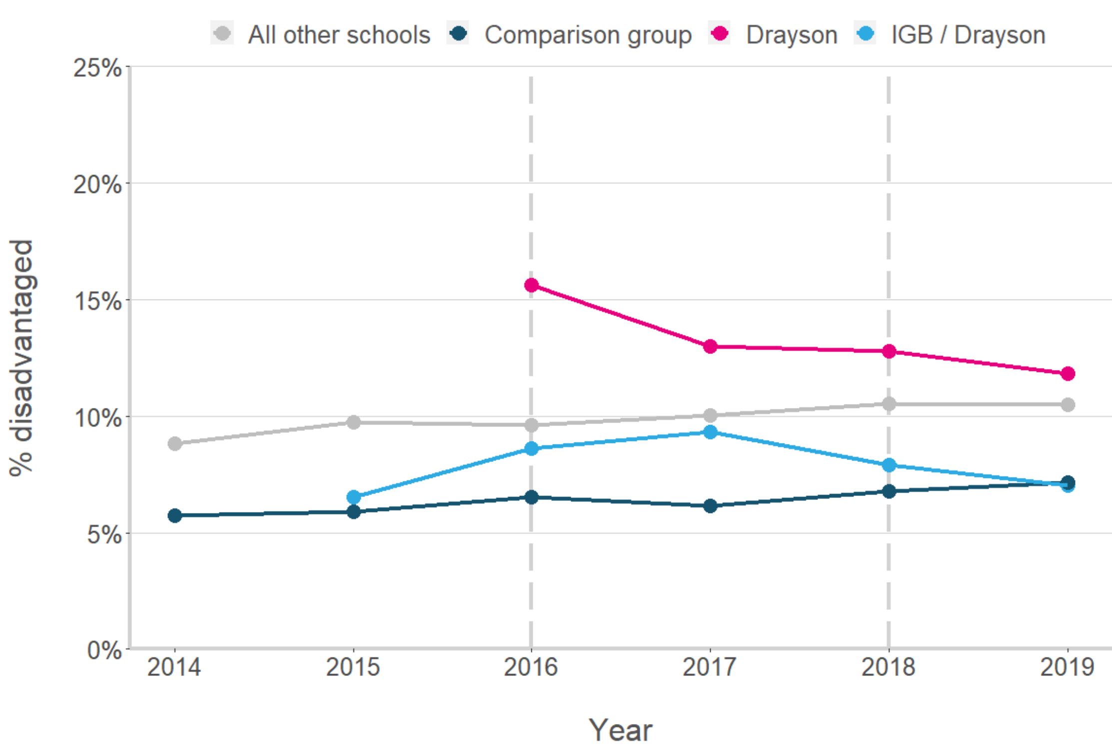


Figure 9b: Proportion of A-level physics exam entrants who were disadvantaged, 2014-19. Data suppressed where n<10.



5 Results

This section presents estimates of the impact of the IGB / Drayson project on the outcome measures. Estimates are presented along with 95% confidence intervals.

5.1 Formatting of results

Results are given in four different forms: estimated impact, effect size, months of progress and odds ratios.

Estimated impact is given in the same units as the outcome measure. In this report, it is used for the GCSE grade outcome measure. An estimated impact of one in 2019 would mean that we'd expect a pupil at an IGB / Drayson school to achieve one grade higher than a pupil at a comparison school. However, this is complicated by changes to GCSE grading during the period covered by this report. Prior to 2018, GCSEs were graded A*-G. Although these have been converted to a notional 9-1 scale[3], the two grading systems are not directly equivalent.

Effect sizes are used here as a way to get around this problem and create estimates that can be compared across years. They also allow us to compare the magnitude of an effect across different outcome measures, such as GCSE grade and progression to A-level physics.

Effect sizes a standardised version of the estimated impact. That is, they are the estimated impact divided by the standard deviation in the outcome measure among all pupils. Because effect size a standardised measure, it can be compared across different outcomes; this means that it is a more helpful way of comparing the effect of the project on GCSE grades across the outcome years.

However, effect sizes can be difficult to interpret; it is not immediately obvious whether an effect size of, for example, 0.5 is large or small. Months of progress are a measure used in education research to try and help with this. In this report, effect sizes were translated into equivalent months of progress using guidance developed by the Education Endowment Foundation[4], as shown in table 3. In our example, an effect size of 0.5 would be the equivalent of six months of additional progress; expressed using the months of progress measure, it is clear that this is a large effect.

Table 3: Effect sizes and equivalent months of progress

Effect size from	To	Months of progress
-0.04	0.04	0
0.05	0.09	1
0.10	0.18	2
0.19	0.26	3
0.27	0.35	4

[3] This scale is A*=8.5; A=7; B=5.5; C=4; D=3; E=2; F=1.5; G=1

[4] As described at **https://educationendowmentfoundation.org.uk/projects-and-evaluation/evaluating-projects/evaluator-resources/writing-a-research-report**, accessed January 2020

0.36	0.44	5
0.45	0.52	6
0.53	0.61	7
0.62	0.69	8
0.70	0.78	9
0.79	0.87	10
0.88	0.95	11

Finally, odds ratios are used for reporting the estimated effect on progression and female progression. These ratios tell us the relative odds of a pupil progressing to complete an A-level in physics, depending on whether the student attended a treated school or a comparison school. An odds ratio of one would mean that a student from a treated school has exactly the same odds of progressing as a student from a comparison school. An odds ratio above one means that a student from a treated school is more likely to progress, and an odds ratio of below one means that they are less likely.

Odds ratios have been converted into effect sizes, then translated into months of progress using table 1. The conversion from odds ratio to effect size was done using the following formula:

$$\text{effect size} = \log(odds\ ratio) * \frac{\sqrt{3}}{\pi}$$

5.2 GCSE Grades

GCSE grades are shown in this section as point scores ranging from 9-1, with a difference of one point being the equivalent of one grade. An estimated effect of 0.5, for example, would suggest that pupils in IGB / Drayson schools achieved the equivalent of half a grade more than pupils in comparison schools, after controlling for pupil demographics.

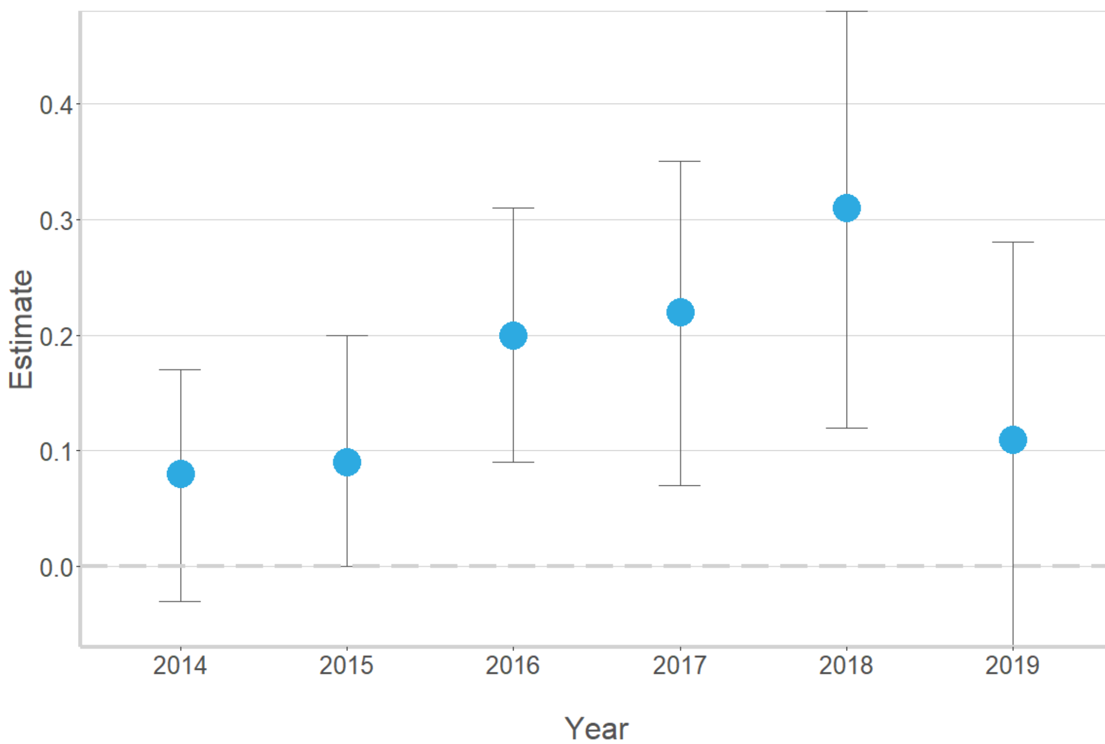
Estimates of the impact of the IGB / Drayson projects on attainment at GCSE Physics are shown in table 4, with 95% confidence intervals (all to two decimal places). Results are also summarised in figure 10.

Table 4: Estimated effect of the IGB / Drayson projects on attainment at GCSE Physics

Year	Lower CI	Estimate	Upper CI	Effect size	Months of progress
2014	-0.03	0.08	0.17	0.07	1
2015	0.00	0.09	0.20	0.08	1
2016	0.09	0.20	0.31	0.16	2
2017	0.07	0.22	0.35	0.13	2
2018	0.12	0.31	0.48	0.17	2
2019	-0.07	0.11	0.28	0.06	1

These results provide evidence that the IGB / Drayson projects had a positive effect on attainment in GCSE physics. With the exception of 2014 and 2019, results in all of the outcome years are both significant and positive, and suggest that pupils achieved between a tenth and a third of a grade more than similar pupils in matched comparison schools. This translates into between one and two months of additional progress.

Figure 10: Estimated effect of the IGB / Drayson projects on attainment at GCSE Physics



5.3 Entry to A-level physics

5.3.1 Overall

The results in this section are expressed as odds ratios and the outcome years shown in this section indicate the year in which pupils completed their A-levels. The most recent results available are for 2019: these are for pupils who completed KS4 in 2017 and who would have completed A-levels in 2019.

Estimates of the impact of the IGB / Drayson projects on the likelihood of pupils progressing to complete an A-level in physics are shown in table 5, with 95% confidence intervals (all to two decimal places). Results are also summarised in figure 11.

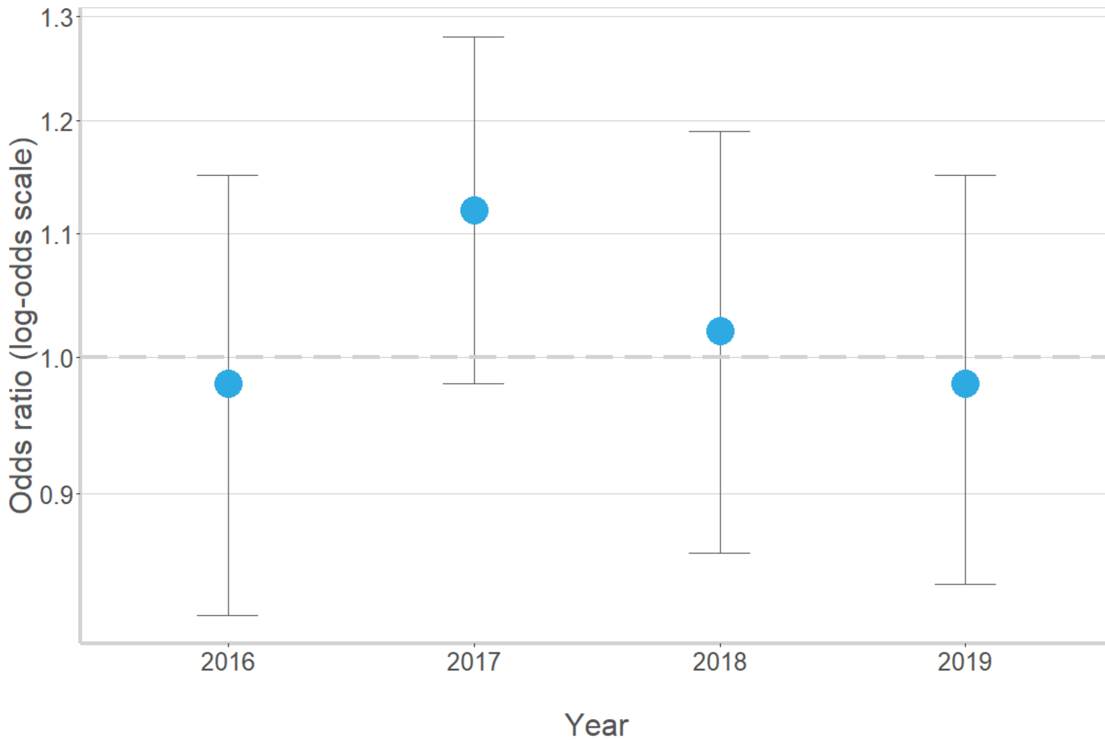
Table 5: Estimated effect of the IGB / Drayson projects on progression to A-level Physics

Year	Lower CI	Estimate	Upper CI	Effect size	Months of progress
2016	0.82	0.98	1.15	0.00	0
2017	0.98	1.12	1.28	0.03	0
2018	0.86	1.02	1.19	0.00	0
2019	0.84	0.98	1.15	0.00	0

These results do not provide conclusive evidence that the IGB / Drayson projects had a positive effect on the likelihood that a pupil would progress to complete an A-level in physics.

The estimated impact was above one for 2017 and 2018, but below one for 2016 and 2019, and none of the results were significant. None of the effect sizes were large enough to translate into any additional months of progress.

Figure 11: Estimated effect of the IGB / Drayson projects on progression to A-level Physics



5.3.2 Female pupils

As above, the results in this section are expressed as odds ratios, and the outcome years shown in this section indicate the year in which pupils completed their A-levels.

Estimates of the impact of the IGB / Drayson projects on the likelihood of female pupils progressing to complete an A-level in physics are shown in table 6, with 95% confidence intervals (all to two decimal places). Results are also summarised in figure 12.

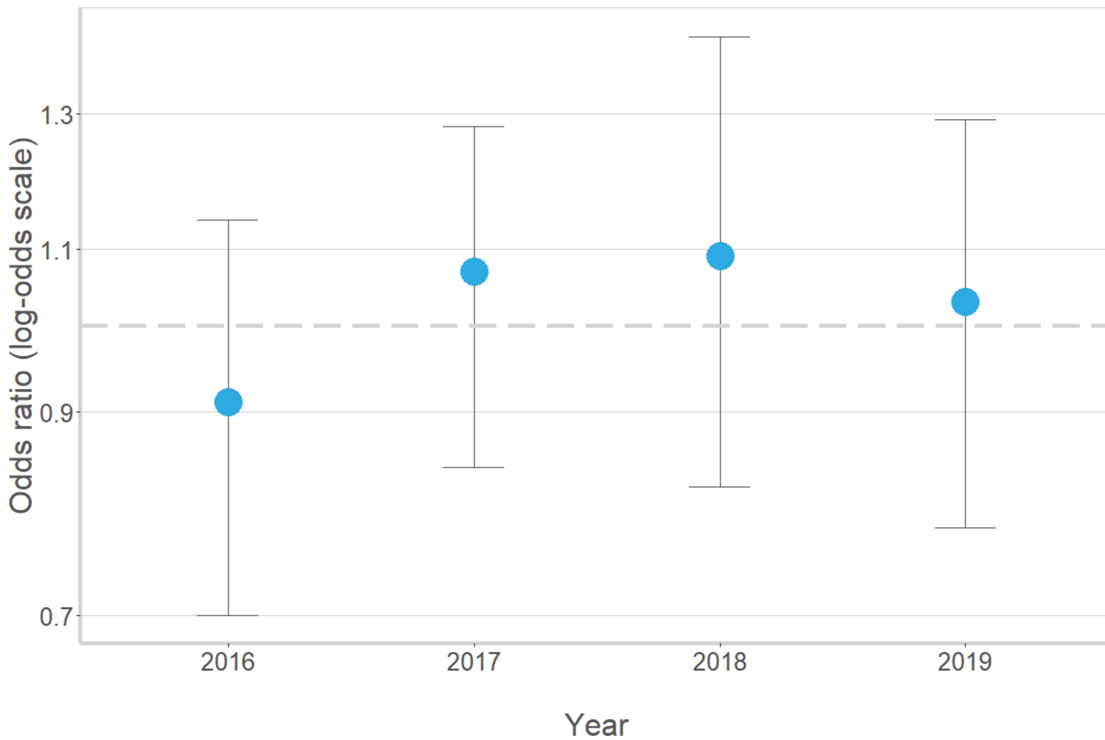
Table 6: Estimated effect of IGB / Drayson projects on female progression to A-level Physics

Year	Lower CI	Estimate	Upper CI	Effect size	Months of progress
2016	0.70	0.91	1.14	-0.02	0
2017	0.84	1.07	1.28	0.02	0
2018	0.82	1.09	1.43	0.02	0
2019	0.78	1.03	1.29	0.01	0

These results do not provide conclusive evidence that IGB / Drayson projects had a positive effect on the likelihood that a female pupil would progress to complete an A-level in physics. With the exception of 2016, all estimates were positive, suggesting that female pupils from

IGB schools were slightly more likely to progress to complete an A-level in physics, but none were significant; that is, all of the confidence intervals contained one. None of the effect sizes were large enough to translate into any additional months of progress.

Figure 12: Estimated effect of IGB / Drayson projects on female progression to A-level Physics



6 Conclusions

6.1 Summary of results

This evaluation did not find conclusive evidence to show that the IGB / Drayson projects had a positive effect on the likelihood of entry in A-level physics, either for all pupils or for female pupils.

However, we did find that the IGB / Drayson projects had a significant positive effect on GCSE physics grade, the equivalent of up to a third of a grade, or two months of additional progress. We also found a small positive effect on the likelihood of female pupils progressing to complete an A-level in Physics in IGB schools, but these estimates were not significant, and were not large enough to translate into any additional months of progress.

6.2 Limitations of evaluation design

This evaluation matched treated schools to comparison schools using observational data from the National Pupil Database (NPD). This type of evaluation is known as a quasi-experimental design. However, ideally, from an evaluation perspective, the project would have been provided to schools as part of a randomised control trial (RCT).

With a quasi-experimental design, there are a number of possible problems. In our analysis, we had to rely on the data in the NPD, but the NPD data is limited. For example, it does not include information about social class, parental occupations or school funding levels. Not accounting for these unobserved variables may introduce bias into our estimates. Using a quasi-experimental design also leaves open the question of how schools were selected to join the project. Recruitment for the IGB and Drayson projects was done by a team based around the country often using local knowledge to identify suitable schools. We had no way of replicating this selection process using data, and this may have led to underestimation of effects, if our comparison group included schools that would not have been deemed to be in need of support.

A sensitivity analysis using a matched comparison group created using the nearest neighbour method produced results that were broadly similar to those found using our preferred method, but did not reproduce the significant positive effects found for GCSE grades. However, the nearest neighbour method failed to produce a comparison group that was well-balanced with respect to GCSE grade prior to the project's start, so the results produced using this method should be deemed less reliable than those produced using CBPS. Nevertheless, this casts some doubt as to whether the significant effects found are reliable; while the alternative method found positive effects, they were smaller than those found in the main analysis and were not significant.

The project was relatively small, with just 26 schools taking part. Although this still gave a reasonable number of pupils on which to fit regression models, the smaller sample may mean that estimates are less reliable. A larger sample may have provided more reliable estimates and / or smaller confidence intervals. The limited size of the intervention also meant that we were unable to pursue using a matched difference-in-difference evaluation design, which might otherwise have been useful for a project of this sort. The Drayson project was too small, with just six schools, for us to draw any robust conclusions.

Some comparison schools may have taken part in similar projects, or teachers from those schools may have attended training similar to that offered by the projects. However, we attempted to minimize this risk by excluding potential comparison schools that took part in the IOP's Stimulating Physics Network project from the comparison group; while not specifically focused on gender balance, this project offered support to teachers of physics that may have had some overlap with that offered by IGB / Drayson. Despite these exclusions, it is still possible that some comparison schools we were offered support by other organisations. If this was the case, our analysis would not be an evaluation of the project against no equivalent support, but instead against no support in some cases and other, similar support in the rest. This could lead us to underestimate the effect of the projects, assuming that the equivalent support had a positive effect on some comparison schools' outcomes. We would note, however, that not controlling for this effect may be the relevant analysis as it represents an evaluation of the project against current conditions, with schools' choices to engage with other projects or training being included in the makeup of controls.

We would be tentative in asserting that the results of this evaluation represent the true size of the projects' impact for the reasons outlined above. The ideal evaluation of the project would have come from a fully randomised control trial which would allow for isolation of project participation as a lone variable of interest. As this was not the case, the above results represent the best estimate of the effectiveness of participation in the project that we were able to provide.

7 Appendix

7.1 Summary statistics

The attached 'Summary statistics.xlxs' Excel workbook includes background data on how IGB schools compare to other state-funded mainstream schools in England, and to schools in the IGB comparison group.

Data from three years before the IGB / Drayson projects began up until the most recent year for which data is available is provided on the following:

- Outcome measures
  - GCSE physics grade
  - Entry in A-level physics
  - Female entry in A-level physics
- Entry rates in Closing Doors subjects (Biology, Chemistry, English, Psychology and Economics) for all pupils and for female pupils
- Entry rates to A-level physics among disadvantaged pupils

Snapshots of data for the year before the IGB / Drayson projects began and the most recent year for which data is available are provided on the following:

- A-level physics entry by band
  - This shows the number of schools from which a given number of pupils who subsequently entered A-level physics
- A-level physics entry by ethnicity
- A-level physics entry by IDACI quintile
- A-level physics entry by KS2 prior attainment quintile

7.2 Sensitivity analysis

The results produced using the nearest neighbour matching method are shown below.

Table 4: Estimated effect of the IGB / Drayson projects on attainment, progression and female progression, alternative matching method

Year	Outcome	Lower CI	Estimate	Upper CI
2014	GCSE Grade	-0.03	0.08	0.17
2015	GCSE Grade	0.00	0.09	0.20
2016	GCSE Grade	0.09	0.20	0.31
2017	GCSE Grade	0.07	0.22	0.35
2018	GCSE Grade	0.12	0.31	0.48
2019	GCSE Grade	-0.07	0.11	0.28
2016	Progression	0.82	0.98	1.15
2017	Progression	0.98	1.12	1.28
2018	Progression	0.86	1.02	1.19
2019	Progression	0.84	0.98	1.15

2016	Female progression	0.70	0.91	1.14
2017	Female progression	0.84	1.07	1.28
2018	Female progression	0.82	1.09	1.43
2019	Female progression	0.78	1.03	1.29