RS ASSESSMENT FROM HODDER EDUCATION IN COLLABORATION WITH SchoolDash UNDERSTAND.EDUCATION

The effects of age, gender and school type on primary maths and reading attainment

A nationwide analysis of state schools in England using termly assessment tests provided by *RS Assessment from Hodder Education*

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Summary

This paper analyses results from Progress in Understanding Mathematics Assessment (PUMA) and Progress in Reading Assessment (PiRA) tests created by *RS Assessment from Hodder Education*, used by over 6,000 primary schools across England. The key findings include:

- Summer-born pupils show considerably lower average performance in maths and reading than classmates born at other times of the year. Although this gap narrows during the course of primary school, it persists until at least age 11.
- At the very start of primary school, girls show slightly higher average performance in maths, but by Years 2-3 boys overtake them and stay ahead until the end of primary school. Boys show somewhat higher variability in their maths attainment compared to girls.
- The gender differences in maths vary by topic, with boys doing particularly well in number and measures while girls do relatively well in operations and geometry.
- In reading girls are, on average, stronger than boys at the start of primary school, and maintain this advantage all the way to age 11. These gender differences apply roughly equally across different reading topics.
- There are also clear average differences between types of school. Those with higher proportions of disadvantaged pupils show lower average performance in both maths and reading during the early years of primary education, and this gap tends to grow over time. Similarly, schools with higher Ofsted ratings tend to do better than those with lower ratings.

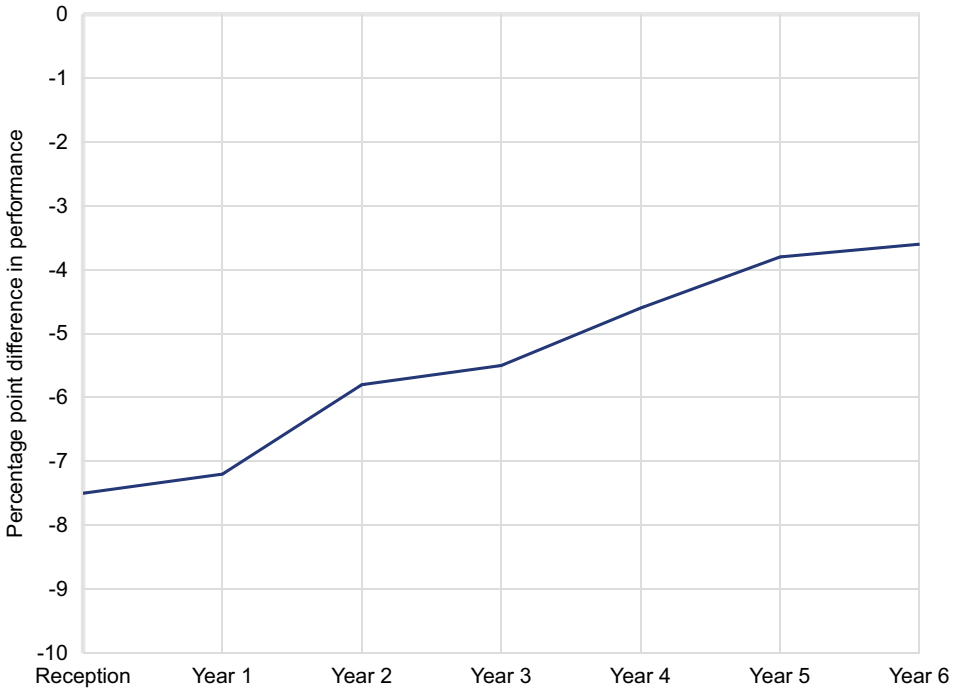
Introduction

There is much discussion about the ways in which pupil and school characteristics can affect academic performance, but large-scale, high-quality data sets are often lacking, especially those providing termly results of pupils throughout every primary school year. A substantial proportion of primary schools in England are now using the PUMA and PiRA tests and entering test results in to MARK (My Assessment and Reporting Kit), a free online marksheet and reporting service for customers of the tests. This paper provides a high-level analysis of over one and a half million anonymous termly standardised test results from the MARK database.

For further information about the kinds of schools included and an explanation of the test scoring system, see the Appendix.

The relative performance of summer-born pupils

***Figure 1:** Maths performance of summer-born pupils relative to other pupils*



Sample sizes for each data point are in the range 5,700-59,000

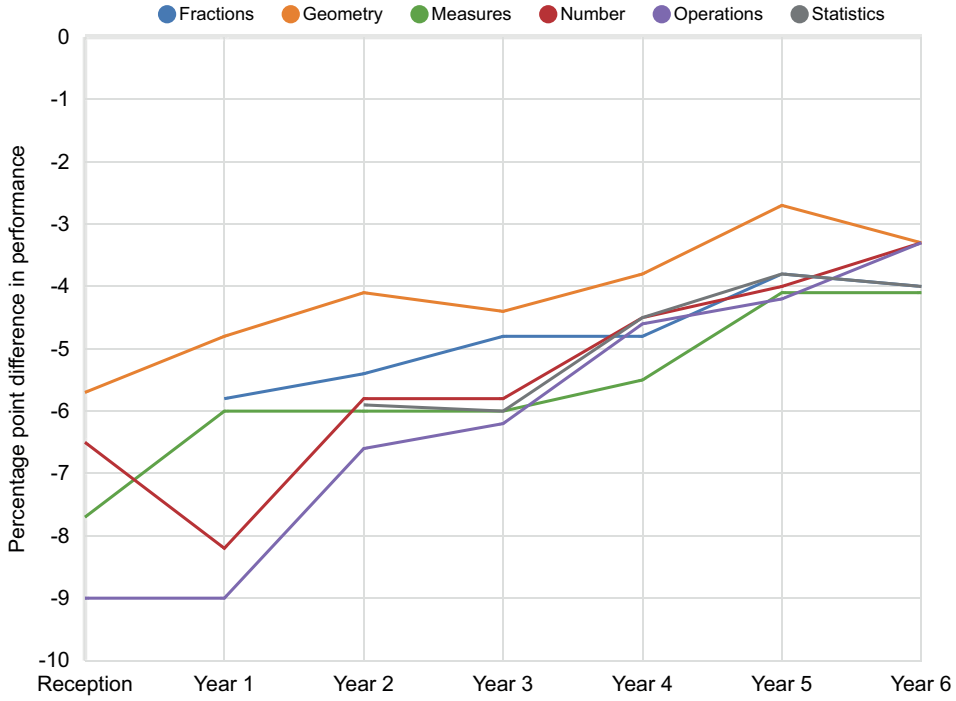
A frequent source of concern among primary school parents and teachers is the fact that children born in the summer can be almost a year younger than classmates born in the autumn. Among other consequences, this has led to increasing numbers of parents delaying their child's school start dates[1]. We have used MARK data to analyse the performance of summer-born pupils (those born from April to August inclusive) and compared them to those born at other times of the year.

As shown in Figure 1, pupils born in the summer achieve an average of 7.5 percentage points lower in Reception-year maths tests compared to their non-summer-born classmates. This difference reduces during the course of primary school but does not disappear, reaching 3.6 percentage points by Year 6.

Similar effects can be seen across the range of mathematical topics, as shown in Figure 2. In Reception year, operations and measures show the largest gaps, while geometry and number show the smallest ones. These differences narrow during the course of primary school.

[1] See for example https://www.gov.uk/government/publications/summer-born-children-school-admission

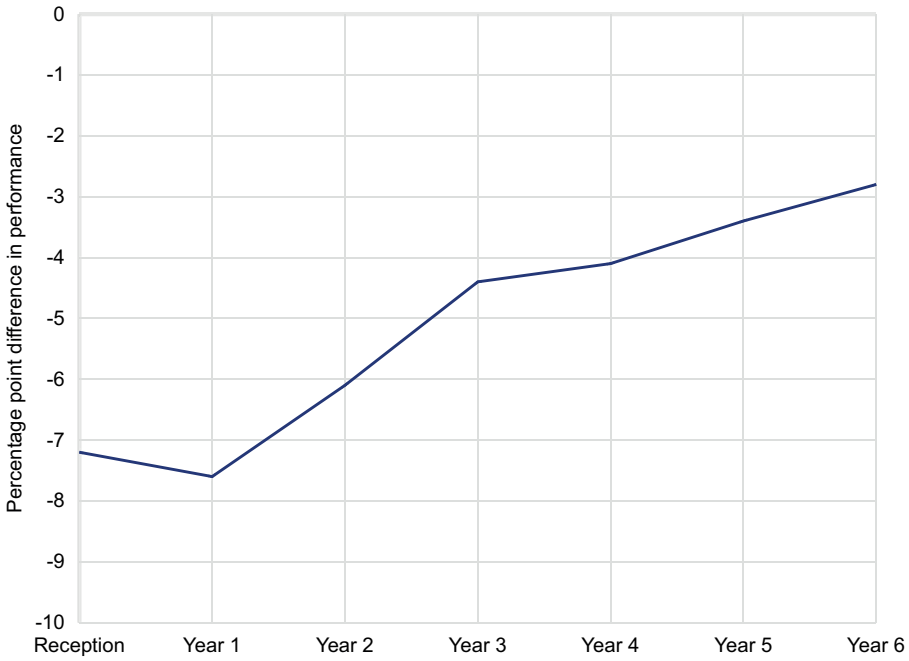
Figure 2: ***Maths performance of summer-born pupils relative to other pupils, by topic***



Sample sizes for each data point are in the range 5,700-59,000

Reading performance shows a similar trajectory, as shown in Figure 3.

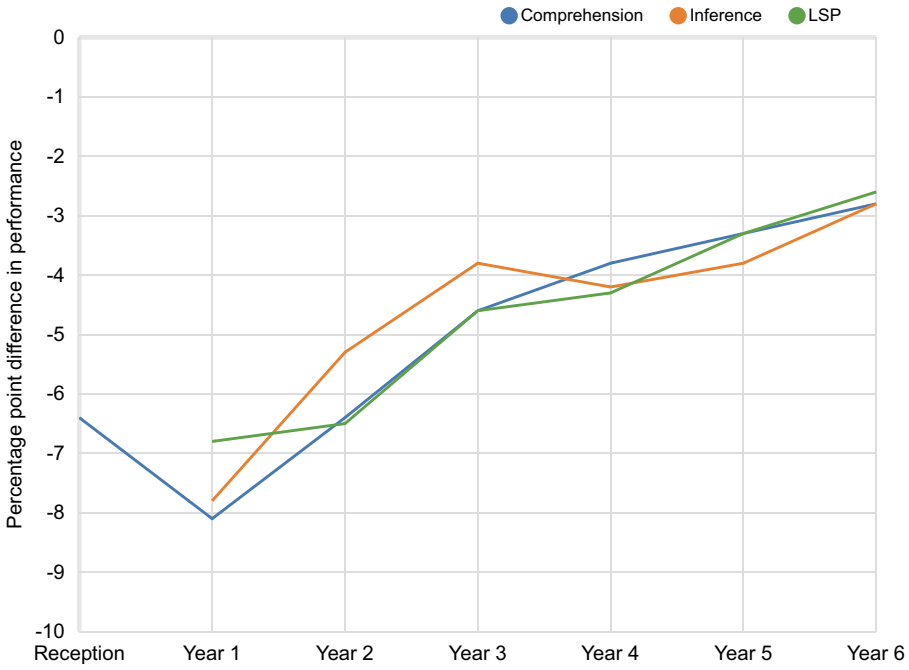
Figure 3: ***Reading performance of summer-born pupils relative to other pupils***



Sample sizes for each data point are in the range 9,600-61,000

Very similar effects hold across different reading topics, including comprehension, inference and language structure and presentation (LSP), as shown in Figure 4.

Figure 4: Reading performance of summer-born pupils relative to other pupils, by topic



Sample sizes for each data point are in the range 9,600-61,000

A comparison of boys and girls

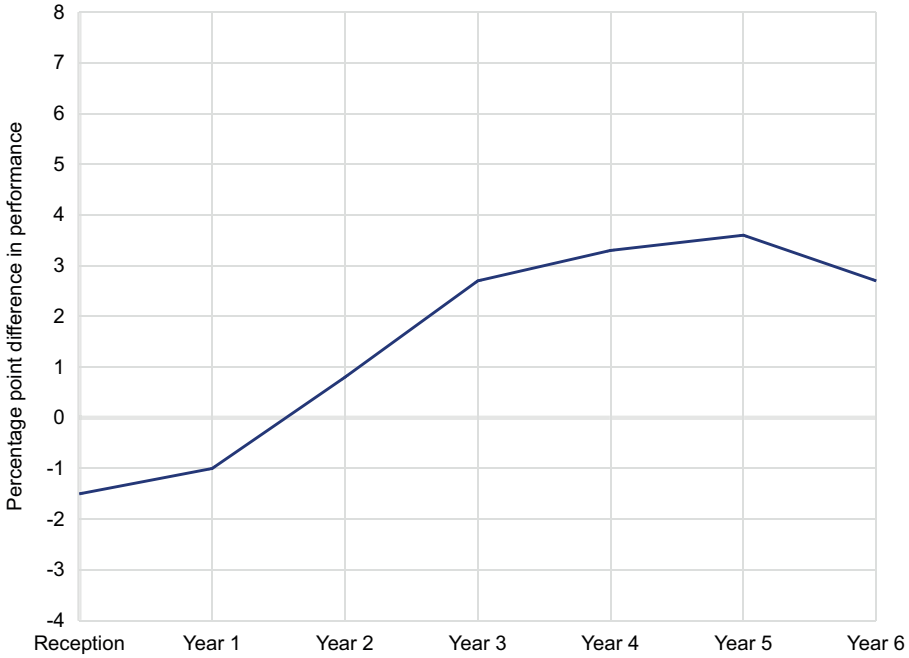
Another frequent comparison is that of boys versus girls, with the former sometimes said to show higher average performance in maths[2] while the latter perform better at literacy. The academic consensus, insofar as it exists, appears to be that these differences are either too small to be important[3] or absent altogether[4]. This section describes the results of a similar analysis of results held in the MARK database.

[2] For a detailed survey of this complex topic, see https://doi.org/10.1111/j.1529-1006.2007.00032.x

[3] For an overview, see *Visible Learning* by John Hattie (Routledge, 2009)

[4] See for example https://doi.org/10.1038/s41539-018-0028-7

***Figure 5:** Maths performance of boys relative to girls*

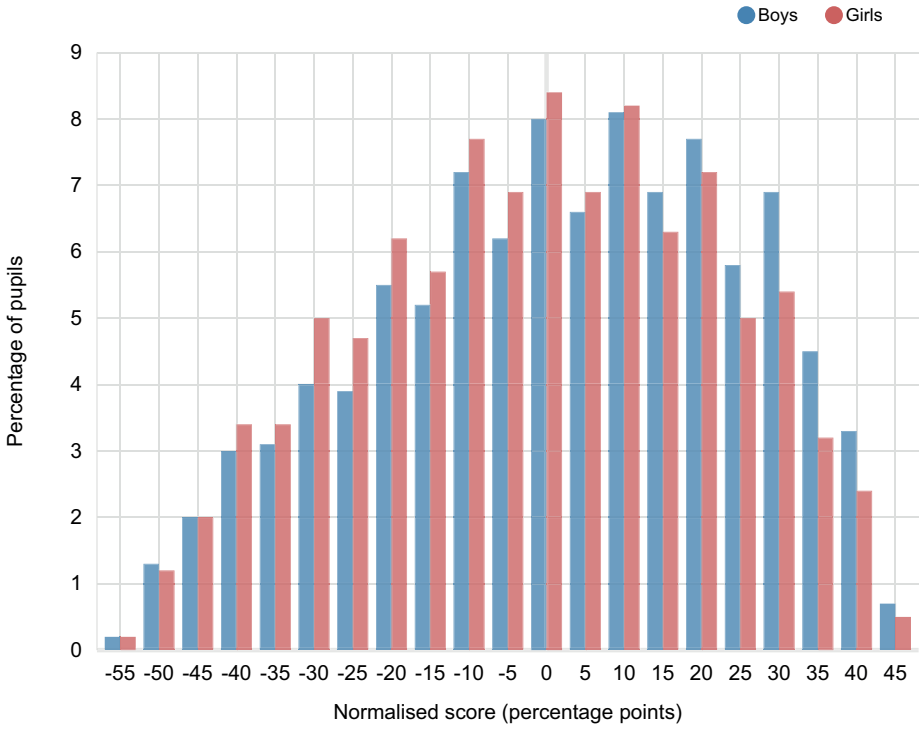


Sample sizes for each data point are in the range 7,100-71,000

As shown in Figure 5, boys actually start primary school achieving slightly lower average marks in maths than girls do, but by Years 2-3 they move ahead and this advantage is sustained until the end of primary school at Year 6.

However, as well as showing higher average performance, boys also show slightly greater variability. This can be seen in Figure 6, which shows the distributions of maths scores for boys and girls in Year 6. While boys are more numerous among those who score highly (on the right of the histogram), they are no less numerous among pupils with very low maths scores (on the left). Conversely, girls tend to be more numerous in the centre of the histogram. Thus, girls show somewhat less variability in maths attainment while at the same time achieving slightly lower average scores.

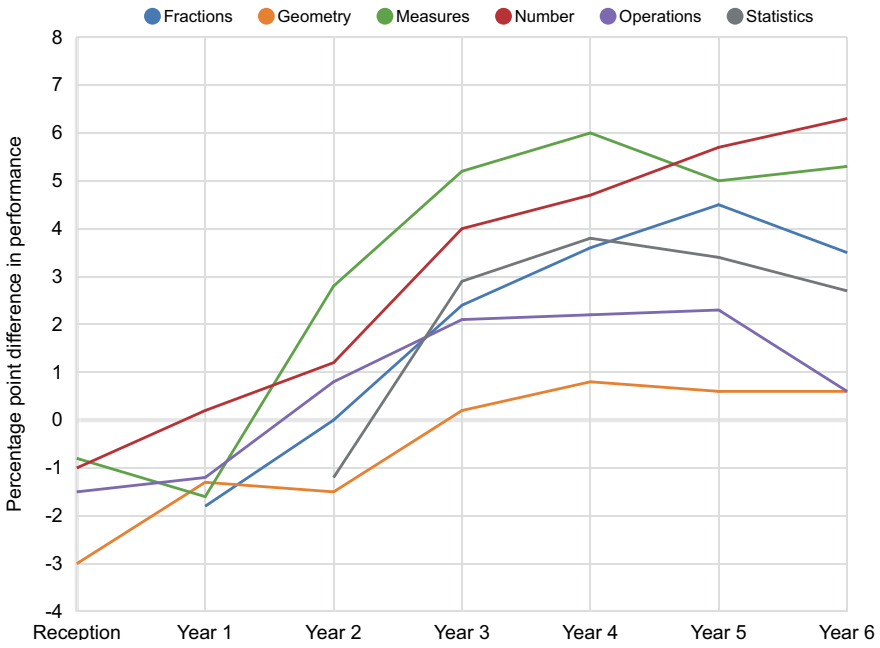
Figure 6: Distribution of maths performance for boys and girls in Year 6



Sample sizes for each group are in the range 34,500-36,100

Furthermore, the higher performance of boys in later primary years is not uniform across different mathematical topics, as shown in Figure 7. In some, such as number and measures, they outperform girls, while in others, such as operations and geometry, both genders show very similar levels of performance.

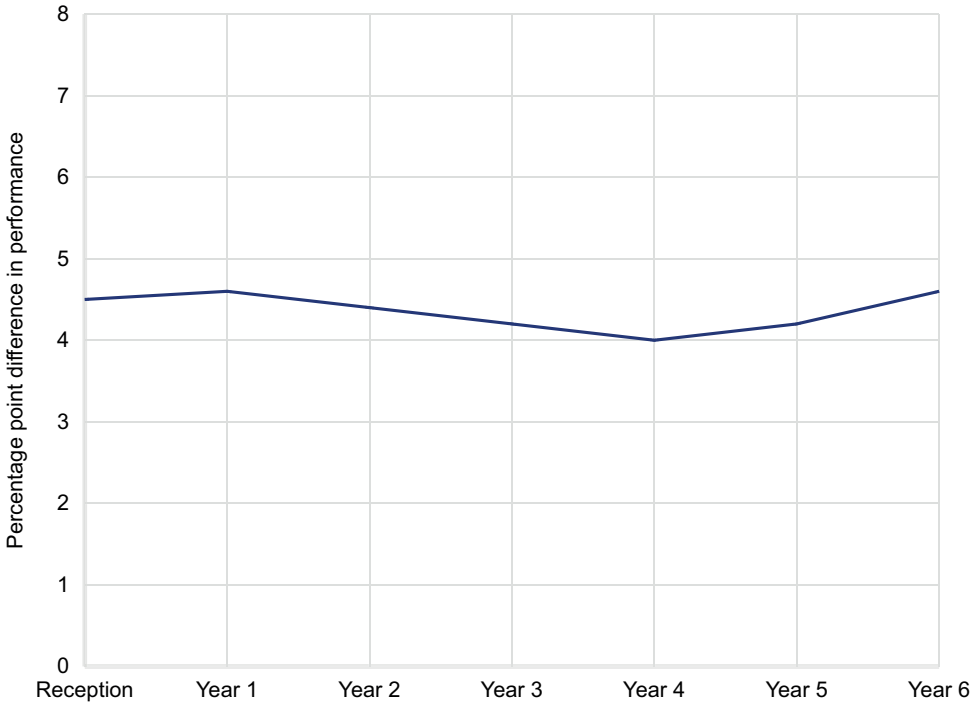
Figure 7: Maths performance of boys relative to girls, by topic



Sample sizes for each data point are in the range 7,100-71,000

In contrast to maths, girls enter school with higher average attainment in reading and maintain this advantage consistently throughout their primary years, as shown in Figure 8.

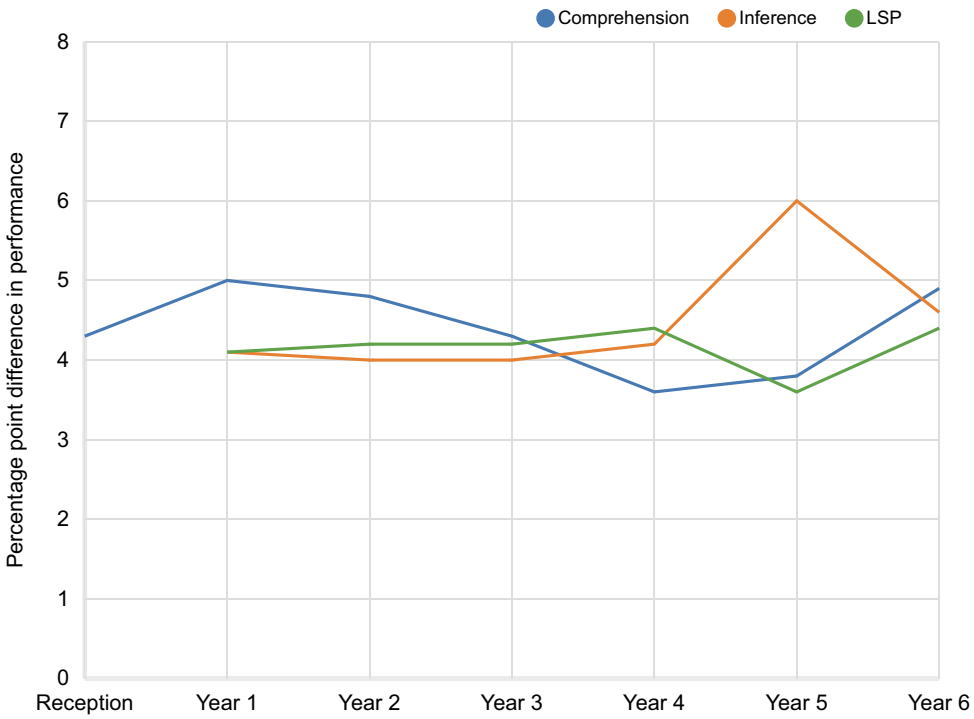
Figure 8: Reading performance of girls relative to boys



Sample sizes for each data point are in the range 11,000-72,000

This pattern applies across different reading topics, including comprehension, inference and LSP, as shown in Figure 9.

Figure 9: Reading performance of girls relative to boys, by topic



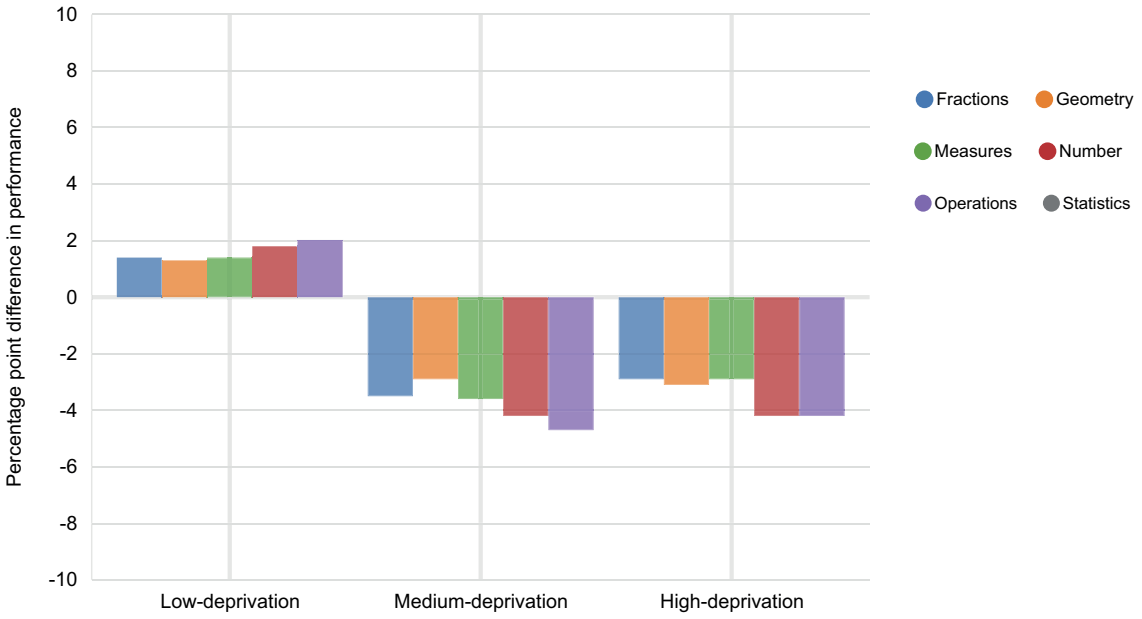
Sample sizes for each data point are in the range 11,000-72,000

The impact of deprivation

As well as studying pupil characteristics, we also see certain trends by school type. Perhaps unsurprisingly, one of the most significant factors is poverty, with low-deprivation schools (<20 % of pupils eligible for free school meals) showing substantially higher average performance in all subject areas than those with high deprivation (>35 % of pupils eligible for free school meals).

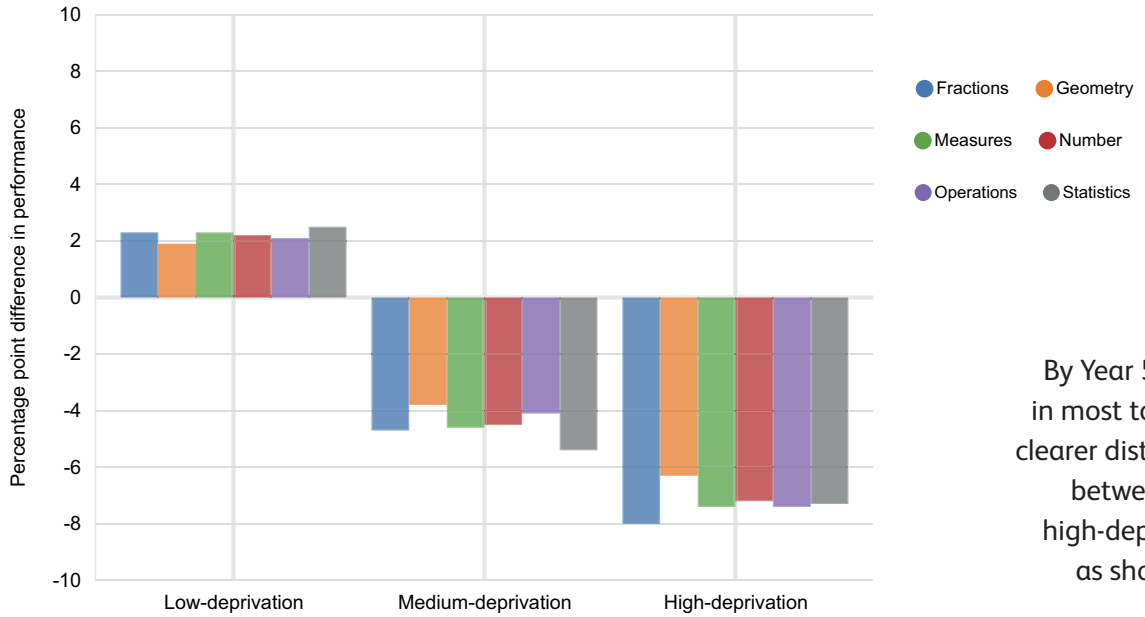
In Year 1, low-deprivation schools show higher attainment across all maths topics compared to medium- and high-deprivation schools, as shown in Figure 10.

Figure 10: Relative maths performance in Year 1 by school deprivation level



Sample sizes for each data point are in the range 10,000-91,000

Figure 11: Relative maths performance in Year 5 by school deprivation level

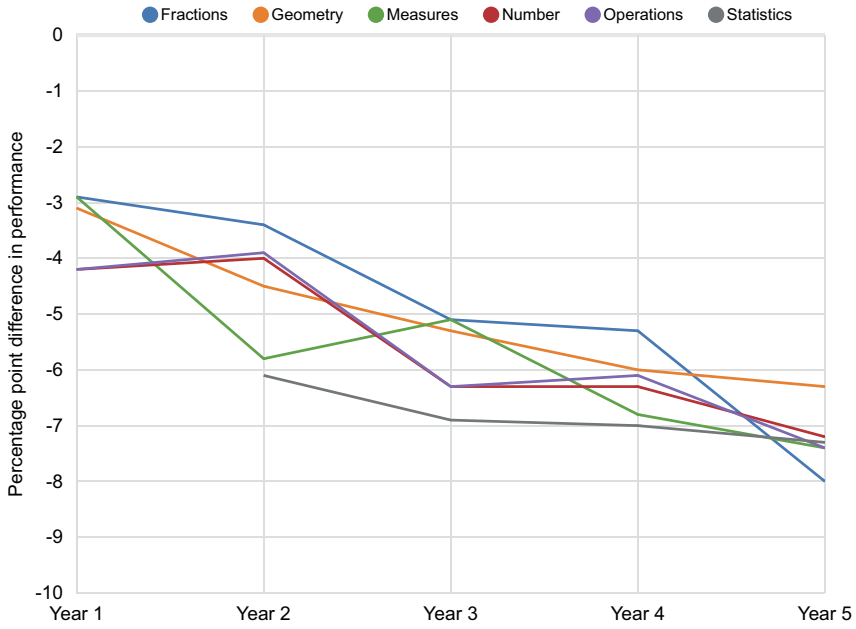


Sample sizes for each data point are in the range 9,700-96,000

By Year 5, this gap grows in most topic areas, and a clearer distinction develops between medium- and high-deprivation schools, as shown in Figure 11.

Focusing just on high-deprivation schools, the differences between Years 1 and 5, seen above, are part of a general trend in which the gap increases as pupils progress through their primary years, as shown in Figure 12[5].

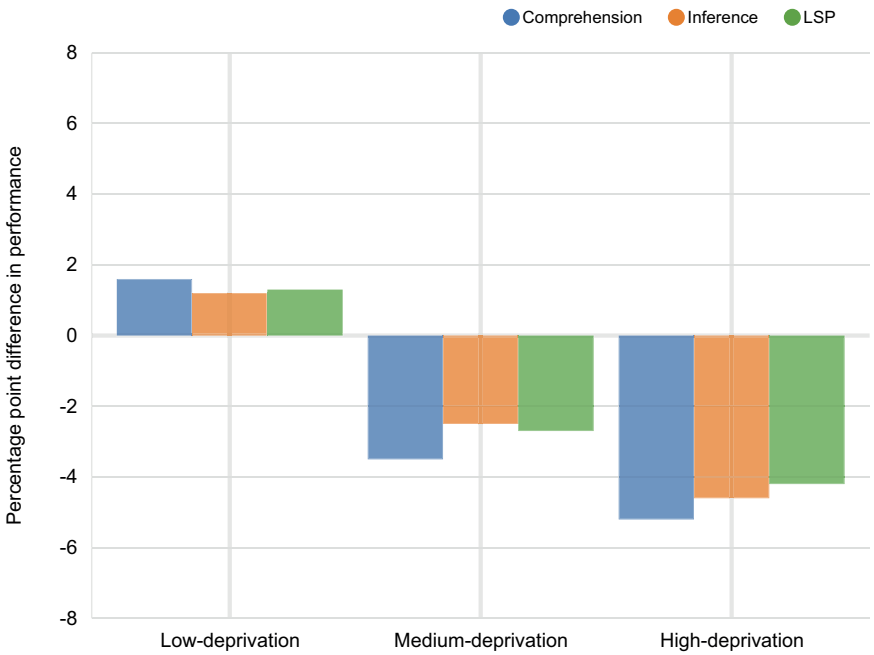
Figure 12: Maths performance in high-deprivation schools relative to all schools, by year group



Sample sizes for each data point are in the range 5,000-11,000. Statistics tests begin in Year 2

Broadly similar trends can be seen in reading, as shown in Figures 13, 14[5] and 15.

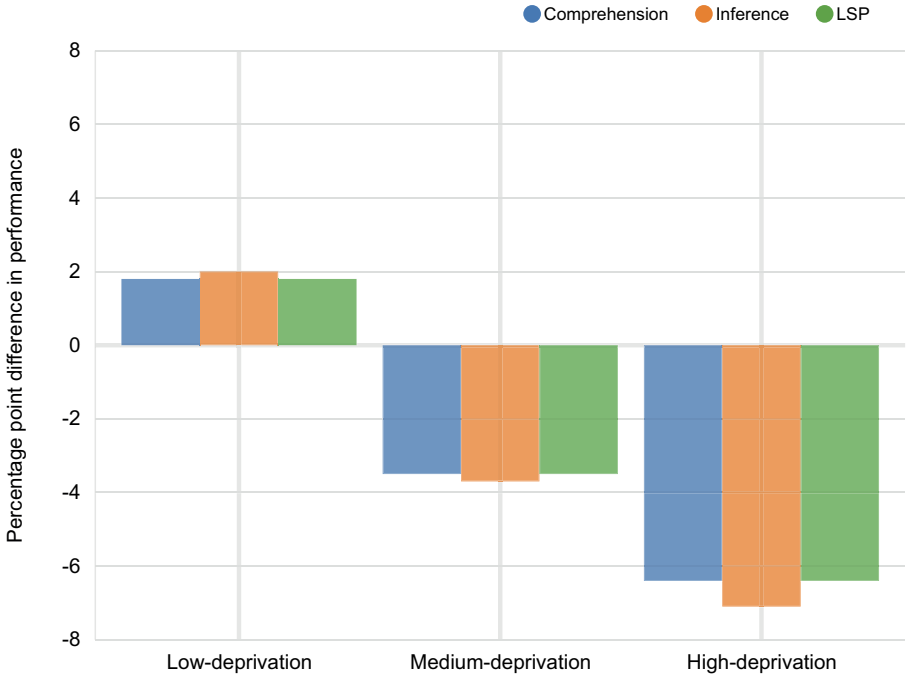
Figure 13: Relative reading performance in Year 1 by school deprivation level



Sample sizes for each data point are in the range 10,000-89,000

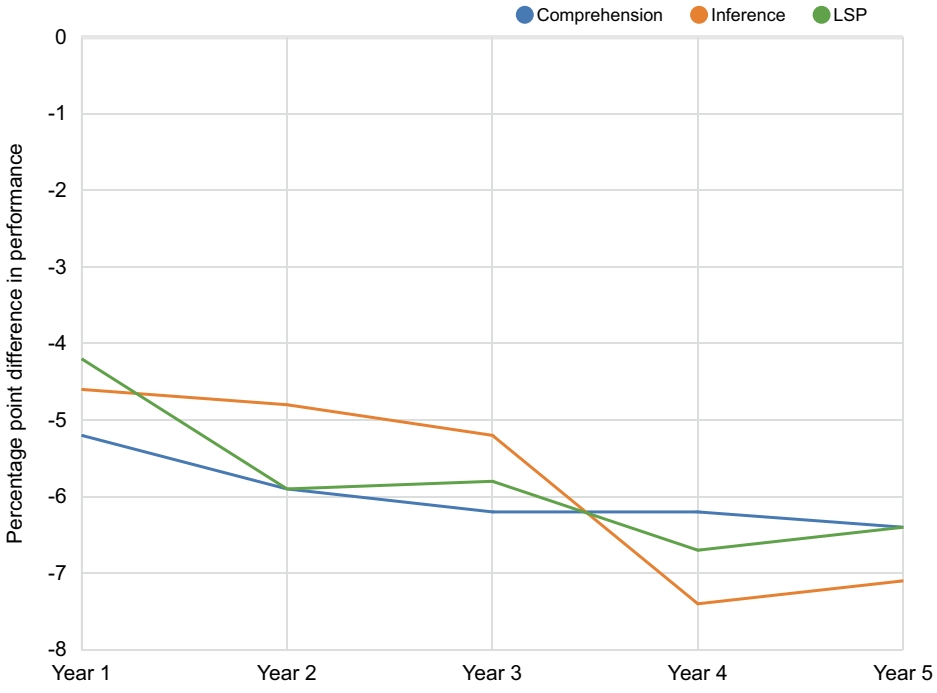
[5] Data for Reception and Year 6 also exist, but sample sizes are smaller so they are omitted from this analysis.

Figure 14: Relative reading performance in Year 5 by school deprivation level



Sample sizes for each data point are in the range 10,000-100,000

Figure 15: Reading performance in high-deprivation schools relative to all schools, by year group



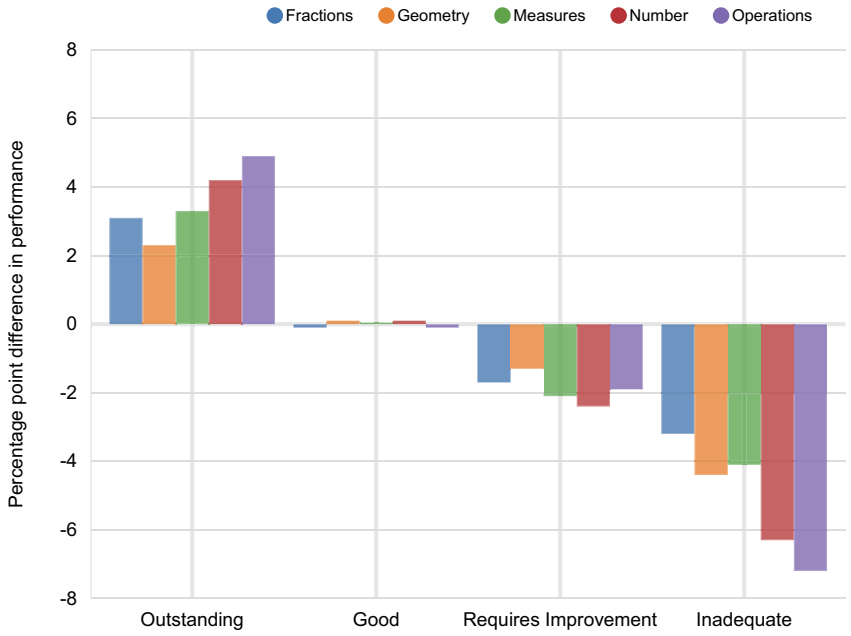
Sample sizes for each data point are in the range 5,300-11,000

While not new, this link between deprivation and a growing gap in academic performance during children's primary years is important and concerning.

Relative performance by school Ofsted rating

Figure 16 shows the relative performance of pupils in schools with different Ofsted ratings. 'Outstanding' and 'Good' schools do, on average, perform better than those rated 'Requires Improvement' or 'Inadequate', though the gap varies by topic. Note that Ofsted ratings are determined in part by test results, so it is not clear to what extent it is a consequence of academic performance rather than a predictor of it.

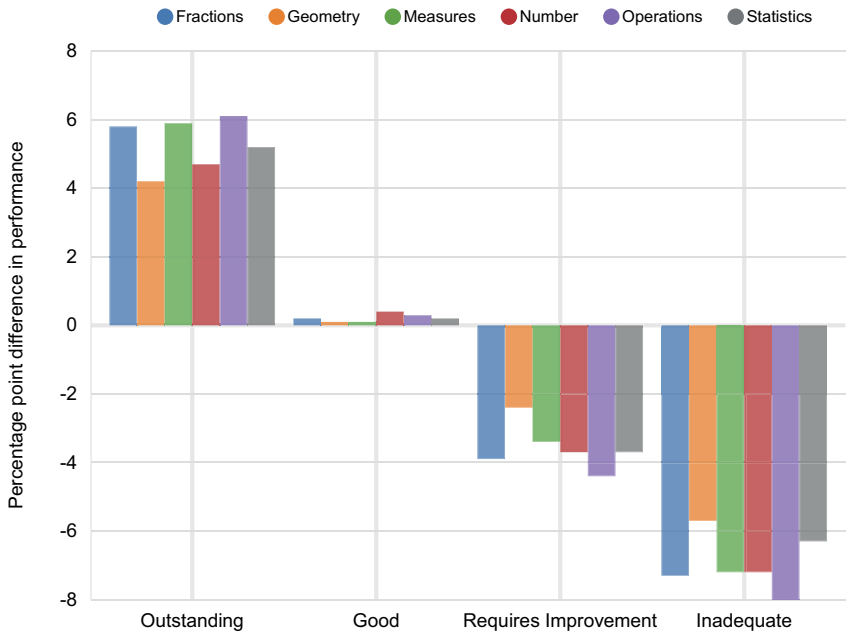
Figure 16: Relative maths performance in Year 1 by school Ofsted rating



Sample sizes for each data point are in the range 6,900-85,000

This gap tends to grow as pupils get older, as shown in Figure 17.

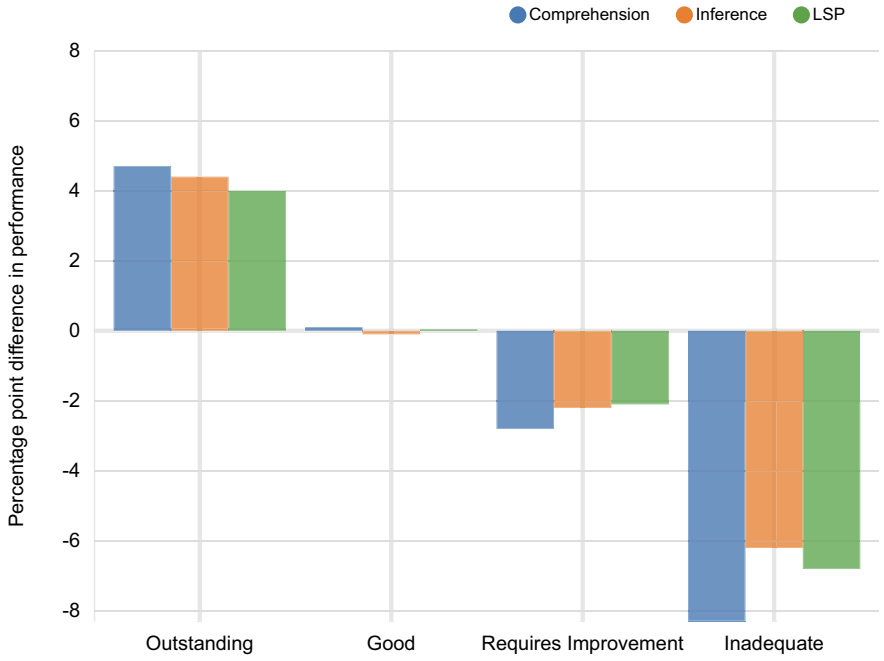
Figure 17: Relative maths performance in Year 5 by school Ofsted rating



Sample sizes for each data point are in the range 7,000-89,000

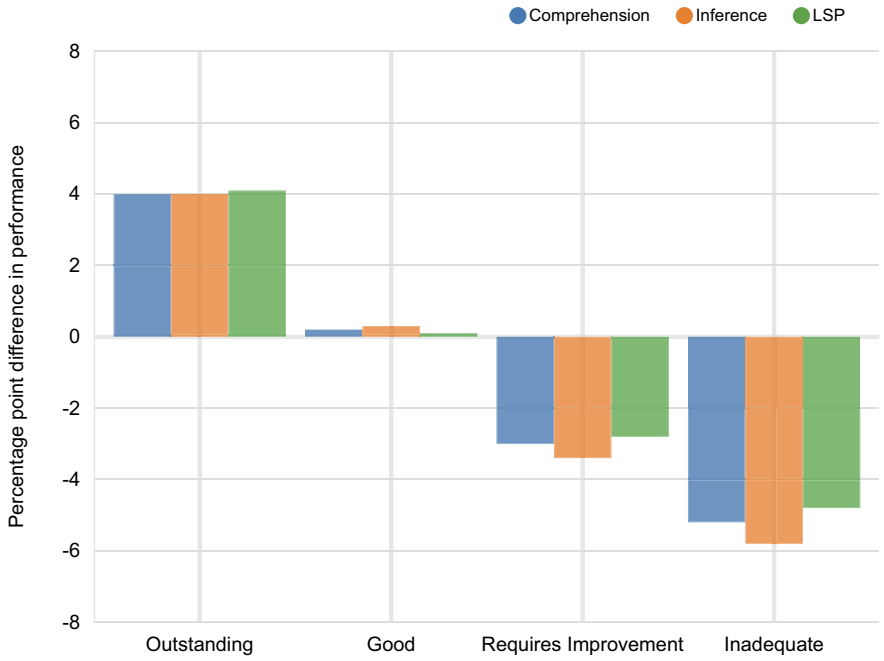
There is a similar pattern for reading, as shown in Figures 18 and 19. In this case, the relative underperformance of 'Inadequate' schools seems, if anything, to reduce between Years 1 and 5. However, the sample sizes here are relatively small due to fewer inadequate schools entering test results, so this should be interpreted with caution.

Figure 18: Relative reading performance in Year 1 by school Ofsted rating



Sample sizes for each data point are in the range 6,300-83,000

Figure 19: Relative reading performance in Year 5 by school Ofsted rating



Sample sizes for each data point are in the range 6,800-95,000

Remarks on differences within and between groups

In considering these differences it is important to bear in mind that the variation within each group is inevitably much greater than any differences between groups. As a result, simply knowing (for example) the gender and date of birth of a pupil provides little indication about his or her likely performance. Nevertheless, these aggregate trends are important in assessing the overall effectiveness and equity of our education system, and we hope that they prove useful in informing priorities and policies.

Appendix: schools, tests and scores

In order to protect the confidentiality of the institutions and individuals concerned, results have been analysed and presented in an anonymised aggregate form.

Represented schools

This analysis is limited to state primary schools in England. All regions and major school types are included, and the sample is broadly representative, albeit with some biases. In particular: Yorkshire and The Humber, London and the West Midlands are over-represented relative to the North East, the North West and East Midlands; urban schools are over-represented relative to rural schools; and schools with Ofsted ratings of 'Inadequate' and 'Requires Improvement' are over-represented relative to 'Outstanding' schools. The most over-represented of these groups contains 71 % more schools than would be expected if all groups were represented equally; the most under-represented contains 45 % fewer schools.

Tests and scores

The data used in this report comes from standardised, termly tests: PUMA and PiRA. The tests were taken from October 2015 to July 2018 inclusive and entered in to MARK, a free marksheet and reporting service. The termly tests are marked by teachers using a robust mark scheme, and raw scores are converted to standardised scores automatically in MARK. Only mainstream state schools in England have been included. We have analysed only results from fully completed tests, with non-zero scores, sat at the correct time of year, by a pupil within the correct age range.

The results presented are based on normalised scores, in which the overall mean score across all pupils for each test is set to zero. Any individual pupil, or group of pupils, may therefore have a score that is positive (higher than mean performance), negative (lower than mean performance) or zero. For example, in the Reception maths tests (Figure 1), summer-born pupils achieved an average of 4.5 percentage points below the overall mean, while non-summer-born pupils achieved an average of 3.0 percentage points above the mean. The difference between these two groups was therefore 7.5 percentage points. Since Reception maths tests have a total of 30 marks, this equates to a difference of just over 2 marks.

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